Sag

Titel: BioEM 2022 (video)
Sagsnummer: 02-1201-107

Dokumenter

Aktnr.	Doknr.	Titel	Brevdato	Type
12	8860577	BioEM 2022: Passwords to Access Online Contents (R1095)	06-07-2022	I, Indgående
11	8726368	ICNIRP Mini-Symposium 2022 Videostreams	22-06-2022	I, Indgående
10	8710209	BioEM 2022 Program Book	21-06-2022	DOK, Dokument
9	8684576	ICNIRP Mini-Symposium Access	17-06-2022	I, Indgående
8	8684574	BioEM 2022: Zoom Links for Online Sessions (R1095)	16-06-2022	I, Indgående
7	8560339	Tilmelding til ICNIRP webinar (1)	31-05-2022	I, Indgående
0	8560341	icnirp_31052022593	31-05-2022	I, Indgående
6	8501350	SV: ICNIRP Mini-Symposium: Recording of session?	20-05-2022	U, Udgående
5	8444960	BioEM 2022: Receipt (Payment Confirmattion) (R1095_PMT1) (1)	11-05-2022	I, Indgående

0	8444961	BioEM2022_Receipt_R1095_PMT1_Beierholm	11-05-2022	I, Indgående
4	8389837	Notification of payment completion(card settlement)	03-05-2022	I, Indgående
3	8389828	BioEM 2022: Confirmation and Invoice for Registration (R1095)	03-05-2022	I, Indgående
2	8389787	BioEM 2022: Payment Completed (Credit Card)(R1095_PMT1)	03-05-2022	I, Indgående
1	8389579	Konferencens sessioner forventes optaget	03-05-2022	U, Udgående

From: BioEM 2022 Secretariat <secretariat@bioem2022.org>
Sent: 06-07-2022 08:48:36 (UTC +01)
To: Anders Ravnsborg Beierholm <anrb@sis.dk>
Cc: secretariat@bioem2022.org <secretariat@bioem2022.org>
Subject: BioEM 2022: Passwords to Access Online Contents (R1095)

Dear Mr. Anders Ravnsborg Beierholm,

Thank you again for your having participated in BioEM 2022.

The following online contents will be available until July 31, 2022.

Download BioEM 2022 Abstract Book (284.9 MB)
https://www.dropbox.com/s/efvwgzviqt31nii/BioEM2022_AbstractCollectionBook_v2_20220618.pdf?dl=0
Password: lhlksae7wau63jljk2h34rpoeifadj293uj

View Poster Presentation PDF Files (No Download Available)
https://www.dropbox.com/sh/7w7azwg2hdj56bk/AAD9HpG9SAh9G3JgCj8Gg44Ya?dl=0
Password: jckns98y3rqjdkj82qrkmndaqo2ierqdjd

View Oral Sessions Recorded on Zoom (mp4) (No Download Available)
https://www.dropbox.com/s/1kdipsxaks0sogy/bioem2022_timetable_with_links0621.docx?dl=0
Password: 98345jhfw9p8fdjkajay43qqj9ppiuhab3

Please note that all the contents indicated above will be destroyed on August 1, 2022, and will not be available thereafter.

Best regards,

Keisuke

Keisuke Hisause (Mr.)
BioEM 2022 Secretariat
c/o Dupler Corp.
3F Sun-Arch Bldg., 3-1 Nemoto, Matsudo, Chiba 271-0077, Japan
Email: secretariat@bioem2022.org

From: info@icnirp.org <info@icnirp.org>
Sent: 22-06-2022 04:55:16 (UTC +01)
To: Anders Ravnsborg Beierholm <anrb@sis.dk>
Subject: ICNIRP Mini-Symposium 2022 Videostreams

Dear All,

Thank you for your interest and your patience.

The videostreams of the ICNIRP minisymposium 2022 are now available at:
https://www.icnirp.org/en/workshops/article/minisymposium2022vid.html

Best regards,
ICNIRP Secretariat

BioEM 2022

The 1st Annual Meeting of *BioEM*
Technical Program and General Information
June 19, 2022 – June 24, 2022
Aichi Industry and Labor Center (WINC AICHI)
Nagoya, Japan

BioEM - Officers and Board of Directors

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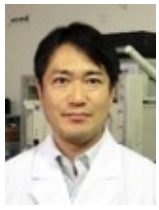
Local Organizing Committee

Jianqing Wang
Co-chair
Japan

Soichi Watanabe
Co-chair
Japan

Akimasa Hirata
Vice-chair
Japan

Daisuke Anzai
Secretary
Japan



Kazuyuki Saito
Secretary
Japan

Atsushi Saito
Treasurer
Japan

Satoshi Nakasono
Treasurer
Japan

Masaki Sekino
Website management
Japan

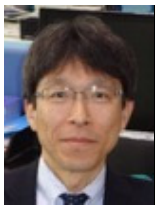
Kanako Wake
Website management
Japan

Masateru Ikehata
Registration system
Japan

Kensuke Sasaki
Registration system
Japan

Yuto Shimizu
Venue and events
Japan

Tomoaki Nagaoka
Venue and events
Japan



Teruo Onishi
Liaison
Japan

Kenichi Yamazaki
Liaison
Japan

Hiroaki Miyagi
Public relations
Japan

Akira Ushiyama
Auditor
Japan

Extended Local Organizing Committee

Luc Martens

Co-chair
BioEM 2021
Belgium

Wout Joseph

Co-chair
BioEM 2021
Belgium

Azadeh Peyman

Co-chair
BioEM 2023
United Kingdom

Sami Gabriel

Co-chair
BioEM 2023
United Kingdom

Marnus van Wyk

South Africa

Micaela Liberti

Italy

Bennett Ibey

United States

Niels Kuster

Switzerland

From the Co-chairs of the Local Organizing Committee

Dear colleagues,

On behalf of the Local Organizing Committee (LOC), it is a pleasure to invite you to BioEM 2022, which will be held in Nagoya, Japan, from June 19th to 24th 2022.

BioEM is the world's largest and most highly recognized international conference in the field of bioelectromagnetics. **BioEM 2022 will be the first annual meeting of the new BioEM Society, after the merger between the Bioelectromagnetics Society (BEMS) and the European BioElectromagnetics Association (EBEA).**

Nagoya is one of the most active areas for bioelectromagnetic research in Japan from the dawn to the present. BioEM 2022 is expected to stimulate further research through the exchange of academic information and ideas. The six-day program of BioEM 2022 will feature invited plenary talks by world-renowned scientists in the field of bioelectromagnetics, as well as various special sessions, workshops and tutorials on the most pressing issues in the field of bioelectromagnetics. The program also contains a variety of technical sessions, poster sessions and social functions. Student competitions are also the focus of the conference. Students from around the world will have the opportunity to present their work in oral and poster sessions, develop their presentation skills, participate in student competitions and network with other members of the community.

In addition to scientific activities, BioEM 2022 will be your opportunity to visit historical city Nagoya, which is located 100 minutes from Tokyo, 50 min from Osaka, and 35 minutes from Kyoto by express train. It is the largest city in central Japan, the fourth largest city in Japan, and one of the nation's most important industrial powerhouses. You can enjoy one-day trip from Nagoya to scenery with fusion of nature and tradition, such as Ise Grand Shrine, Shirakawa-go (a World Heritage site) and more.

The BioEM 2022 LOC is looking forward to your onsite participation in Nagoya. However, the situation of COVID-19 in the world is still not resolved and constantly changing. To enable more people to join BioEM2022, we will hold it in hybrid format. With the hybrid format, you'll have the opportunity to present your work to our community, whether in person in Nagoya or online.

We sincerely thank you for participating in and contributing to BioEM 2022.

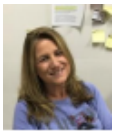
Jianqing Wang and Soichi Watanabe
LOC Co-chairs

Technical Program Committee


Wout Joseph
Co-chair
Belgium


Bennett Ibey
Co-chair
United States


Marthinus Van Wyk
South Africa


Olga Zeni
Italy


Yasir Alfadhl
United Kingdom


Florence Poulletier De Gannes
France

From the Co-chairs of the Technical Program Committee

Dear Colleagues,

On behalf of the Technical Program Committee (TPC), we are pleased to welcome you to BioEM 2022. The conference is in a hybrid format, with authors and participants attending the conference in person in Nagoya, Japan, and others attending remotely. The technical program includes physical sessions with on-site presentations and virtual (on-line) sessions for remote participants.

In addition to the opportunity to learn about research activities, progress and future challenges in the areas of bioelectromagnetics, this event provides a unique opportunity for the promotion and development of graduate students and their research.

We would like to thank the BioEM members and all contributors for the high quality proposals of plenaries, tutorials and workshops that allowed us to select four plenary talks, two tutorials and six workshops that address key issues and hot topics in bioelectromagnetics covered by distinguished speakers. This includes plenaries on exposure risks for persons with implants, biological effects of millimetre waves, transient changes in membrane hydration of liposome exposed to nanosecond electric pulses, and on the Mobikids study. The tutorials cover oxidative stress and methods to reduce confusion and improve scientific progress Bioelectromagnetics research and its theoretical bases. Six workshops will be on thresholds for the nervous system, EMF risks, daily life dosimetry, the IARC decision on RF exposure, new cellular and tissue models, and what we learned in half a century bioelectromagnetics. We would like to especially acknowledge the invited speakers for accepting our invitation and the workshops organizers for their valuable contribution to the conference program.

226 abstracts were submitted this year, and many researchers from the BioEM community acted as external reviewers, whose dedication in assisting the TPC in the abstract review process are greatly acknowledged. The accepted abstracts were assigned into 14 oral sessions and two poster sessions preceded by the student flash poster session. The sessions cover occupational and public health, from experimental studies to dosimetry and mechanistic research, as well as in vitro and in vivo research. We register a strong participation of students this year with 62 submitted abstracts demonstrating the ability of BioEM to attract young researchers by providing them with a motivating research community.

According to the tradition of the BioEM conferences, we will be delighted to have Awards for the Best Student Presentations (poster and platform).

We thank the members of the TPC for their valuable contribution and Astrid Chamson-Reig from Lawson Health Research Institute in Canada who worked particularly hard this year for managing the abstract submission website and the Book of Abstracts. Our special thanks go to the Chairs and the members of the Local Organizing Committee for their efforts in accommodating the BioEM 2022 Conference in the current unusual format.

We are looking forward to see you at BioEM 2022 and sincerely hope you will enjoy the meeting in Nagoya or online!

Bennett Ibey and Wout Joseph (BioEM2022 TPC Co-chairs)

Technical Program Review Committee


Francesca Apollonio
Italy


Anssi Auvinen
Finland


Quirino Balzano
United States


Frank Barnes
United States

Geza Benke
Australia


John Bolte
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Michal Cifra
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Rodney Croft
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Cem M. Deniz
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Marloes Eeftens
Switzerland


Juerg Froehlich
Switzerland


Osamu Fujiwara
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Peter Gajsek
Slovenia


Martin Gledhill
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Ben Greenebaum
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Katia Grenier
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Takashi Hikage
Japan

Anke Huss
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Peter Jeschke
Germany


Wout Joseph
Belgium

Jukka Juutilainen
Finland


Efthymios Karabetsos
Greece

Jolanta Karpowicz
Poland


Leeka Kheifets
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Korea

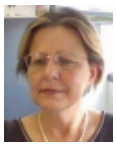

Mohsen Koohestani
France


Leena Korpinen
Finland


Stavros Koulouridis
Greece

Matej Kranjc
Slovenia


Ilkka Laakso
Finland


Susanna Lagorio
Italy


Isabelle Lagroye
France


Alireza Lajevardipour
Australia

Hae-June Lee
Korea

Sarah Loughran
Australia

Mai Lu
China

Isabelle Magne
France

Andrew Marino
United States

Carmela Marino
Italy

Luc Martens
Belgium

Rita Massa
Italy

Mats-Olof Mattsson
Austria

Robert McIntosh
Australia

Hiroaki Miyagi
Japan

Julien Modolo
France

Mihaela Morega
Romania

Satoshi Nakasono
Japan

Denys Nikolayev
France

Alberto Nájera
Spain

Gunnhild Oftedal
Norway

Chiyoji Ohkubo
Japan

Hideyuki Okano
Japan

Teruo Onishi
Japan

Andrei Pakhomov
United States

Olga Pakhomova
United States

Weidong Pan
China

Ruiyun Peng
China

Azadeh Peyman
United Kingdom

Blanka Pophof
Germany

Florence Poulletier De Gannes
France

Stefania Romeo
Italy

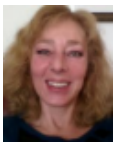
Jack Rowley
Australia

Martin Roosli
Switzerland

Tomonori Sakurai
Japan


Gernot Schmid
Austria


Masaki Sekino
Japan


Myrtill Simko
Sweeden

Rianne Stam
Netherlands


Gabriella
Tognola
Italy

Christer
Tornevik
Sweeden


Shoogo Ueno
Japan

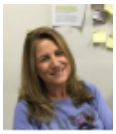

Akira
Ushiyama
Japan


Gunter
Vermeeren
Belgium


Jianqing Wang
Japan


Soichi Watanabe
Japan


Andrew Wood
Australia


Olga Zeni
Italy


Maxim Zhadobov
France

Schedule at a Glance

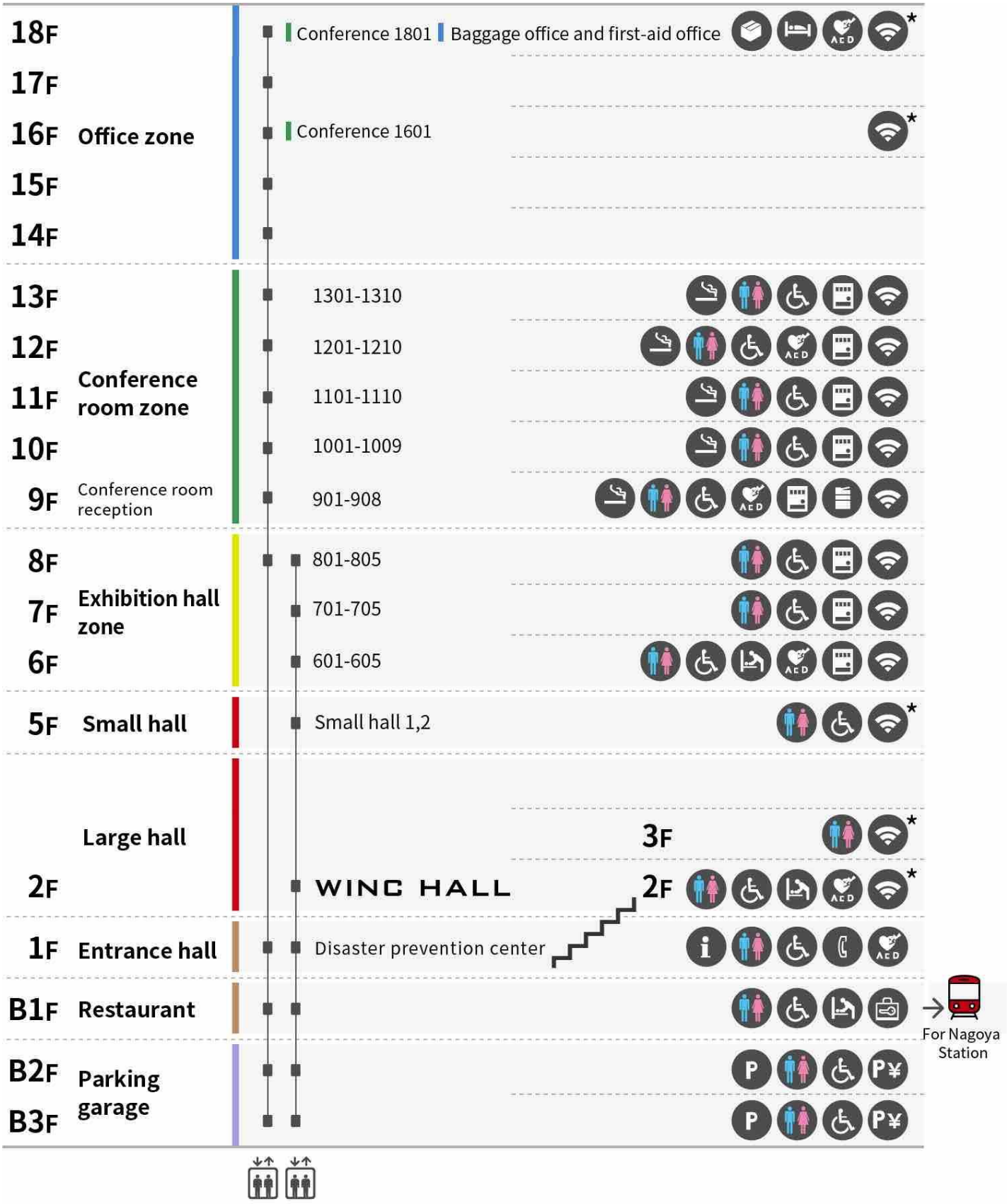
Europe (UTC+2)	US (UTC-5)	JAPAN (UTC+9)	Sunday, June 19	Monday, June 20	Tuesday, June 21	Wednesday, June 22	Thursday, June 23	Friday, June 24
1:00	18:00	8:00						
2:00	19:00	9:00		Opening and Welcome (LH) Plenary 1 (LH)	Plenary 2 (LH)	Tutorial 1 (LH) Tutorial 2 (SH2)	Plenary 3 (LH)	Plenary 4 (LH)
3:00	20:00	10:00	BioEM Board Meeting (EH/604)	Coffee Break (EH)	Coffee Break (EH)	Coffee Break (EH)	Coffee Break (EH)	Oral Session 13 (LH) Oral Session 14 (CR1)
4:00	21:00	11:00		Oral Session 1 (LH) Oral Session 2 (SH2)	Oral Session 3 (LH) Oral Session 4 (SH2)	Oral Session 9 (LH) Oral Session 10 (SH2)	Oral Session 11 (LH) Oral Session 12 (SH2)	Award Session (LH) Closing Ceremony (LH)
5:00	22:00	12:00		BioEM General Assembly (with lunch) (LH)	Lunch Break (Lunch will not be provided.)		Lunch Break (Lunch will not be provided.)	
6:00	23:00	13:00		Workshop 1 (LH) Workshop 2 (SH2)	Oral Session 5 (LH) Oral Session 6 (SH2)		Workshop 5 (LH) Workshop 6 (SH2)	BioEM Board Meeting (CR8)
7:00	0:00	14:00	ICNIRP Workshop* (SH2)	Coffee Break (EH)	Coffee Break (EH)		Coffee Break (EH)	
8:00	1:00	15:00		Student Flash Poster Session A (LH)	Oral Session 7 (LH) Oral Session 8 (SH2)		Student Flash Poster Session B (LH)	
9:00	2:00	16:00		Poster Session A (EH)	Workshop 3 (LH) Workshop 4 (SH2)		Poster Session B (EH)	
10:00	3:00	17:00						
11:00	4:00	18:00						
12:00	5:00	19:00	Welcome Reception (SH1)	Student Icebreaker	Conference Banquet (at "Nagoya Kanko Hotel")			
13:00	6:00	20:00						
14:00	7:00	21:00						

LH: Large Hall
SH1: Small Hall 1
SH2: Small Hall 2
EH: Exhibition Hall (6F)
CR1: Conference Room 1101 (11F)
CR8: Conference Room 1108 (11F)

*The "ICNIRP Workshop" is organized by ICNIRP and partly supported by NITech. The registration fee of this workshop is free.

Floor Maps

Aichi Industry and Labor Center (WINC AICHI)



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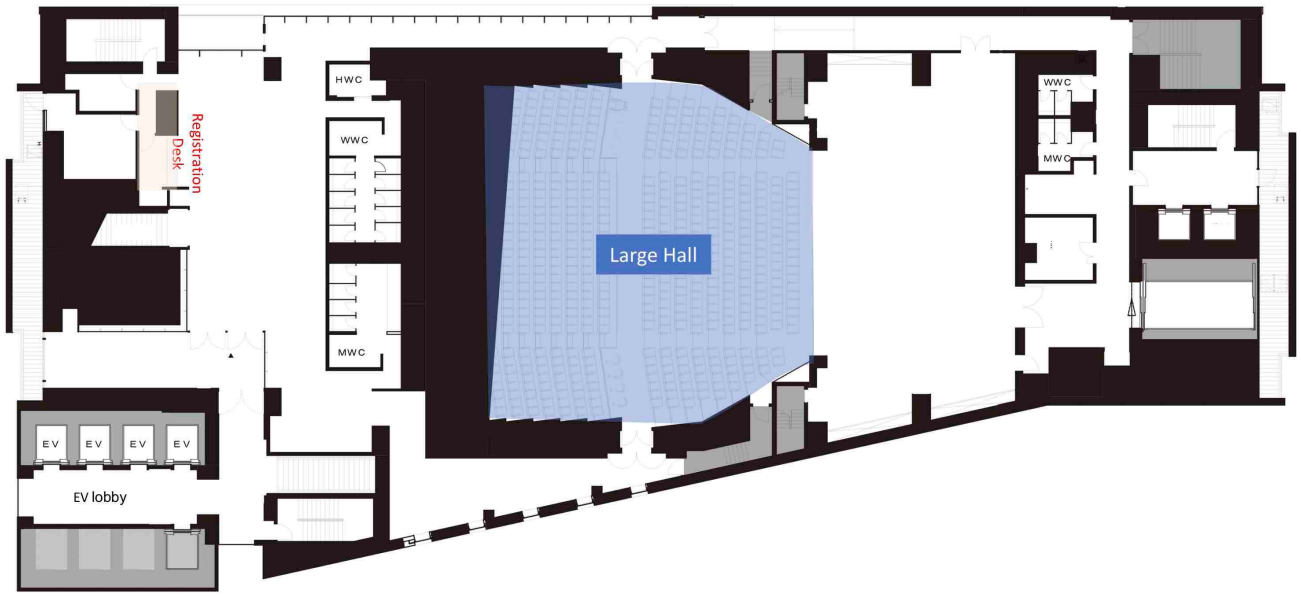
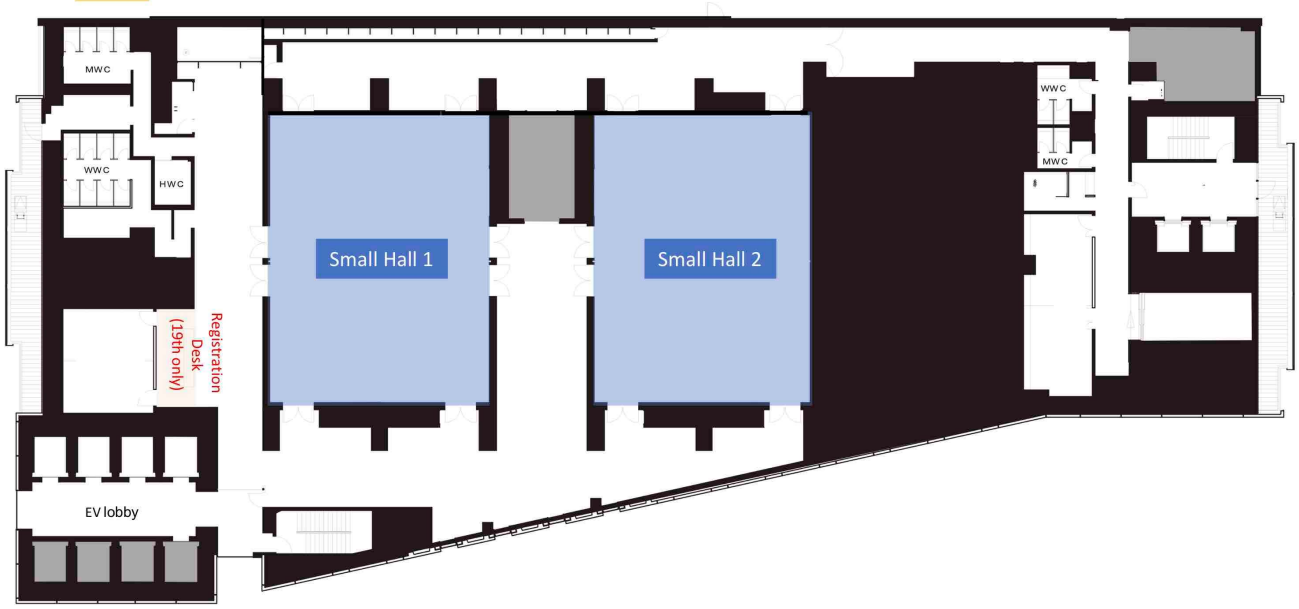
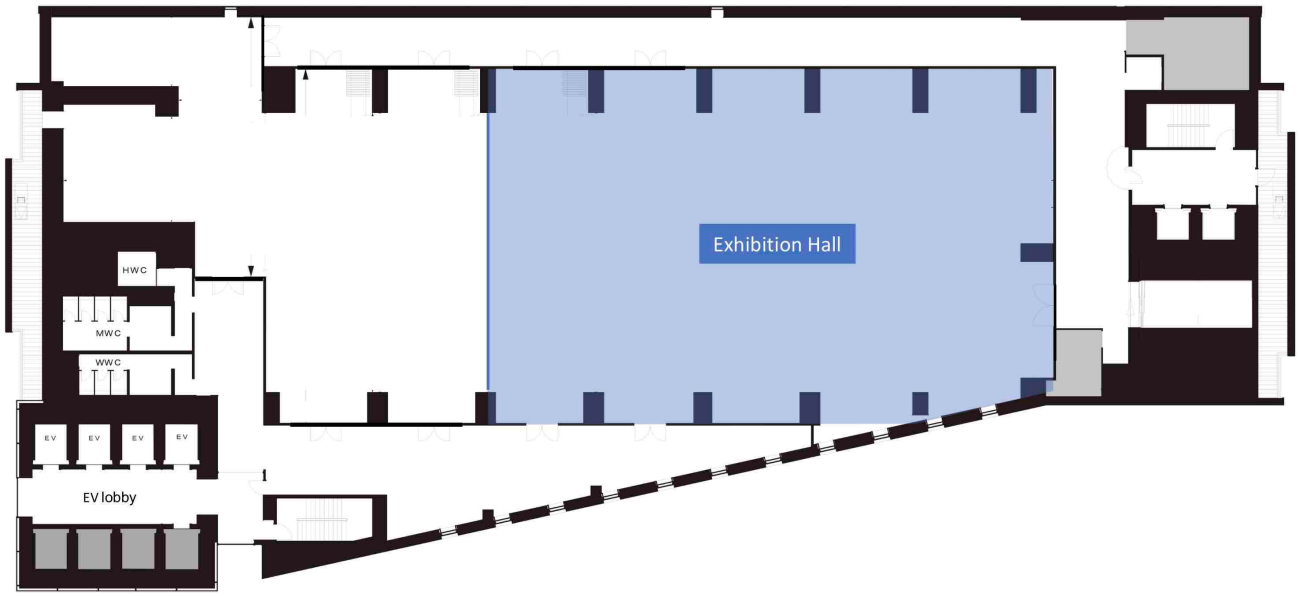

HWC
WWC
MWC
Registration Desk
Large Hall
WWC
MWC
EV
EV
EV
EV
EV lobby

5 F


MWC
WWC
HWC
Small Hall 1
Small Hall 2
WWC
MWC
Registration Desk (19th only)
EV lobby

6 F


Exhibition Hall
HWC
MWC
WWC
EV
EV
EV
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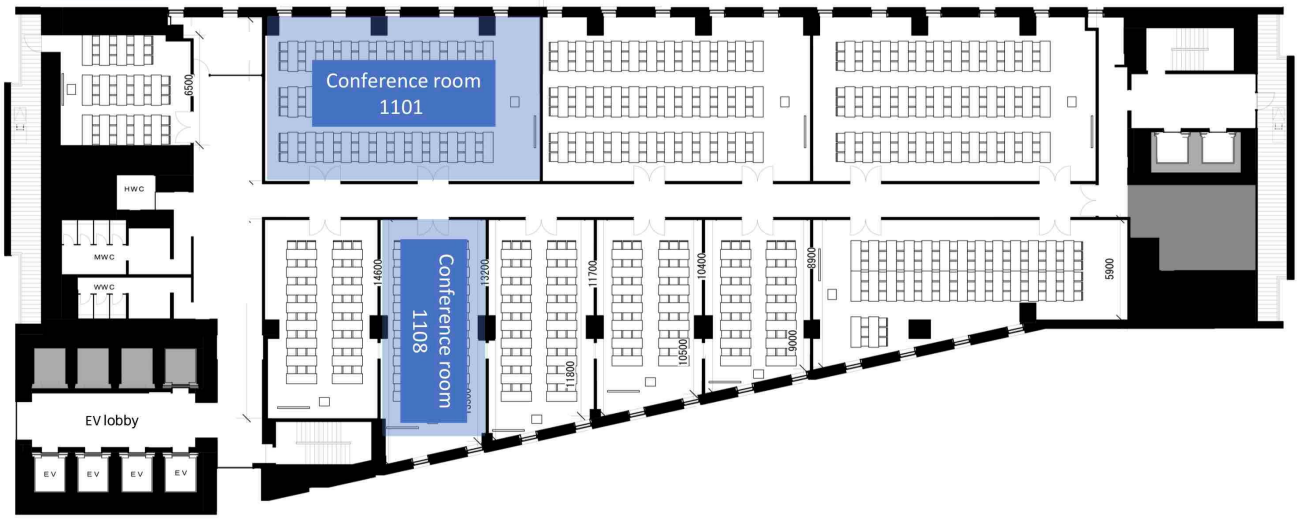
EV lobby

11 F


Conference room 1101
Conference room 1108
6500
14600
13000
11700
10400
9000
11800
10500
9000
5900
HWC
MWC
WWC
EV lobby
EV
EV
EV
EV

General Information

THE CONFERENCE VENUE

BioEM 2022 will be held at Aichi Industry and Labor Center (WINC AICHI), which is the only venue in such close proximity to Nagoya Station that can accommodate 801 people. WINC AICHI has a large hall, two small halls, a large exhibition hall, and a variety of conference rooms.

Aichi Industry and Labor Center (WINC AICHI)
4-4-38 Meieki, Nakamura-ku, Nagoya, Aichi, Japan

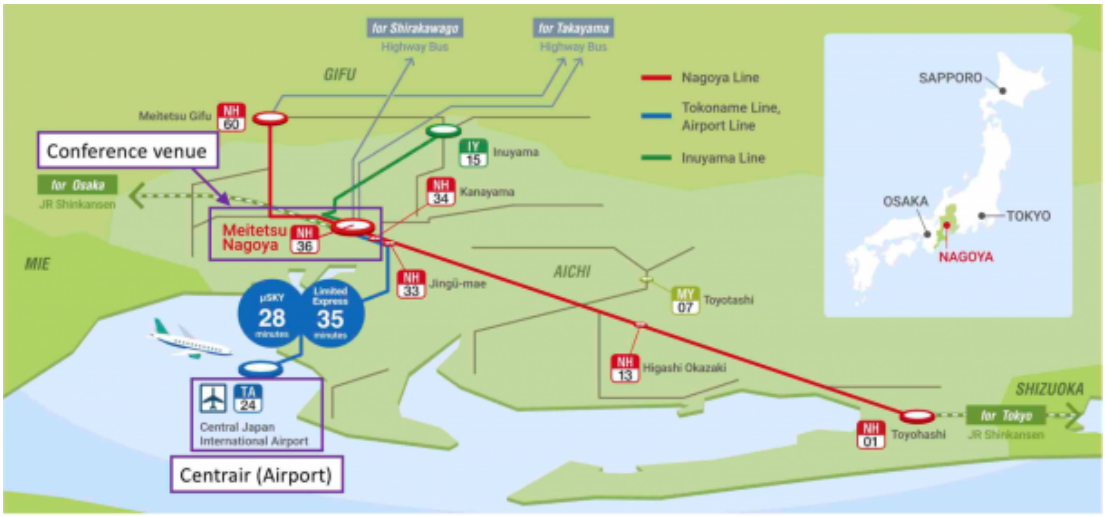
ACCESSIBILITY

WINC AICHI is conveniently just a five-minute walk away from JR Nagoya Station's *Sakura-dori* exit, or a two-minute walk from *Unimall* underground mall exit No.5. https://www.winc-aichi.jp/en/access/

The airport nearest to the venue is "Central Japan International Airport" (or "*Centrair*" for its nickname), which is about 30 minutes away from Nagoya Station by train.

City / Country	Time (Nagoya)	Time (Tokyo)	Time (Osaka)
London / UK	-	12h	12h
Paris / France	-	12h	12h
Sydney / Australia	-	9.5h	9.5h
New York / U.S.A	-	14h	13h
Los Angeles / U.S.A	-	12h	10h
Detroit / U.S.A.	11.5h	12h	-
Vancouver / Canada	-	10h	10.5h
Helsinki / Finland	10h	10h	10h
Frankfurt / Germany	12h	11h	12h
Dubai / U.A.E	10h	9h	11h
Shanghai / China	3h	3.5h	3h
Beijing / China	3.5h	4h	3.5h
Hong Kong / China	4.5h	5h	4h
Taipei / Taiwan	3h	3h	3h
Seoul / Korea	2h	2.5h	2h
Singapore	7h	7.5h	7.5h
Dubai / U.A.E	10h	9h	11h

The time required with a direct flight.



Access from Tokyo to Nagoya:

There is an express bullet train Shinkansen, which runs frequently from *Tokyo Station* to Nagoya Station about every 15 minutes. It takes 1 hour and 40 minutes.

And there are two international airports around Tokyo; *Haneda Airport* and *Narita Airport*.

These two airports are indicated as “Tokyo” but they are different airports.

If you arrive at *Haneda Airport* when you enter Japan, you can go to Tokyo (or Shinagawa) Station by train, and then take a Shinkansen to Nagoya. It takes about 30 minutes from Haneda Airport to Tokyo Station, or you can get off at Shinagawa Station because Shinkansen trains also stops at Shinagawa.

Since the express bullet train Shinkansen runs frequently between Tokyo Station and Nagoya Station about every 15 minutes, usually you do not need to reserve a ticket in advance. You can buy a Shinkansen ticket at a ticket window or vending machine in Haneda Airport or Tokyo Station (or Shinagawa Station) after you arrive in Japan.

On the way back to Tokyo from Nagoya, you can buy a Shinkansen ticket in the same way. You can also buy the ticket the day before departure to Tokyo because the conference venue is in front of Nagoya Station.

Of course, reservations are possible. Please see the following website:

https://global.jr-central.co.jp/en/tickets/buy/

If you arrive at *Narita Airport* when you enter Japan, we recommend that you take a domestic flight from Narita to Centrair Airport (the airport nearest to the conference venue), because it takes longer by train. If you still prefer traveling by train to move from Narita Airport, note that it will take about 1 hour to Tokyo Station. You should take a “*Keisei Skyliner*” train from Narita Airport to Nippori Station, which is about 40 minutes. There, you should change trains for Yamanote-Line and go as far as Tokyo Station, which will take about 12 minutes.

A Keisei Skyliner ticket from Narita Airport to Nippori Station is 2,570 JPY per person, and a ticket from Nippori to Tokyo is 160 JPY. If you prefer not changing trains, there is another train called "*JR Narita Express*," which will directly take you from Narita Airport to Tokyo Station. A one-way ticket of JR Narita Express is 3,470 JPY per person, and it will take 1 hour from Narita Airport to Tokyo Station.

Please note that trains in Japan usually do not operate all day. The first train of the day can be available around 6:00 AM or later, and the last train around 0:00 AM or earlier, but this differs among railway companies.

In case you arrive at Narita Airport or Haneda Airport later than 4:00 PM, we recommend that you stay at a hotel near the airport (or in Tokyo) for the first night, and move to Nagoya the next morning. After landing at your airport, it may take longer than usual for you to be able to leave the airport due to Covid-19 inspections or checking processes, so you should consider the time for this as well.

Access to the conference venue (WINC AICHI) from Nagoya Station

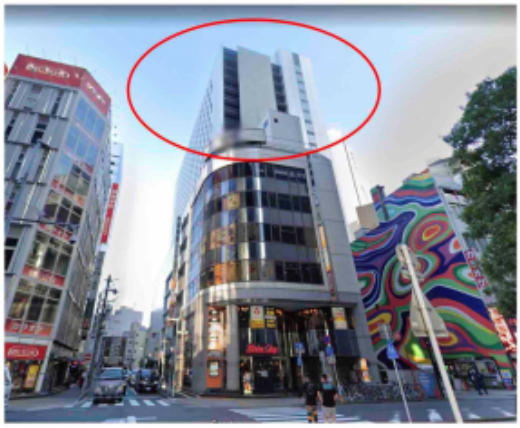
①

②

③

④

Conference venue can be found on your right (behind the building)



REGISTRATION AND INFORMATION DESK

The Registration Desk will be open during the following hours:

June 19 (Sun.): 14:00-20:00 (5th Floor Foyer)
June 20 (Mon.): 8:10-17:30 (2nd Floor Foyer)
June 21 (Tue.): 8:10-17:30 (2nd Floor Foyer)
June 22 (Wed.): 8:10-14:00 (2nd Floor Foyer)
June 23 (Thu.): 8:10-17:30 (2nd Floor Foyer)
June 24 (Fri.): 8:10-11:00 (2nd Floor Foyer)

Those who have registered for "Physical Attendance" should come to the Registration Desk at the venue. Detailed information about "how to check-in" will be shown on the website.

CONFERENCE BADGE

Badges must be worn at all times during the meeting and during all social events (registered guests as well). The badges will be delivered at the Registration desk.

CONFERENCE LUNCH AND COFFEE BREAKS

Lunch will NOT be provided, as there are a variety of restaurants around the venue, where participants can enjoy many different kinds of food by themselves during lunch hour. On Monday, June 20, however, a free lunch will be prepared for all the participants in the "BioEM General Assembly." Coffee services will be provided in the morning and in the afternoon from Monday to Friday.

SOCIAL EVENTS

1. GENERAL INFORMATION

Aichi Industry and Labor Center (WINC AICHI), the conference venue, is conveniently just a five-minute walk away from JR Nagoya Station's *Sakura-dori* exit, or a two-minute walk from *Unimall* underground mall exit No.5. https://www.winc-aichi.jp/en/access/

In the center of the city you can enjoy historic buildings (castles, temples, shrines, etc.) as well as many restaurants/bars.

2. WELCOME RECEPTION, Sunday June 19

The Welcome Reception is scheduled from 18:30 to 20:00 on Sunday, June 19, 2022 at "Small Hall 1" on the 5th floor of WINC AICHI.

All the "Physical" attendees with "Full Registration" (as well as their accompanying persons) are invited to the Welcome Reception without any extra fees.

3. STUDENT ICEBREAKER, Monday June 20

The Student Icebreaker will be held from 18:30 on Monday, June 20, 2022, at a bar close to WINC AICHI (details TBD).

This will be a great occasion for students to get to know each other sharing a few drinks.

4. CONFERENCE BANQUET, Tuesday June 21

Please join us for the Conference Banquet at 19:00 on Tuesday, June 21, 2022, which will be held at "Nagoya Kanko Hotel." https://www.nagoyakankohotel.co.jp/en/access/

All the "Physical" attendees with "Full Registration" or "One-Day Registration (Tue. June 21) with Banquet" (as well as their accompanying persons) are invited to the Conference Banquet without any extra fees.

At the entrance floor of the hotel, there is a gorgeous tearoom "*Chashitsu* (茶室)" replicating the ones loved by *Toyotomi Hideyoshi* (豊臣秀吉), one of the greatest *Samurai* warlords (*Sengoku Busho* (戦国武将)).

Begin with a cocktail or Japanese *Sake* (*Nihon-shu* (日本酒)) having Gala dinner served in this majestic atmosphere.

Dance time is planned as your expectation, but may not be allocated depending on the situation of COVID-19... (TBD)

ORAL AND POSTER PRESENTATION GUIDELINES

Please find below some potentially useful material to assist you in preparing a presentation for BioEM 2022. Papers are to be presented in two basic formats: Oral and Poster Presentations. Below you will find specific information concerning these two formats.

If for any reason you find yourself unable to present your paper, please try to arrange for someone else to present it. **If nobody is available to present your work, you must notify the Technical Program Committee (TPC) Chairs well ahead of time (at tpc@bioem.org). If the presentation does not take place, the corresponding abstract will be removed from the online abstract book.**

Due to the current Covid-19 situation, the BioEM 2022 conference will be a hybrid conference, with some people physically attending in Nagoya and other people attending online. The Local Organizing Committee (LOC) delivers the onsite video streaming and online conference platform.

Photos or video recording by the audience are strictly prohibited. However, the LOC will record all the oral sessions on Zoom and allow the registrants to view the recorded videos (with password protection) until the end of July 2022.

1. Presentation materials

All the presenters at BioEM 2022 are required to prepare their presentation materials, some of which should be submitted to the LOC beforehand. The LOC will provide a Dropbox link for presenters to transmit the electronic files around the beginning of June 2022.

During and after the conference, the following materials will be viewable for the BioEM 2022 registrants until the end of July 2022 (with password protection):

a) Oral Sessions Recorded on Zoom (mp4)
b) Electronic Poster Presentations (PDF)

However, all the presentation materials collected by the LOC, as well as the session videos recorded during the conference, will be completely destroyed and unavailable after August 1, 2022.

The following table summarizes necessary files for each presentation style. The deadline for submissions of materials through Dropbox is 11:00 on June 16, 2022 (UTC+9).

	Presenters should be at...	**Presentation materials (ppt or PDF) should be...**	**Printed poster(s) should be...**	**Electronic poster(s) (PDF with corresponding author's email address) should be...**	**Pre-recorded presentation video (MP4)...**
Oral Presenter (onsite) (see 2.1)	Conference Venue	brought in by presenter in person (or can be uploaded to Dropbox beforehand).	--	--	--.
Oral Presenter (online) (see 2.2)	Zoom Platform	shared on Zoom platform.	--	--	should be uploaded to Dropbox beforehand. (maximum 11 minutes for regular oral)
Poster Presenter (onsite) (see 3.1)	Conference Venue	--	printed and brought in by the presenter in person.	uploaded to Dropbox beforehand.	--
Poster Presenter (online) (see 3.2)	Zoom Platform	shared on Zoom platform.	--	uploaded to Dropbox beforehand.	--
Student Flash Presenter (onsite) (see 4.1)	Conference Venue	brought in by presenter in person (or can be uploaded to Dropbox beforehand). (maximum 3 slides)	--	--	--
Student Flash Presenter (online) (see 4.2)	Zoom Platform	shared on Zoom platform. (maximum 3 slides)	--	--	should be uploaded to Dropbox beforehand. (maximum 2 minutes)

2. Oral Presentations for speakers (including invited speakers)

Invited speakers presenting in Plenaries, Tutorials, and Workshops should check their time slots in this program book. Regular oral presentations have been allocated a 15-minutes time slot. These 15-minutes

must include the presentation, questions, and transitioning to the next speaker. It is recommended that speakers plan on an 11-minute presentation to allow for questions, discussion and transition (4 minutes). **There will be an online platform for questions and answers.** It is important to strictly adhere to this schedule as most oral presentations are scheduled in parallel sessions.

2.1 Oral speakers attending physically in Nagoya

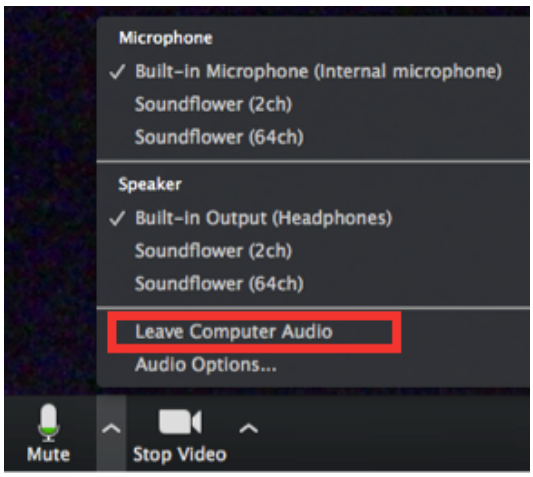
Onsite oral speakers can give presentations at the conference venue.

Each meeting room will be equipped with a personal computer to accommodate PowerPoint and PDF presentation formats. There will be a designated contact person coordinating the upload of your presentation file in your session room. Please coordinate with this person to upload your presentation preferably the day before, or during the break before your session at the latest. (As for presentations on Monday, June 20, you can access the session room computers from 18:30 to 19:30 on Sunday the 19th.) Presenters are strongly encouraged to verify that their presentation materials have been uploaded properly on the on-site equipment. Presentation materials can be loaded via USB flash drive. Some of you may prefer uploading your presentation materials through the Dropbox link provided by the LOC prior to the conference.

Arrive at your session room at least 15 minutes prior to the start of the session and familiarize yourself with the audio-visual equipment.

All oral presenters are expected to support their presentation with a corresponding slideshow. The slides should be prepared in either PowerPoint (PPT/PPTX) or PDF format to ensure maximum compatibility with the equipment available on-site. Videos should either be embedded into the slides, or, if linked, be contained in the same folder of the main presentation document, and not linked to any online file with network access.

You can use your own computer to project your slides, if you want. In such a case, prior to the session, install the Zoom application and access a corresponding Zoom meeting, just like you are presenting online. Both wired LAN and WiFi are available in the meeting room. ***Share your slides on the Zoom application****. You do not have to connect video cables (HDMI or VGA) to the computer. The slides are projected to the screen in the meeting room from another computer which the LOC prepares and connects to Zoom meeting. The slides are delivered also to online participants. Your voice is collected using a microphone operated by the organizers.* ***You must select "Leave Computer Audio" from the audio popup menu (See a screenshot below).*** *This is necessary for avoiding unintended audio feedback. Even if you use your own computer, the slides should be uploaded to the designated computer at the conference venue for backup purpose.*



2.2 Oral speakers attending remotely

Online oral speakers can give presentations by accessing a Zoom meeting corresponding to the session. Each speaker can choose either playing a pre-recorded talk video or making a live presentation. The pre-recorded video is streamed by an operator in the conference venue. Video streaming is recommended if your internet connection is not always stable. If you make a live presentation, share your slides from your own computer. You should turn your camera on during your presentation so that audience sees your face. **All the online speakers, whether live presentation or video streaming, are required to upload a pre-recorded talk to the Dropbox link provided by the LOC for backup purpose.**

Also, please note that online oral speakers are requested to access the Zoom platform at the time of the session and prepare for questions, even if you wish to use your video recording.

Instructions for recording your talks:

- All files must be in MP4 Format.

- You can easily record your presentation using a Zoom function. Start a Zoom meeting by yourself with no one else logging in, and click “Record” and start your talk. After you finish your presentation, stop recording, and then an MP4 file will be saved on your computer.
  Microsoft PowerPoint has a recording function as well, which may be as easy as Zoom recording.
- Video length: 11 minutes for regular oral presentations.
- Slideshow should be recorded with presenter's face displayed in the corner of the screen so that the material presented is not hidden behind the recording of the presenter.
- Aspect Ratio: 16:9 (or 4:3) Landscape
- The LOC will provide a Dropbox link for your uploads. It is important the file name consists of your session ID, your presentation order in the session, and your last name, separated by underscores (example: S01_1_Wang). The session code and the presentation order are shown in this program book.

Tips for recording audio/video:

- Use an area as quiet as possible.
- Avoid areas that have echo.
- A good headset with a microphone set close to your mouth BUT away from direct line of mouth to reduce “pops”. Try to avoid using default, built-in microphones on your computer, if possible.

3. Poster Presentations

Poster Sessions are an important part of the BioEM 2022 conference and allow for immediate and effective communication between all those interested in specific subjects, actions or programs. Posters should be carefully designed and prepared to ensure their full impact. The physical poster will be mounted on a dedicated board in the 6th-floor Exhibition Hall at the conference venue. **Online posters will be presented on Zoom meeting.** Each online poster presenter will be assigned to one breakout room.

Poster Sessions are scheduled on Monday and Thursday from 16:30 to 18:00 respectively, with physical posters and online posters simultaneously presented. **The first 45 minutes (16:30-17:15) will be a core time for physical posters.** Presenters of physical posters must stand in front of their posters during this core time. In the meantime, online presenters can either present their posters or visit other posters (Physical posters are available in an electronic format). Online audience can send e-mails to physical poster presenters for making questions. **The second 45 minutes (17:15-18:00) will be a core time for online posters.** Presenters of online posters must stay in their breakout rooms during this core time. Onsite presenters can either present their posters or visit other physical and online posters.
The aim or setting these core times is to facilitate interactions between physical and online participants. Audience is expected to visit physical posters during the first core time and visit online posters during the second core time. Physical participants can access the Zoom meeting using WiFi in the conference venue.

3.1 Poster presenters attending physically in Nagoya

Onsite poster presenters must present their poster during the poster session detailed above, as usual. Presenters must also upload a PDF of the poster to the Dropbox link provided by the LOC before the conference starts. The PDF files of poster presentations will be uploaded to the online platform and viewable for the BioEM 2022 audience. In the PDF of your poster, show an e-mail of the corresponding author clearly for receiving questions from online audience.

Instructions for electronic posters uploaded to the designated website:

- PDF format
- Corresponding authors email address should be shown.

At the conference venue, a single-sided board in portrait format (height 210 cm x width 90 cm) will be available for each presenter to attach their poster. You are advised to limit your poster size to 120 cm (height) x 90 cm (width) (A0 size is preferable) but you should consider the margins of the board. Push-pins for mounting posters will be provided by the organizers. The boards will be numbered to correspond to poster numbers in the Program, with student posters clearly identified.

Onsite poster presenters should be present at their posters for the duration of their core time to discuss their work and answer questions, as there will be a flux of attendees.

Mounting: Presenters can mount their posters during the following hours, but the poster setup must be finished by 15:00 on Monday, June 20.

- June 19 (Sun.): from 15:00 to 18:00
- June 20 (Mon.): from 8:00 to 15:00

Each board will be marked with the poster number, as indicated in the final program.

There will be help on Sunday and Monday and material ready for mounting.

Removal: Posters must be removed by the presenters themselves between 18:00 and 19:00 on Thursday, June 23.

3.2 Poster presenters attending remotely

Online poster presenters can show their electronic posters in individual Zoom breakout rooms. Prepare your poster in PowerPoint or PDF format, and share it on the designated Zoom platform. You should also upload the PDF file of your poster presentation through the Dropbox link provided by the LOC prior to the conference.

Online poster presenters should access a Zoom meeting corresponding to the session. In the main meeting room, you should be able to find your “breakout room” with the indication of your presentation ID. Select the breakout room, go in there, and wait for audience to come in.

When you present your poster to audience, it is recommended to give a short overview explanation first in one minute with your poster shared through Zoom, and then to let the audience make questions. Do NOT make a long explanation because audience may want to visit as many posters as possible. You should turn your camera on when you have audience in your breakout room so that the audience sees your face. Make your presentation as interactive as possible, carefully watching the audience’s response.

Instructions for posters for online presentation:

- PDF format (PowerPoint is also acceptable for your presentation in a breakout room)
- Corresponding authors email address should be shown.

4. Student Flash Poster Sessions

All student posters will also be presented at “Student Flash Poster Sessions,” which will take place in the Large Hall on Monday and Thursday from 15:30 to 16:30, followed by the main “Poster Sessions.” Student presenters should prepare for their communication carefully (in English). Each presenter will have **2 minutes to present 3 slides maximum** for the flash presentation (discussions will follow afterwards at the main Poster Session). You should introduce yourself in the beginning of the presentation and point out the main findings of your work. Hence the presentation should not include new material that is not shown on your poster. The chairs will call up the next presenter after the 2 minutes are over and you must leave the podium.

4.1 Student flash presenters attending physically in Nagoya

Onsite student flash presenters can give presentations at the conference venue.

Instructions on how to upload your presentation materials into the session room computer are the same as those for "onsite oral presenters" (see 2.1). **In the student flash session, however, you are not allowed to connect your own computer to the projection system in order for the next presenter to begin his/her presentation immediately after you.**

4.2 Student flash presenters attending remotely

Online student flash presenters can give presentations through Zoom platform.

Instructions on how to give presentations are the same as those for "online oral presenters" (see 2.2), and you can choose either playing a pre-recorded talk video or making a live presentation. **However, the pre-recorded video must be 2 minutes at the longest.**

Organized by BioEM

*__BioEM__ is a new society which has been merged from the following two societies:

The Bioelectromagnetics Society (BEMS)

European BioElectromagnetics Association (EBEA)

Co-organized by

Center of Biomedical Physics and Information Technology, Nagoya Institute of Technology

Technical Sponsor

Union Radio-Scientifique Internationale / International Union of Radio Science (URSI)

Supporters

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Technical Committee on Electromagnetics Compatibility, The Institute of Electrical Engineers of Japan

Technical Committee on Electromagnetics Compatibility, The Institute of Electronics, Information and Communication Engineers (IEICE)

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Kagawa University, Nagoya Institute of Technology, DIMS Institute of Medical Science Inc.

Standardization of Experimental Protocol for Safety Assessment of EMF (STEPS EMF)

Hokkaido University, Kurume University, Aichi Gakuin University, and Kagawa University

Hokkaido University, Center for Environmental and Health Sciences

Investigation of Threshold of Thermal Response Exposed to Millimeter Wave Depending on Age and Environment, Nagoya Institute of Technology, Kurume University, Saga University

Investigation of Thermal Pain Threshold for Contact Current at Intermediate Frequency Band, Nagoya Institute of Technology, Utsunomiya University, Fujita Health University

Virtual Exhibitor

SEIKOH GIKEN

Technical Program

Sunday June 19, 2022

Session: M1
BioEM Board Meeting
Sunday June 19, 2022 • 10:00 - 17:00
Exhibition Hall

ICNIRP Workshop
Sunday June 19, 2022 • 14:00 - 18:00
Small Hall 2

Welcome Reception
Sunday June 19, 2022 • 18:30 - 20:00
Small Hall 1

Monday June 20, 2022

Opening and welcome
Monday June 20, 2022 • 08:30 - 09:00
Large Hall

Session: P1
Plenary 1: EM exposure risks for persons with implants: A neglected population?
Monday June 20, 2022 • 09:00 - 10:00
Large Hall
Chairs: Micaela Liberti & Wout Joseph

P1-1 [09:00]

EM exposure risks for persons with implants: A neglected population?

Niels Kuster[1] & Aiping Yao[2]

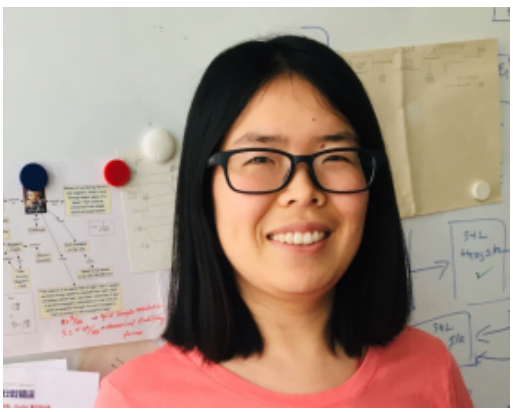
[1]*ETH Zurich & IT'IS Foundation, Zurich, Switzerland*

[2]*School of Information Science and Engineering, Lanzhou University, Lanzhou, China*

Biographical sketch

Part 1: Professor Niels Kuster received his MSc and PhD degrees in Electrical Engineering from the Swiss Federal Institute of Technology in Zurich (ETH Zurich). He was appointed as Assistant Professor in 1993 and Adjunt Professor in 2001 at the ETH Zurich Department of Information Technology and Electrical Engineering (D-ITET). Since 1999, Niels is the founding Director of the Foundation for Research on Information Technologies in Society (IT'IS), Switzerland. His research interests include (i) experimental and computational electromagnetics (subHz–300 GHz) in complex environments, (ii) computational life sciences, and (iii) human and animal virtual anatomical models that are functionalized with dynamic tissue models. He founded several spin-off companies and has published over 250 peer-reviewed publications on measurement techniques, computational electromagnetics, dosimetry, exposure assessments, and bioexperimentation. Niels is also deeply involved in standards organizations and technology transfer through collaboration with technology companies. He is a Fellow of the IEEE Society, a delegate of the Swiss Academy of Sciences. He served in various board functions of BEMS and EBEA (president of BEMS 2008 – 2009). In 2012, he received the d'Arsonval Award from BEMS.

Part 2: Dr. Aiping Yao is currently an associate professor in school of information science and engineering at Lanzhou University. She completed her master degree at Chinese Academy of Science and got her Ph.D from ETH Zurich. Before she joined Lanzhou University, she also worked at IT'IS Foundation as a project leader.



Her research interest lies in the field of computational electromagnetic and bioelectromagnetics, especially in the electromagnetic safety evaluation for patients with implantable medical devices under magnetic resonance imaging (MRI).

Abstract

Summary

The number of patients implanted with medical devices has constantly and rapidly grown and now comprises several million patients worldwide. The current safety guidelines and national regulations for electromagnetic exposures do not consider the potential additional risks due to the presence of conductive implants. The objective of this plenary is to summarize the state of the art in this area, and to identify present research gaps and regulatory shortcomings.The first part of plenary will discuss the mechanism of local enhancements of

induced fields as a function of frequency and implant size, and review the conditions under which these enhancements can pose additional health risks.In the second part, we illustrate how these risks are evaluated and mitigated in the special case of magnetic resonance (MR) examination, through a set of approaches with tunable complexity and conservativeness which can be extended to regulation of other exposure scenarios.

Rationale

The risks posed to persons with implants have been largely ignored and will likely become a growing concern due to rapidly increasing number of people with implants being exposed to strong low frequency fields, such as wireless power transfer systems. The topic is of interest to regulators, engineers, and experts involved in exposure assessment and risk analysis.

Coffee Break
Monday June 20, 2022 • 10:00 - 10:30
Exhibition Hall

Session: S01
Session 1: Dosimetry measurements
Monday June 20, 2022 • 10:30 - 12:00
Large Hall
Chairs: Akimasa Hirata & Azadeh Peyman

S01-1 [10:30]
STUDENT PAPER

Verification of code-selective 5G measurements to assess the maximal RF exposure to mobile-radio base stations with dynamic spectrum sharing

Lisa-Marie Schilling[1], Christian Bornkessel[1] & Matthias Hein[1]

[1]*RF & Microwave Research Laboratory, Thuringian Center of Innovation in Mobility, TU Ilmenau, Ilmenau, Germany*

Keywords: Dosimetry (measurements), RF/Microwaves, Work in Progress
Presented by: Lisa-Marie Schilling

The dynamic spectrum sharing technology is increasingly being used to enable parallel operation of 4G and 5G in one frequency band. 5G code-selective measurements provide a new method to assess the maximal exposure to 5G and offer an alternative to the frequency-selective method used so far. We have investigated this code-selective method and compared the maximal exposure of 5G and 4G with dynamic spectrum sharing. Theoretically, 5G and 4G should generate the same maximal RF exposure, assuming the same transmit power in the frequency band under consideration. This assumption was confirmed by measurements, so the suitability of the code-selective method for measurements at 5G base stations with dynamic spectrum sharing was proven.

S01-2 [10:45]

Tabletop exposure system for assessment of radiofrequency compatibility of medical implants with magnetic resonance examination

Session: S02
Session 2: Electroporation
Monday June 20, 2022 • 10:30 - 12:00
Small Hall 2
Chairs: Florence Poulletier De Gannes & Lluis M. Mir

S02-1 [10:30]

MHz compression of nanosecond pulsed electric fields can target clearance of specific tissues based on their charging time constant

Richard Nuccitelli[1], Bruce Freimark[1], Amanda McDaniel[1], Dacia Gonzalez[1], Kristin von Rothstein[1] & Esin B. Sözer[1]

[1]*Biology, Pulse Biosciences, Hayward, CA, USA, 94545*

Keywords: Electroporation, Pulsed, Work in Progress
Presented by: Richard Nuccitelli

Megahertz nanosecond pulsed electric field (MHz-nsPEF) technology applies repeated packets of nanosecond pulses at a lower electric field amplitude than single-pulse nsPEF but at a million times faster rate (typically 1-3 MHz). Each pulse induces a potential on the capacitive components of the target tissue, and the subsequent pulses are applied before the complete potential discharge resulting in a stepwise increase in the membrane potential. The packet number of these pulses required to reach membrane breakdown depends on the charging time constant of the tissue so some tissues can be cleared with a packet number that will have no effect on tissues with a longer time constant.

S02-2 [10:45]
STUDENT PAPER

Electrochemotherapy with microsecond and nanosecond pulses leads to the same cellular

Lena Kranold[1, 2], Myles Capstick[1], Tolga Goren[1] & Niels Kuster[1, 2]

[1]*IT'IS FOUNDATION, Zürich, Switzerland, 8004*

[2]*Department of Information Technology and Electrical Engineering, ETH Zurich, Zürich, Switzerland, 8092*

Keywords: Dosimetry (measurements), RF/Microwaves, Work in Progress

Presented by: Lena Kranold

A compact, tabletop-sized radiofrequency (RF) field generator that can rapidly generate a diverse range of tangential incident E-fields along defined implant test routings to efficiently measure the enhancement (heating or terminal voltage) exhibited by medical implants has been developed. By controlling amplitude and phase of the two excitation modes, implants are exposed to diverse E-field conditions at 64/128 MHz, equivalent to 1.5 T or 3 T magnetic resonance (MR) examination. Field distribution simulations have been validated in both magnitude and phase using vector probe measurements.

S01-3 [11:00]

A near field measurement approach for comprehensive on-body uplink/downlink exposure measurement

Marco Zahner[1], Fabian Schneider[1], Martin Röösli[2, 3] & Jürg Fröhlich[1]

[1]*Fields at Work GmbH, Zurch, Switzerland, 8032*

[2]*Swiss Tropical and Public Health Institute, Allschwil, Switzerland*

[3]*University of Basel, Basel, Switzerland*

Keywords: Dosimetry (measurements), RF/Microwaves, Work in Progress

Presented by: Marco Zahner

A novel measurement device with integrated detectors for measuring and visualizing the exposure to radiofrequency electromagnetic fields (RF-EMF) from using the own mobile phone is developed. The concept is based on a sensor flex PCB inserted in a 3D printed headphone-like support and a data logger node as wearable parts including the necessary components for the data acquisition and storage. A measurement was set up in the lab to verify the functionality of the current device. The assembled sensor patch was used to detect the emissions of a smartphone actively transferring data triggered by a data transfer speed benchmarking app. The resulting measured pattern is repeatable and consistent.

amount of cisplatin in vitro

Angelika Vižintin[1], Stefan Marković[2], Janez Scancar[2] & Damijan Miklavčič[1]

[1]*University of Ljubljana, Ljubljana, Slovenia, 1000*

[2]*Department of Environmental Sciences, Jožef Stefan Institute, Ljubljana, Slovenia, 1000*

Keywords: Electroporation, Pulsed, Completed (unpublished)

Presented by: Angelika Vizintin

We showed in vitro that electrochemotherapy with nanosecond pulses results in increased cellular cisplatin accumulation (compared to non-electroporated cells). We also compared whether the amount of cisplatin in cells is the same after electroporation with nanosecond pulses as with 8 × 100 µs pulses, which are standardly used in electrochemotherapy. We show that with properly chosen nanosecond pulse parameters, the same amount of cisplatin is accumulated in cells and same decrease in cell survival is achieved as with 8 × 100 µs pulses. Increased cisplatin accumulation is most likely the dominant mechanism of cell death also in electrochemotherapy with nanosecond pulses.

S02-3 [11:00]
STUDENT PAPER

High voltage sub-nanosecond pulses: generation and optoelectronic delivery system based on electrodes embedded in an optical fiber

Nour Tabcheh[1], Rosa Orlacchio[1], clément Strutynski[2], Sylvain Danto[2], Thierry Cardinal[2], Vincent Couderc[1], Philippe Leveque[1] & Delia Arnaud-Cormos[1, 3]

[1]*University of Limoges, CNRS, Xlim, UMR 7252, Limoges, France, 87000*

[2]*Institute of Chemistry of the Condensed Matter of Bordeaux (ICMCB), Pessac, France, 33608*

[3]*Institut Universitaire de France (IUF), Paris, France, 75005*

Keywords: Electroporation, Pulsed, Completed (unpublished)

Presented by: Nour Tabcheh

In this paper, we develop an experimental setup of a newly designed, sub-nanosecond high voltage generator for in vitro bioelectric experiments. Based on the frozen wave principle, the generator uses two optoelectronic silicon switches. The proposed generator is able to generate three different forms of pulses, including unipolar, bipolar, and paired, with modulable amplitude and adjustable delay between pulses polarities. We also discuss the frequency characterization of a hybrid optoelectronic system and its ability to transmit the generated pulses. The system is composed of a polyethersulfon fiber with

classical multimode optical fiber core surrounded by two metallic electrodes.

S01-4 [11:15]

Assessment of RF-EMF exposure near 5G NR small cells

Sam Aerts[1], Kenneth Deprez[1], Leen Verloock[1], Robert G Olsen[2], Luc Martens[1], Phung Tran[3] & Wout Joseph[1]

[1]*Department of Information Technology, Ghent University / imec, Ghent, Belgium, 9052*

[2]*Washington State University, Pullman, WA, USA, 99164-2752*

[3]*Electric Power Research Institute (EPRI), Palo Alto, CA, USA, 94304*

Keywords: Dosimetry (measurements), RF/Microwaves, Completed (unpublished)
Presented by: Sam Aerts

In this study, measurements of radiofrequency (RF) electromagnetic fields (EMFs) were conducted in the near vicinity of two types of 5G New Radio (NR) base stations: one featuring an Advanced Antenna System (AAS) with an array antenna at low height and the other a lower-power microcell base station on an accessible flat roof. The measurement results were scaled to lower output powers in order to estimate exposures of users and non-users in the vicinity of small-cell base stations that may be widely deployed in 5G NR networks. For members of the general public, the maximum exposure ratio (compared to ICNIRP guidelines) was 0.68, at a distance of 1.3 m from the base station.

S01-5 [11:30]

Evaluation of exposure systems for international joint animal study

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Keywords: Dosimetry (measurements), RF/Microwaves, Work in Progress
Presented by: Sangbong Jeon

S02-4 [11:15]

A single 5 ns pulse triggers a transient membrane depolarization in chromaffin cells from mice conditionally expressing a genetically-encoded voltage indicator (GEVI)

Ciara Viola[1], Lisha Yang[1], Normand Leblanc[1], Gale Craviso[1] & Thomas Gould[2]

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Keywords: In vitro, Pulsed, Work in Progress
Presented by: Ciara Viola

Recent work from our laboratory using mice expressing the genetically-encoded Ca^{2+} indicator GCaMP6f has shown that a 5 ns pulse evokes a rapid rise in intracellular Ca^{2+} that is due to Ca^{2+} influx via voltage-gated Ca^{2+} channels. Here we examined the changes in transmembrane potential that occur by monitoring membrane fluorescence levels in mouse ACC expressing the genetically-encoded voltage indicator ASAP-2. In response to a 5 ns pulse as well as to a nicotinic receptor agonist, there was a rapid decrease of fluorescence. A reduction of fluorescence was also observed in whole-cell patch clamped cells following injection of a depolarizing current from –70 mV to –10 mV.

S02-5 [11:30]
STUDENT PAPER

Does the shape of a 5 ns pulse affect the threshold voltage to induce a calcium response in adrenal chromaffin cell?

Anithakrithi Balaji[1], Josette Zaklit[1], Normand Leblanc[2], Gale Craviso[2], Sung-Hae Yun[1] & Jihwan Yoon[1]

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Keywords: In vitro, Pulsed, Work in Progress
Presented by: Anithakrithi Balaji

Nanosecond Electric Pulses (NEPs) are an effective tool for electrostimulation of biological cells. Ca^{2+}dependent exocytosis is triggered in bovine adrenal chromaffin cells when stimulated with a 5 ns pulse. Upon stimulation, there is a rapid increase in

SUMMARY Research teams in Korea and Japan are conducting international joint animal study for validation of the US National Toxicology Program (NTP) research study. As an animal exposure system, reverberation chambers (RC) with the same structures were built in both countries. In this paper, we describe the exposure systems and show the results of evaluation of exposure systems under various loading conditions.

S01-6 [11:45]

Experimental analysis of the RF EMF exposure from 5G millimeter wave base stations

Paramananda Joshi[1], Fatemeh Ghasemifard[1], David Anguiano Sanjurjo[1], Bo Xu[1], Carla Di Paola[1], Davide Colombi[1] & Christer Tornevik[1]

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Keywords: Dosimetry (measurements), RF/Microwaves, Work in Progress
Presented by: Davide Colombi

In this work, an experimental analysis of the RF EMF exposure from base stations operating at 28 GHz in a live 5G network is presented. The results include statistics on the time-averaged power transmitted by several massive MIMO base stations monitored continuously over a period of several days. The effect of beamforming and beam-steering on the RF exposure is studied by evaluating the spatial distribution of energy into different antenna beams. The data are collected directly from the base stations using a dedicated tool for monitoring of the actual transmitted power in spatial segments. Complementary in-situ measurements by means of a probe and a spectrum analyzer are conducted with the objective to validate the power monitoring tool.

S02-6 [11:45]
STUDENT PAPER

Using subnanosecond pulsed electric fields to electroporate bacteria and eukaryotic cells

Leslie Vallet[1], Njomza Ibrahimi[2], Laurent Ariztia[2], Franck Andre[1], Marc Rivaletto[2], Antoine Silvestre de Ferron[2], Anthony Ranchou-Peyruse[3], Bucur Novac[2,4], Laurent Pecastaing[2] & Lluis M. Mir[1]

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Keywords: In vitro, Pulsed, Work in Progress
Presented by: Leslie Vallet

The present study explores the ability of ca. 910 ps duration pulsed electric fields (PEFs) to electroporate bacteria (E.Coli DH5α strain), examining the influence of various parameters such as the number of pulses applied, the pulse repetition frequency (PRF) and the temperature. The work aims at finding conditions of reversible and irreversible electroporation for ulterior applications on eukaryotic cells and in medicine.

Lunch
Monday June 20, 2022 • 12:00 - 13:30

Session: M1
BioEM General Assembly
Monday June 20, 2022 • 12:00 - 13:30
Large Hall

Session: W1
Workshop 1: Utilities Threshold Initiative Consortium (UTIC)
Monday June 20, 2022 • 13:30 - 15:00
Large Hall
Chairs: Alexandre Legros & Satoshi Nakasono

W1-1 [13:30]

Evaluation of neuronal network activity in high-intensity power frequency magnetic fields

Atsushi Saito[1], Masayuki Takahashi[1], Yukihisa Suzuki[2], Yasuhiko Jimbo[3] & Satoshi Nakasono[1]

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High-intensity time-varying electromagnetic fields stimulate the human body through excitation of the nervous system. However, the threshold of the magnetic field-induced neuronal modulation in the cellular- to network-level has not been elucidated. In this study, we used brain-derived neuronal networks for evaluation of stimulus threshold by high-intensity power frequency magnetic field (hPF-MF) exposure. Using the multi-electrode array recording system, we could detect the modulation of the synchronized bursting activity after hPF-MF exposure. Based on these results, we will introduce the effectiveness and challenges of evaluating the threshold of neuronal modulation by cellular experiments using the newly designed experimental approach.

W1-2 [13:50]

Utilities Threshold Initiative (UTIC) Workshop: Human perception of electric fields and influencing factors

Michael Kursawe[1], Dominik Stunder[1], Andrea Kaifie-Pechmann[2], Sarah Driessen[1], Thomas Krampert[3], Simon Kimpeler[3], Thomas Kraus[1, 2] & Kathrin Jankowiak[1]

[1]*Research Center for Bioelectromagnetic Interaction (femu) - Institute for Occupational, Social and Environmental Medicine, Uniklinik RWTH Aachen University, Aachen, Germany*

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[3]*Institute for High Voltage Equipment and Grids,*

Session: W2
Workshop 2: A workshop in celebration of a half century of bioelectromagnetism research: What have we learned?
Monday June 20, 2022 • 13:30 - 15:00
Small Hall 2

W2-1 [13:30]

Workshop Introduction

Kenneth Foster[1] & Vijayalaxmi[2]

[1]*Department of Bioengineering, University of Pennsylvania, Philadelphia, PA, USA, 19104*

[2]*Department of Radiology, University of Texas Health Science Center, San Antonio, TX, USA, 78229*

Research on bioelectromagnetics goes back for many years in radar and space research, industrial processing, telecommunications, medical applications, and to understand possible health hazards of nonionizing radiation. This field has witnessed remarkable growth during the past half Century, and the founding and growth of two scientific societies covering this diverse field, the Bioelectromagnetics Society (BEMS, founded 1978) and the European BioElectromagnetics Association (EBEA, founded in 1989).

In celebration of the merger of BEMS and EBEA, this Workshop brings together four speakers who have long been leaders in this field, to assess in broad terms what we have learned about bioelectromagnetics during in the past half-Century and, perhaps, where we go from here.

W2-2 [13:45]

A Half Century of Human Bioelectromagnetism Research: What Have We Learned

Sarah Loughran[1]

[1]*EME Program Director, Australian Radiation Protection and Nuclear Safety Agency, Melbourne, Australia, 3085*

The question of whether exposure to low-level electromagnetic energy, particularly radiofrequency (RF) fields, is associated with health effects in humans is a long-standing question that remains today. This presentation will focus on the human and epidemiological bioelectromagnetics research over the past 50 years, what we have learned, and where we go from here.

Digitalization and Power Economics, RWTH Aachen University, Aachen, Germany

In the course of the energy transition, transmission systems need to be modified leading to another quality of human exposure. In whole-body experimental studies, electric field (EF) perception was investigated. As a key finding, a synergistic effect on human perception when combining alternating current (AC) and direct current (DC) EF to hybrid EF was found. Environmental factors, such as relative humidity, significantly affect the human EF perception. Further research is necessary to understand underlying mechanisms in more detail and support the prevention of unwanted sensory perception by contributing to the determination of limit values.

W1-3 [14:05]

Impact of extremely low frequency magnetic and electric fields on the human vestibular system: A retrospective overview

Nicolas Bouisset[1, 2], François Deschamps[3], Isabelle Magne[4], Pierre-André Cabanes[4], Martine Souques[4], Michel Plante[5], Genevieve Ostiguy[5] & Alexandre Legros[1, 2, 6, 7, 8]

[1]*Human Threshold Research Group, Lawson Health Research Institute, London, ON, Canada*

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[3]*RTE, Département Concertation et Environnement, Cœur Défense, Paris-La Défense, France*

[4]*Service des Études médicales, EDF, Levallois-Perret Cedex, France*

[5]*Hydro-Québec, Montréal, Québec, Canada*

[6]*Department of Medical Biophysics and Medical Imaging, Western University, London, Ontario, Canada*

[7]*EuroMov Digital Health in Motion, Univ Montpellier, IMT Mines, Montpellier, France*

[8]*Eurostim, Montpellier, France*

Exposure to extremely low-frequency magnetic fields (ELF-MF) induces electric fields (E-Fields) within the human body. If sufficiently strong, these E-Fields can modulate human neurophysiology. The vestibular system is extremely sensitive to very small E-Fields. Moreover, animal and canalithic models show that ELF-MF can modulate its activity. This suggests that, in humans, such a system could also be impacted when exposed to ELF-MF. We gather, herein, human data spanning over five years, summarizing the impact of ELF-MF and induced E-Fields on the human vestibular system. Implications for possible contributions to standards and guidelines, as well as potential clinical applications, will be discussed.

W2-3 [14:00]

Evolution of *in vitro* and *in vivo* exposure systems and progress in dosimetry assessment

C. K. Chou[1]

[1]*C-K. Chou Consulting, Dublin, CA, USA, 94568-7339*

To understand the biological effects of radiofrequency fields (RF) on humans, in vitro and in vivo studies exposing cell cultures, isolated tissues, laboratory animals and human subjects have been conducted. Dosimetry of non-ionizing radiation can be complicated because frequency and polarization, tissue dielectric properties, object size and shape, and the presence of metallic stimulating and recording instruments can all affect energy absorption in exposed samples and animals. In addition, temperature control in an exposure system is essential because temperature changes can influence biological responses. Typical exposure systems are reviewed in this presentation.

W1-4 [14:20]

Implications of understanding the mechanisms of transcranial alternating current stimulation (tACS) for EMF guidelines and standards

Julien Modolo[1, 2] & Alexandre Legros[2, 3, 4, 5]

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[4]*EuroMov Digital Health in Motion, Univ Montpellier, IMT Mines, Montpellier, France*

[5]*EuroStim, Montpellier, France*

Non-invasive brain stimulation is the focus of an increasingly growing body of multidisciplinary researching, ranging from neuroscience to physics. Unlocking the full potential of clinical applications of transcranial alternating current stimulation (tACS), involves a mechanistic understanding of the underlying mechanisms of action. In the following, we attempt to review some of the recent key results from the tACS literature, and argue that a wide range of results from the tACS literature can be explained with a relatively limited number of experimentally supported mechanisms. Also, we discuss the significant implications of the tACS literature in terms of updating EMF exposure guidelines and standards.

W1-5 [14:35]

Thresholds for central and peripheral nervous system responses to electric and magnetic stimulations in the LF range: review of recent and ongoing studies, international standards and guidelines implications, link towards clinical applications

Alexandre Legros[1, 2, 3, 4], François Deschamps[5], Isabelle Magne[6], Pierre-André Cabanes[6], Martine Souques[6], Genevieve Ostiguy[7] & Michel Plante[7]

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[6]*Service des Études médicales, EDF, Levallois-*

W2-4 [14:15]

Progress in In Vivo and In Vitro investigations

Myrtill Simko[1]

[1]*Sciproof International, Östersund, Sweden, 83158*

A main driver behind experimental research on possible biological effects of both low frequency magnetic fields and high frequency electromagnetic fields has been possible adverse effects on human health due to exposures. Thus, many studies have been used for risk assessment purposes, although they were not necessarily intended for such purposes.

W2-5 [14:30]

Recent advances in biomedical applications in bioelectromagnetics

Shoogo Ueno[1]

[1]*Department of Biomedical Engineering, Graduate School of Medicine, The University of Tokyo, Tokyo, Japan, 113-0033*

My presentation is focused on advances in biomedical applications in bioelectromagnetics, in particular, on transcranial magnetic stimulation (TMS), biomedical imaging based on magnetic resonance imaging (MRI), and new potential therapeutic applications for brain diseases and regenerative medicine based on new findings obtained in our laboratory which include acceleration of bone growth and nerve regeneration by magnetic fields, and modulation of iron ions uptake and release into and from iron cage proteins, ferritins, by radio frequency (RF) electromagnetic fields. These technologies based on bioelectromagnetics are leading medicine and biology into new horizons through their novel applications of magnetism and electromagnetics.

Perret Cedex, France

[7]*Hydro-Québec, Montréal, QC, Canada*

This presentation will review the most recent scientific developments in the field of human experimental responses to ELF/LF electric and magnetic stimulations/exposures, both from a basic science and from a clinical application's perspective. Most importantly, this presentation will synthetize all the workshop previous presentations and will highlight importance in the context of the current effort of updating the IEEE-ICES and ICNIRP Standards and Guidelines in the corresponding frequency range. An effort will also be made to project the potential implications towards future clinical applications.

Coffee Break
Monday June 20, 2022 • 15:00 - 15:30
Exhibition Hall

Session: FA
Student Flash Poster Session A
Monday June 20, 2022 • 15:30 - 16:30
Large Hall
Chairs: Niels Kuster & Martin Röösli

Session: PA
Poster Session A
Monday June 20, 2022 • 16:30 - 18:00
Exhibition Hall

Student Icebreaker
Monday June 20, 2022 • 18:30 - 19:30

Tuesday June 21, 2022

Session: P2
Plenary 2: What about 5G? - Biological effects of millimetre waves – research base, safety standards, and knowledge gaps
Tuesday June 21, 2022 • 08:30 - 09:30
Large Hall

P2-1 [08:30]

What about 5G? - Biological effects of millimetre waves – research base, safety standards, and knowledge gaps

Myrtill Simko[1]

[1]*SciProof International AB, Östersund, Sweden*

Biographical sketch

Prof. Dr. Myrtill Simkó is a Professor in Cell Biology at the Institute of Advanced Studies, Strömstad Academy, and Scientific Director at SciProof International AB, Östersund, Sweden. She was previously at the Austrian Institute of Technology and at the Austrian Academy of Sciences in Vienna, Austria, at the University of Rostock in Germany, held a guest professorship at the Örebro University in Sweden. She has over 30 years of experience in EMF research and teaching, her research focuses on the mode of action of cell reactions after exposure to electromagnetic fields, with an emphasis on the modulation of redox homeostasis and the involvement of the immune system, as well as the use of EMF-based diagnostics and therapeutics. She pioneered the idea that ELF-MF positively modulates the immune system. She has published numerous papers, book chapters, and review articles in this field. Her focus is also on high quality experimental work, including exposure conditions and biological studies.

Abstract

Radio waves in the frequency band from 30 to 300 GHz (wavelengths from ten to one millimetre) in the electromagnetic spectrum belong to the millimetre waves (MMW). These waves have a short range in the Earths´ atmosphere and attenuate fast due to the gaseous atmosphere. Thus, they can only be used for short range terrestrial communication but will nevertheless play a role in the 5G-based mobile communication technology (FR2) which presently is rolled out globally.

Compared to frequencies presently used for mobile communication, studies that specifically focus on biological and health-related effects of MMW are more sparse but are presently initiated in higher numbers. This lecture will provide and overview of available research findings, primarily from in vivo animal studies and in vitro studies, based on a recent review article (Simkó and Mattsson [1]) and additional recent studies. Furthermore, the presentation will cover risk assessment aspects and relevant safety standards such as ICNIRP and IEEE. Finally, identified knowledge gaps relevant for safety considerations will be addressed.

[1] Simkó, M., & Mattsson, M. O. (2019). 5G wireless communication and health effects—A pragmatic review based on available studies regarding 6 to 100 GHz. International Journal of Environmental Research and Public Health, 16(18). https://doi.org/10.3390/ijerph16183406

Coffee Break
Tuesday June 21, 2022 • 09:30 - 10:00
Exhibition Hall

Session: S03
Session 3: Computational Dosimetry
Tuesday June 21, 2022 • 10:00 - 11:30
Large Hall
Chairs: Emmanuelle Conil & Luc Martens

S03-1 [10:00]

Occupational exposure to transcranial magnetic stimulation coil: a systematic numerical risk assessment

Simona D'Agostino[1, 2], Micol Colella[1], Micaela Liberti[1], Rosaria Falsaperla[2] & Francesca Apollonio[1]

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Keywords: Dosimetry (computational), ELF/LF, Completed (published)
Presented by: Micaela Liberti

This study aims to perform a classification and rigorous numerical evaluation of the risks of occupational exposure in the health environment related to the management of Transcranial Magnetic Stimulation (TMS) treatment. The study investigates the numerically estimated induced electric field that occurs in the human tissues of the operator exposed to the variable magnetic field produced by TMS during clinical treatments. The results show that, under the evaluated exposure conditions, there are some criticalities for the operator, that depend on the model of the TMS coil, its relative position with respect to the operator's body, on the percentage of maximum stimulator output (%MSO) and on the distance between the source and the operator.

S03-2 [10:15]
STUDENT PAPER

Dosimetric study on magnetic and galvanic vestibular stimulation

Janita Nissi[1] & Ilkka Laakso[1, 2]

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[2]*Aalto Neuroimaging, Aalto University, Espoo, Finland*

Keywords: Dosimetry (computational), ELF/LF, Work in Progress
Presented by: Janita Nissi

A person's sense of balance can be affected using galvanic vestibular stimulation (GVS). Similarly,

Session: S04
Session 4: In vivo
Tuesday June 21, 2022 • 10:00 - 11:30
Small Hall 2
Chairs: Ali Jahanshahi & Hideyuki Okano

S04-1 [10:00]
STUDENT PAPER

The influence of a 1 GHz radio-frequency electromagnetic field exposure on pupae development of the yellow-fever mosquito (*Aedes aegypti*)

Eline De Borre[1], David Toribio[1], Pie Müller[2], Tobias Suter[2], Wout Joseph[1] & Arno Thielens[1]

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Keywords: In vivo, RF/Microwaves, Completed (unpublished)
Presented by: Eline De Borre

The influence of 1 GHz electromagnetic fields exposure on the development of Yellow Fever mosquito (Aedes aegypti) pupae is for the first time investigated using a Transverse Electromagnetic (TEM) cell with electric field strengths of 43.5 V/m and 92 V/m. Pupae exposed for 24 hours to either of the exposure conditions, showed slower development into adults than the pupae placed in the TEM cell without the radio frequency fields (sham). The wing length (a proxy for body length) was unaffected.

S04-2 [10:15]

Nano-Pulse Stimulation™ technology is a novel bioelectric energy modality that permanently eliminates murine primary dermal pancreatic carcinoma tumors and inhibits the growth of rechallenge tumors

Amanda McDaniel[1], Bruce Freimark[1], Kristin von Rothstein[1], Dacia Gonzalez[1] & Richard Nuccitelli[1]

[1]*Biology, Pulse Biosciences, Hayward, California, USA, 94545*

Keywords: In vivo, Pulsed, Work in Progress
Presented by: Amanda McDaniel

Nano-Pulse Stimulation™ (NPS™) technology is a non-thermal energy modality that applies ultrafast,

moving in a strong static magnetic field can cause feelings of vertigo. These sensations are suspected to be the result of an induced electric field affecting the function of the vestibular system responsible for maintaining balance. In this work, the strength of electric field induced by movement in magnetic field and GVS were approximated computationally with high resolution anatomical models and the finite element method. Based on the results, a magnetic field with dB/dt around 2 T/s could produce a field strong enough to affect the vestibular system.

S03-3 [10:30]

Coverage factors for efficient assessment of human exposure in the close near field of low frequency magnetic field sources

Jingtian Xi[1] & Niels Kuster[1, 2]

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Keywords: Dosimetry (computational), ELF/LF, Work in Progress

Presented by: Niels Kuster

Compliance of the magnetic field sources should be demonstrated with basic restrictions (i.e., limits of induced fields) since the reference levels (i.e., limits of incident fields) largely overestimate human exposure in the close near field of these sources. However, the conservative assessment of the maximum induced electric field requires hundreds of simulations using anatomical models. In this study, we determine a generally applicable coverage factor for the induced electric field by comparing the results in 12 Virtual Population anatomical models and a standardized homogeneous half-space phantom. By applying the coverage factor, the compliance testing effort will be reduced to only one simulation.

S03-4 [10:45]

Effective conductivity model for reduction of stair-casing error for low-frequency numerical

high-amplitude electric pulses in the nanosecond range. Pan02 tumors were grown intradermally and treated with NPS, with or without resiquimod. Efficacy of the treatments was assessed followed by a rechallenge of Pan02 tumor cells in mice whose tumors were completely eliminated. High energy NPS proved most efficacious at elimination of a primary tumor (93%), however the medium dose NPS + resiquimod condition was superior at preventing regrowth of a tumor after rechallenge (6/10). Overall, NPS technology is a novel treatment modality that may have the capacity to both eliminate a tumor and prevent the regrowth of a future one.

S04-3 [10:30]

Low pulsed electrical fields for inducing transient blood-brain barrier disruption: *in vitro* and *in vivo* studies

Shirley Sharabi[1], David Last[1], Yael Bressler[1, 2, 3], Dianne Daniels[1], Orly Ravid[3], Daniel Rand[3], Sigal Liraz-Zaltsman[3, 4, 6], Yael Mardor[1, 2] & Itzik Cooper[3, 5]

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Keywords: In vivo, Pulsed, Work in Progress

Presented by: Shirley Sharabi

The effects of low pulsed electrical fields (L-PEFs) on the blood brain barrier (BBB) were studied in vitro and in vivo. Significant reversible permeability increase of an in vitro human BBB model was found for small/large molecules and cells, an order of magnitude below the threshold for electroporation. Delayed-contrast MRI revealed BBB disruption in mice treated with non-invasive L-PEFs (28-65 V/cm in the disrupted volume) which completely resolved after 1-4 h. Doxorubicin concentration in the brain 4 h post L-PEFs was X230 its IC50 in GL261 glioma cells. Our results demonstrate the feasibility of non-invasive/efficient/safe BBB disruption using L-PEFs, leading the way to new means for non-invasive drug delivery into the CNS.

S04-4 [10:45]

***In vivo* investigation of potential anti-epileptiform effects of transcranial alternating**

dosimetry

Yinliang Diao[1] & Dan Shi[2]

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Keywords: Dosimetry (computational), ELF/LF, Work in Progress
Presented by: Yinliang Diao

In this study, we proposed an effective conductivity model for the computation of the induced electric field under the exposure to low-frequency magnetic field. The conductivity on the edge of voxel was obtained as a weighted average of the conductivities of neighbouring tissues, taking the filling ratio as the weights. The computational results using a two-dimensional two-layer model demonstrated the effectiveness of the proposed method in suppressing the staircasing error, which was commonly observed for the low-frequency numerical dosimetry using voxel-based models. Future study will extend the method for general three-dimensional body models.

S03-5 [11:00]

A numerical study on miniaturized coils for focal nerve magnetic stimulation

Micol Colella[1, 2], Daniel Z. Press[3], Rebecca M. Laher[3], Courtney E. McIlduff[3], Seward B. Rutkove[3], Antonino Mario Cassara[4], Francesca Apollonio[1], Alvaro Pascual-Leone[5], Micaela Liberti[1] & Giorgio Bonmassar[2]

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Keywords: Dosimetry (computational), ELF/LF, Completed (unpublished)
Presented by: Micol Colella

In this numerical simulation study, a miniaturized coil (i.e., mcoil) was optimized for efficient stimulation of the peripheral nervous system. Furthermore, the optimal mcoil solution was applied to the wrist of two different neurofunctionalized human body models, with very different anatomies to predict the mcoil nerve stimulation efficacy.

current stimulation (tACS): a new rodent model

Audrey Barbedette[1], Gabriel Dieuset[1], Fabiola Alonso[1], Pascal Benquet[1], Fabrice Wendling[1] & Julien Modolo[1]

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Keywords: In vivo, ELF/LF, Work in Progress
Presented by: Audrey Barbedette

One third of epileptic patients are refractory to drugs. A possible candidate therapy is tACS, which remains to be explored, motivating the development of animal models. To this aim, we performed a dosimetric evaluation and extended a mouse model of cortical epilepsy. The electric field between the recording electrodes is consistent with human dosimetric evaluations. In vivo, isolated epileptic spikes, epileptiform discharges and seizures were observed. In an experimental group, stimulation decreased their occurrence rate, suggesting a neuromodulation effect. Due to a relatively small sample size and a limited number of stimulation frequencies tested, further investigations are needed to confirm the anti-epileptic effects of tACS.

S04-5 [11:00]

BioEM, where does it come from? Brief summary of internationalisation

Rene De Seze[1]

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Keywords: In vivo, All Frequencies, Other
Presented by: Rene De Seze

Studies and knowledge on Bioelectromagnetics are provided by scientists from different societies, amongst them two are of importance for the scientific event of this year: BEMS and EBEA, which merged to found BioEM. BEMS emerged first in USA in the 80th, with from the beginning an international participation. EBEA came then in the 90th. BEMS meetings started to alternately hold in Europe in 1994 and all around the world since 2007. Common BEMS/EBEA meetings were first hold together in 2005 in Dublin and in 2009 in Davos. Finally, a single common meeting was decided in 2013 in Thessaloniki. Merging has been initiated with a first document shared with members in 2016, an agreed vote in 2019 and dissolution by merger in 2021. Here we are …

S03-6 [11:15]

Evaluation of cortical electrostimulation thresholds in human for uniform magnetic field exposure at intermediate frequencies

Jose Gomez-Tames[1, 2], Thomas Tarnaud[3], Akimasa Hirata[1, 2], Wout Joseph[3] & Emmeric Tanghe[3]

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Keywords: Dosimetry (computational), IF, Work in Progress

Presented by: Jose Gomez-Tames

Protection levels are derived for human protection to protect against painful electrostimulation, attributable to axonal activation, at intermediate frequencies. To quantify the stimulation from the external field and improve the accuracy of restrictions by deriving the thresholds in a scientific manner, multi-scale simulation has been suggested. This study investigates brain cortical stimulation thresholds by considering different excitable membrane models populating the motor cortex of various human head models as the most comprehensive evaluation done up to now. The results confirm the conservativeness of the protection limits for the different considered conditions for general public.

S04-6 [11:15]
STUDENT PAPER

Thermoacoustic tomography of the human abdomen: Safety assessment

David Garrett[1], Jinhua Xu[1], Geng Ku[1] & Lihong V. Wang[1]

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Keywords: In vivo, RF/Microwaves, Work in Progress

Presented by: David Garrett

Thermoacoustic tomography (TAT) is an emerging medical imaging modality which benefits from both rich microwave contrast and mm-scale acoustic resolution. To achieve sufficient sensitivity, high peak power (10s-100s kW) but brief (< 1 μs) microwave pulses are typically radiated into tissue, resulting in detectable pressures waves from thermoelastic expansion. While previous human studies have examined the breast or extremities, we have developed a new TAT system for human abdominal imaging. Such high microwave power leads to safety concerns which must be addressed. Here, we present an overview of TAT and steps taken to ensure adherence to safety standards through analytical and computational (Sim4Life, ZMT Zurich MedTech AG) approaches.

Lunch
Tuesday June 21, 2022 • 11:30 - 13:00

Session: S05
Session 5: Dosimetry measurements
Tuesday June 21, 2022 • 13:00 - 14:30
Large Hall
Chairs: Sam Aerts & Teruo Onishi

S05-1 [13:00]

Determination of maximal RF exposure to 5G massive MIMO base stations under non-line-of-sight conditions – Part 1: Theoretical and numerical investigations

Christian Bornkessel[1], Lisa-Marie Schilling[1], Anna-Malin Schiffarth[2], Thomas Kopacz[2], Dirk Heberling[2, 3] & Matthias Hein[1]

[1]*RF & Microwave Research Laboratory, Thuringian Center of Innovation in Mobility, TU Ilmenau, Ilmenau, Germany*

Session: S06
Session 6: Human
Tuesday June 21, 2022 • 13:00 - 14:30
Small Hall 2
Chair: Myrtill Simko

S06-1 [13:00]
STUDENT PAPER

A study on machine learning methods for accuracy improvement of in-body device localization

Daria Dmitrieva[1], Daisuke Anzai[1], Jens Kirchner[2], Georg Fischer[2] & Jianqing Wang[1]

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Keywords: Dosimetry (measurements), RF/Microwaves, Work in Progress

Presented by: Christian Bornkessel

This paper addresses misestimations of RF exposure found in measurements at 5G massive MIMO base stations under non-line-of-sight conditions. One possible cause is incorrectly determined gain correction factors, which are used for extrapolating the measured SSB exposure to the maximal possible exposure. Plausibility considerations based on geometrical optics are used to identify corresponding scenarios; here, the measurement points are in places where the envelopes of the traffic and broadcast beams are not identical and the exposure is dominated by reflections. Numerical simulations also show an increasingly locally small-scale varying field distribution. A verification of these considerations by measurement is successfully done in part 2.

S05-2 [13:15]

Determination of maximal RF exposure to 5G massive MIMO base stations under non-line-of-sight conditions – Part 2: Verification by field measurements

Anna-Malin Schiffarth[1], Thomas Kopacz[1], Christian Bornkessel[2], Lisa-Marie Schilling[2], Matthias Hein[2] & Dirk Heberling[1, 3]

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Keywords: Dosimetry (measurements), RF/Microwaves, Work in Progress

Presented by: Anna-Malin Schiffarth

For determining maximum exposure to 5G massive MIMO base stations, measurement and extrapolation methods already exist. However, misestimations of the maximum exposure were found for measurement points without line-of-sight (NLOS) to the base station. Based on preliminary considerations in part 1 of this paper, the exposure at eleven NLOS measurement points was determined. The antenna gain correction factors based on the radiation patterns of the antenna were compared with the actual gain correction factors derived from the measurements with multipath propagation conditions. It is shown that the resulting

S06-2 [13:15]
STUDENT PAPER

Peripheral nerve stimulation thresholds in human subjects exposed to the extremely low-frequency magnetic fields (50-60Hz)

Eleonore Fresnel[1, 2], Nicolas Bouisset[1, 3], Florian Soyka[6], Carsten Alteköster[6], François Deschamps[7], Martine Souques[8], Isabelle Magne[8], Pierre-André Cabanes[8], Genevieve Ostiguy[9], Michel Plante[9] & Alexandre Legros[1, 2, 3, 4, 5]

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Keywords: Human, ELF/LF, Work in Progress

misestimation of the maximum exposure occurs, when the measurement point is not in the coverage areas of both SSB and traffic beams.

Presented by: Eleonore Fresnel

Humans are exposed to extremely low-frequency magnetic fields (ELF-MF<300Hz) every day via power lines and appliances. Exposure to certain doses can modulate nervous system function. Indeed, the induced electric fields and currents produced by the ELF-MF impact the central and autonomous nervous system. To our knowledge, no study has directly tested the impact of ELF-MF on the human peripheral nervous system (PNS), and the exposure limits from the standards and guidelines result from extrapolations based on thresholds obtained at much higher frequencies. This research aims to establish the PNS stimulation threshold at ELF-MF on humans. **Keywords**: Extremely Low Frequency Magnetic Fields, Peripheral Nervous System, Threshold, Perception

S05-3 [13:30]

A handheld system for *In Situ* exposure assessment of WPT systems with basic restrictions

Myles Capstick[1], Mischa Sabathy[2], Manuel Broennimann[2], Bruno Rivara[2], Bruno Klopott[2], Sven Kuehn[2], Jingtian Xi[1], Dahye Choi[1] & Niels Kuster[1, 3]

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Keywords: Dosimetry (measurements), ELF/LF, Completed (unpublished)

Presented by: Myles Capstick

This abstract presents the hardware and software of the Magnetic Amplitude and Gradient Probe System (MAGPy), which is a hand-held system for in situ exposure assessment and compliance testing of wireless power transfer systems and other strong magnetic field sources operating between 3 kHz and 10 MHz. MAGPy is unique in that it not only measures the incident magnetic and electric fields, but also estimates the induced fields using the generic gradient source model. Therefore, it enables the demonstration of compliance for much stronger wireless power transfer systems than any other measurement instrument.

S06-3 [13:30]

Results of web-based surveys on the use of wireless communications in residences and awareness of radio frequency exposure in daily life in Japan

Kazuhisa Kamegai[1], Masao Taki[1], Miwa Ikuyo[1], Teruo Onishi[1] & Soichi Watanabe[1]

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Keywords: Human, RF/Microwaves, Completed (unpublished)

Presented by: Kazuhisa Kamegai

Two web-based questionnaire surveys have been carried out in Japan. One is aimed to investigate the use of wireless communication devices in residences. We were able to identify the use of cell phones, wireless LANs, and various wireless devices in residences, as well as their trends by age and other factors.The other is to obtain the picture of the awareness of radio frequencies exposure in daily life. In addition to revealing the current level of understanding and sources of information about radio frequencies around the respondents, we were also able to learn about people's awareness of the relationship between radio frequencies exposure and their concerns on health effects of radio frequency exposure.

S05-4 [13:45]
STUDENT PAPER

Advantages and limitations in applying AC and DC-coupled four-electrode probe for low frequency dielectric spectroscopy of biological samples

S06-4 [13:45]

Importance of diverse anatomy in virtual population for risk assessment of magnetic resonance examination

Lena Kranold[1, 2], Tolga Goren[1], Sunder Rajan[3] & Niels Kuster[1, 2]

Cindy Karina[1, 3], Myles Capstick[1], Azadeh Peyman[2] & Niels Kuster[1, 3]

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Keywords: Dosimetry (measurements), ELF/LF, Work in Progress

Presented by: Cindy Karina

This paper describes the development and experimental evaluation of a four-electrode probe, which aims to accurately measure biological tissues/liquids at frequencies below 4 MHz. Electrode polarization is an artifact seen in the measurement of saline solutions as well as biological samples. We investigate different coupling regimes in the context of electrode polarization effects. The two topologies, which are broadly described as AC- and DC-coupled, were assessed in terms of their observable electrode polarization as well as their phase responses. Passive networks were produced for characterization and as basis for calibration and compensation methods. Further measures to improve the performance of the probe are discussed.

S05-5 [14:00]

Design and experimental characterization of a cell culture incubator used as a reverberation chamber for *in vitro* experiments at 3.5 GHz

Rosa Orlacchio[1], Guillaume Andrieu[1], Alexandre Joushomme[2], Lorenza Patrignoni[2], Florence Poulletier De Gannes[2], Isabelle Lagroye[2], Yann Percherancier[2], Delia Arnaud-Cormos[1, 3] & Philippe Leveque[1]

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Keywords: Dosimetry (measurements), RF/Microwaves, Completed (unpublished)

Presented by: Rosa Orlacchio

This paper details the design and experimental characterization of a novel fifth generation (5G) in vitro exposure system at 3.5 GHz. The main novelty of our study consists in the use of a cell culture incubator as a reverberation chamber to provide simultaneously controlled biological conditions (37°C and 5% CO_2) and homogenous specific absorption rate (SAR) level during the exposure of up to 10

S06-5 [14:00]

WITHDRAWN

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Keywords: Human, RF/Microwaves, Work in Progress

Presented by: Lena Kranold

For the safety assessment of magnetic resonance (MR) examinations, numerical anthropomorphic phantoms are used to estimate the distribution and intensity of induced E-fields. This study investigates the impact of anatomical variation on MR-induced fields, and the corresponding compatibility/risk evaluation of generic active implantable medical devices (AIMD) routed as spinal cord stimulators, deep brain stimulators, pacemakers and cochlear implants. Even when a single generic transfer function is considered, the worst-case enhancement can be found in each of 12 anatomical models for at least one configuration. Hence, to comprehensively assess risks of MR examination, the widest available range of anthropomorphic phantoms must be considered.

tissue culture plates. An experimental methodology, based on the measurements of the S_{11} parameters was used to determine the chamber "well stirred condition" frequency f_{wsc}. Afterwards, SAR was quantified in the exposed cell culture medium through temperature measurements showing a good homogeneity with maximum variation lower than 30%.

S05-6 [14:15]

Increase of absorbed power density due to antenna/body coupling at 60 GHz

Massinissa Ziane[1], Maxim Zhadobov[2] & Ronan Sauleau[1]

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Keywords: Dosimetry (measurements), RF/Microwaves, Completed (published)
Presented by: Massinissa Ziane

When a wireless device is located close to human body, near-field interactions may modify the absorbed power density (APD). In this study, we analyze antenna/human body interactions at 60 GHz and their impact on APD due to destructive/constructive interference. APD distribution is measured using a multi-physics technique of near-field pattern visualization at the surface of human skin model. Our results demonstrate that for some positions of the antenna presence of the body results in a significant increase of APD (up to 103.3%). This suggests that accurate measurement of APD requires accounting for the presence of user in proximity of the wireless device under test and free-space measurements may result in a significant uncertainty.

S06-6 [14:15]

Systematic review of the physiological and health-related effects of radiofrequency electromagnetic field exposure from wireless communication devices on children and adolescents in experimental and epidemiological human studies

Lambert Bodewein[1], Dagmar Dechent[1], David Graefrath[1], Thomas Kraus[1], Tobias Krause[1] & Sarah Driessen[1]

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Keywords: Human, RF/Microwaves, Review, Commentary, Recommendation, Evaluation
Presented by: Sarah Driessen

In this review, 42 epidemiological and 11 experimental studies on children and adolescents were systematically researched and analyzed in view of the health-related effects of radiofrequency electromagnetic fields (RF EMF) from wireless communication devices. We rated methodological limitations in 35 studies. Evidence for the effects of RF EMF on subjective symptoms, cognition, and behavior was low to inadequate. Studies investigating early childhood development, brain activity, cancer, and physiological parameters were considered inadequate to draw conclusions concerning possible effects. Based on the current data, it remains unclear whether children and adolescents are particularly sensitive to mobile communication exposure.

Coffee Break
Tuesday June 21, 2022 • 14:30 - 15:00
Exhibition Hall

Session: S07
Session 7: Public Health / Occupational
Tuesday June 21, 2022 • 15:00 - 16:30
Large Hall
Chairs: Gunnhild Oftedal & Sarah Loughran

S07-1 [15:00]

The Australian Radiation Protection and Nuclear Safety Agency's electromagnetic energy program

Sarah Loughran[1]

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Keywords: Public Health Policy, RF/Microwaves, Other

Presented by: Sarah Loughran

The Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) is the Australian Government's primary authority on radiation protection and nuclear safety. In recognition of concerns around electromagnetic energy (EME) and health, ARPANSA has recently established an EME Program that contributes to research, knowledge, protection policies, and risk communication in this field.

S07-2 [15:15]

SAR Measurements for Exposure Assessment of 2.45 GHz RF WPT System

Andrey Andrenko[1], Yuto Shimizu[1] & Tomoaki Nagaoka[1]

Session: S08
Session 8: Mechanistic / Theoretical
Tuesday June 21, 2022 • 15:00 - 16:30
Small Hall 2
Chair: Daisuke Anzai

S08-1 [15:00]

Collaborative, sustainable, and FAIR neurosciences in bioelectronic medicine: the SPARC Data Resource Center

Esra Neufeld[1], Joost Wagenaar[2], Peter Hunter[3], Maryann Martone[4], Bernard de Bono[3], Maci Heal[5] & Niels Kuster[1, 6]

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Keywords: Mechanistic/Theoretical, ELF/LF, Work in Progress

Presented by: Esra Neufeld

Bioelectromagnetic medicine requires models of the nervous system and its physiological role, and advanced simulation methods. In the context of the SPARC program, infrastructure has been established to support collaborative, sustainable, and FAIR research. It i) organizes and disseminates data, ii) provides curation, standardization, and knowledge management services, iii) generates interactive visualizations of nerve-organ anatomy and function, and iv) provides integrated simulation and data analysis. Showcased examples include the publication of explorable data analyses, a treatment planning pipeline for spinal-cord stimulation, and the use of SPARC image-data as part of an AI- and biophysics-based nerve-stimulation/sensing model.

S08-2 [15:15]

A possible model for weak magnetic field effects based on nuclear magnetic moments

Frank Barnes[1]

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Keywords: Public Health Policy, RF/Microwaves, Completed (published)
Presented by: Andrey Andrenko

The purpose of this study has been an establishment of SAR measurement method as part of the conformity evaluation procedure for the RF WPT system to be used in various applications. We present the SAR measurement method and an evaluation example of one RF WPT system operating at 2.45 GHz.

S07-3 [15:30]

Emerging EMF topics - An update on the Swiss BERENIS expert group activities

Stefan Dongus[1, 2], Peter Achermann[4], Jürg Fröhlich[5], Jürg Kesselring[6], Meike Mevissen[7], David Schuermann[3], Alexander Reichenbach[8], Maurane Riesen[8], Sebastian Egger[8], Edith Steiner[9] & Martin Röösli[1, 2]

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Keywords: Public Health Policy, All Frequencies, Work in Progress
Presented by: Stefan Dongus

Mandated and funded by the Swiss Federal Office for the environment, the BERENIS expert group is continuously monitoring newly published research with regard to potential health risks of non-ionising radiation. Since 2014, BERENIS identifies emerging topics of particular relevance, and publishes assessments of selected studies in quarterly newsletters. An update on new activities will be presented, including a new search tool for studies reported by BERENIS' newsletters based on a Shiny App.

University of Colorado, Boulder, CO, USA, 80309

Keywords: Mechanistic/Theoretical, All Frequencies, Work in Progress
Presented by: Frank Barnes

Nuclear Magnetic Spins and EMF Effects on Biological Systems and the effects of feedback with time delays and pertibations phases on oscillating biological systems.

S08-3 [15:30]

RF EM fields effects on aqueous environment near lipid membranes: an analysis based on MD simulations

Laura Caramazza[1, 2], Paolo Marracino[3], Micaela Liberti[1, 2] & Francesca Apollonio[1, 2]

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Keywords: Mechanistic/Theoretical, RF/Microwaves, Work in Progress
Presented by: Laura Caramazza

The need to unravel the interaction mechanism between biological systems and radiofrequency electromagnetic (RF EM) fields is supported by the ongoing interest in using them in the new low latencies, massive network capacity, wideband telecommunication technologies, as 5G mm-Wave, with a public concern on their safety. Molecular dynamics (MD) simulations give the chance to evaluate physical interactions with biological matter occurring at the atomistic level and in ns timescales. In this work authors provide the response of a biological hydrated membrane to the RF EM fields from a molecular point of view, comparing the effects with a static field exposure; a focus on the role of interfacial water when a 26 GHz RF field is applied, is given.

S07-4 [15:45]
STUDENT PAPER

Human biomonitoring study on genetic effects of long-term occupational exposure to extremely low-frequency magnetic fields (ELF-MF)

Ha Nguyen[1, 2], Giovani Vandewalle[3], Eva De Clercq[2], Roel Anthonissen[2], Birgit Mertens[2], Jean-Francois Collard[1], Maurice Hinsenkamp[1], Luc Verschaeve[2], Feipel Veronique[1] & Maryse Ledent[2]

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Keywords: Occupational, ELF/LF, Work in Progress
Presented by: Ha Nguyen

Current guidelines and standards are set to prevent the established effects of acute exposure to extremely low-frequency magnetic fields (ELF-MF). However, questions still remain about long-term exposure. A few biomonitoring studies on the effects of occupational ELF-MF exposure were reported, but these obtained contrasting results. In this study, the occupational ELF-MF exposure of electrical employees was assessed based on both job title and actual exposure to improve the accuracy of exposure assessment. Comet assay and Micronucleus test were applied to investigate the genetic effects of exposure on employees' blood samples. Obtained results did not provide evidence of an effect of occupational exposure to ELF-MF on genetic damage.

S07-5 [16:00]

Risk assessment for EMF workplaces in Germany - Technical Rules to translate the EMF Ordinance into occupational safety and health practice

Peter Jeschke[1], Carsten Alteköster[2] & Erik Romanus[1]

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Keywords: Occupational, All Frequencies, Completed (published)
Presented by: Peter Jeschke

In 2016, the European Directive 2013/35/EU has been implemented into German legislation by the EMF Ordinance. Technical Rules will be published to improve the comprehensibility and usability of the EMF Ordinance. To implement safe and healthy workplaces,Technical Rules assist employers,

S08-4 [15:45]

WITHDRAWN

S08-5 [16:00]

Design of millimeter wave electric field measurement scheme based on I/Q modulation technique

Xu Xu[1], Wenwen Zhu[1], Tongning Wu[1] & Congsheng Li[1]

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Keywords: Mechanistic/Theoretical, All Frequencies, Completed (unpublished)
Presented by: Xu Xu

With the properties of low latency and ultra-fast transmission rate, millimeter wave offers unprecedented challenges to electric field measurement of millimeter wave while effectively contributing to the advancement in cutting-edge fields. For the above problems, this paper proposed a millimeter-wave electric field measurement scheme based on I/Q modulation technique, and selects hardware to validate the scheme in the 24~40 GHz band. The experimental results showed

particularly in small and medium sized enterprises. Similar to harmonised product standards, Technical Rules provide presumption of conformity with the EMF Ordinance. The following contribution provides an overview of their content, explains the difference compared to international standards, and elaborates on specialties in risk assessment. Once officially published in German language, the Technical Rules will be made publically available in English too.

S07-6 [16:15]

The influence of membrane channel dynamics on occupational exposure limit values

Florian Soyka[1], Thomas Tarnaud[2], Wout Joseph[2], Luc Martens[2] & Emmeric Tanghe[2]

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Keywords: Occupational, ELF/LF, Completed (unpublished)
Presented by: Florian Soyka

Occupational exposure limit values for body internal electric fields can be derived from thresholds for action potential generation. These thresholds can be calculated with electrostimulation models. An important and so far, often neglected part of these models are the membrane channel dynamics describing the ionic currents. This work shows how exposure limit values change significantly with different dynamics (up to a factor of 22). Therefore, future exposure guidelines should take the influence of membrane channel dynamics into account when deriving exposure limit values.

S08-6 [16:15]

Permanent magnet application for aligning the wireless power transfer system for implantable medical devices

Haerim Kim[1], Jangyong Ahn[1], Seongho Woo[1], Jaewon Rhee[1], Bumjin Park[1] & Seungyoung Ahn[1]

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Keywords: Mechanistic/Theoretical, RF/Microwaves, Work in Progress
Presented by: Haerim Kim

Recently, interest in the application of wireless power transfer (WPT) technology to improve the stability and convenience of implantable medical devices (IMDs) is increasing. However, in the case of a WPT system for IMDs, misalignment is easy to occur due to the miniaturization and positional characteristics of the coil. In this paper, a method for aligning the WPT system for implantable medical devices using the permanent magnet (PM) is proposed. Analyze the effect of permanent magnet on the WPT coil part and design a PM based on the analysis. The proposed method is analyzed and verified through simulation.

Session: W3
Workshop 3: Monitoring of EMF exposures in real daily lives
Tuesday June 21, 2022 • 16:30 - 18:00
Large Hall
Chairs: Shanshan Wang & Masao Taki

W3-1 [16:30]

Workshop Introduction

Teruo Onishi[1], Masao Taki[1] & Joe Wiart[2]

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[2]*Telecom Paris, Paris Tech, Palaiseau, France, F-91120*

Aim of this workshop is to present monitoring technologies and current situations in some countries of EMF exposures in real daily lives. It is also to discuss how to apply for more various and complicated situations of EMF environment, harmonize monitoring procedures and to disclose monitoring data in considerations of risk communications.Workshop orgnized by Prof. Masao Taki (NICT, Japan) ; m_taki@nict.go.jp and Prof. Joe Wiart (Paris-Tech, France); joe.wiart@telecom-paris.fr

W3-2 [16:30]

Drive test measurement-based prediction of RF EMF exposure using ANN model

Shanshan Wang[1], Taghrid Mazloum[1] & Joe Wiart[1]

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In this paper, we exploit artificial neural networks to reconstruct radiofrequency (RF) electromagnetic field (EMF) exposure from real measurement data obtained while driving in Paris. The driving test measurements were done by using a spectrum analyzer (Tektronix) connected to a 3-axis antenna via a switch. The measurement data covering a broadband frequency range (700MHz to 2700MHz) is converted into ‘equivalent 900’ exposure level for each unique location. Then, the artificial neural network is built with publicly accessible inputs

Session: W4
Workshop 4: EMF risk communication - Lessons learned and future cooperation
Tuesday June 21, 2022 • 16:30 - 18:00
Small Hall 2
Chairs: Thomas Tarnaud & Chiyoji Ohkubo

W4-1 [16:30]

EMF risk communication – Lessons learned and future cooperation

Chiyoji Ohkubo[1], Michael Repacholi[2], Jeong-Ki Pack[3] & Christian Raupach[4]

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To date, numerous studies have been conducted on health effects of electromagnetic fields (EMF) exposure that have contributed to health risk assessments. Health risks can be avoided by adhering to the exposure limits recommended by national/international EMF exposure guidelines. However, the public’s main concern is that exposure to low-level EMF below the exposure guidelines may adversely affect health. This concern requires clear risk communication with the public, based on solid scientific evidence. In this workshop, we will discuss what we have learned from EMF risk communication activities in Japan, South Korea and Germany, and how we can cooperate with other national programs in the future.

related to base station information and trained using ground truth from the measurement data. The results show a good prediction on the RF EMF exposure level in the outdoor environments.

W3-3 [16:45]

Measurement methods for in situ 5G MaMIMO exposure assessment and application in commercial 5G deployments

Wout Joseph[1]

[1]*Ghent University, Ghent, Belgium*

W3-4 [17:00]

Monitoring in Japan

Teruo Onishi[1]

[1]*National Institute of Information and Communications Techology, Koganei, Japan*

W3-5 [17:15]

Monitoring in Korea

Sangbong Jeon[1]

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W3-6 [17:30]

Monitoring in France

Emmanuelle Conil[1]

[1]*ANFR, Paris, France*

W3-7 [17:45]

Monitoring in EU Horizon project

Theodoros Samaras[1]

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Conference Banquet
Tuesday June 21, 2022 • 19:00 - 21:30
Nagoya Kanko Hotel

Wednesday June 22, 2022

Session: T1
Tutorial 1: Bioelectromagnetics research and its theoretical bases: How to reduce confusion and improve scientific progress
Wednesday June 22, 2022 • 08:30 - 09:30
Large Hall
Chair: Sarah Loughran

T1-1 [08:30]

Bioelectromagnetics research and its theoretical bases: How to reduce confusion and improve scientific progress

Rodney Croft[1, 2]

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[2]*Australian Centre for Electromagnetic Bioeffects Research, Australia*

Biographical sketch

Rodney Croft's initial training was in philosophy. He then completed psychological science training followed by a PhD in human neurophysiology methodology at the University of Wollongong in Australia. His postdoctoral research utilized such neurophysiology techniques to explore a range of issues, primarily coupling these with pharmacological treatments to better understand psychiatric illnesses. He began his bioelectromagnetics research in 2000, and since then has focused on determining potential adverse effects of radiofrequency (RF) electromagnetic field (EMF) exposure on human brain function. He is Director of the National Health & Medical Research Council of Australia (NHMRC) Centre of Research Excellence into RF EMF health, Chair of the International Commission on Non-Ionizing Radiation Protection (ICNIRP), led the development and recent publication of ICNIRP's RF EMF guidelines, and regularly contributes to the community via the provision of guidance on non-ionizing radiation and health.

Abstract

In recent years, science has been faced with a substantive challenge in that it has been shown that many of its conclusions are not replicable. This is referred to as the 'replication crisis', and is problematic because it shows that we can't rely on many of the conclusions reported in scientific articles. Indeed it is particularly problematic because simple indicators of which conclusions can be relied-on have not been identified. Although this is an issue for all researchers, it is particularly important for those starting their careers, as there is not an unambiguous body of facts that can be relied on, and is it not always clear how to choose research methods that provide meaningful contributions to science. However, by understanding the theoretical bases of the scientific method, and how many of the current research practices differ from what has been shown to be appropriate, we have the opportunity to refine our research practices to overcome the replication crisis and the lack of certainty that it entails.

This tutorial will help improve people's understanding of the strengths and limitations of various aspects of the scientific method, and in doing so provide both the means to differentiate between real and spurious claims, and the opportunity to pursue research objectives more rapidly and reliably. To this end, the tutorial will: 1/ Provide a background to the scientific method, including how it differs from other methods and why it is thought to produce more trustworthy conclusions; 2/ Show how a range of important methodological issues currently used in science relate to those theoretical bases (e.g. statistics, attribution of causation, appeal to experts, appeal to summary documents); 3/ Show how divergence between scientific practice and its theoretical bases can lead to false claims and failed replication; and 4/ Provide guidance on how to more validly conduct and interpret research.

Session: T2
Tutorial 2: Oxidative stress in research and the problem of biomarkers in EMF research
Wednesday June 22, 2022 • 08:30 - 09:30
Small Hall 2

T2-1 [08:30]

Oxidative stress in research and the problem of biomarkers in EMF research

Felix Meyer[1], Bernd Henschenmacher[2], Pietro Ghezzi[3] & Henry J. Forman[4, 5]

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Oxidative stress is hypothesized to play a major role in explaining putative effects of non-ionizing electromagnetic on cells, animals and humans. There are many papers claiming to show an alteration and even enhancement of the production of reactive chemical species leading to oxidative stress after exposure to electromagnetic fields from static fields to fields in the radiofrequency range. Many of these papers have methodological flaws including the use of inappropriate markers for oxidative stress or the use of inadequate measurement methods or both of these problems. Additionally, the use of proper controls is missing in many papers.

Coffee Break
Wednesday June 22, 2022 • 09:30 - 10:00
Exhibition Hall

Session: S09
Session 9: Computational Dosimetry
Wednesday June 22, 2022 • 10:00 - 11:30
Large Hall
Chairs: Azadeh Peyman & Jose Gomez-Tames

S09-1 [10:00]

Does clothing impact absorbed power and body heating in emerging 5G mmWave bands?

Giulia Sacco[1], Stefano Pisa[2] & Maxim Zhadobov[1]

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[2]*Department of Information Engineering, Electronics and Telecommunications, Sapienza University of Rome, Rome, Italy, 00184*

Keywords: Dosimetry (computational), RF/Microwaves, Completed (published)
Presented by: Giulia Sacco

With upcoming massive deployment of 5G the operating frequencies are progressively expanding towards the millimeter-wave (mmW) range. In dosimetry studies exposure is typically evaluated considering the field impinging on nude skin. However, in some scenarii the presence of a textile impacts the electromagnetic power deposition. This effect is investigated considering a near-surface tissue model illuminated by a plane wave at 26 GHz and 60 GHz. Our results demonstrate that the textile in contact with skin increases the steady-state temperature rise up to 52% at 26 GHz and 46% at 60 GHz. In presence of an air gap between textile and skin the temperature variations range from −3.5% to 20.6% at 26 GHz and from −11.1% to 20.9% at 60 GHz.

S09-2 [10:15]

Age-dependent electromagnetic and thermal dosimetry in emerging 5G mmWave bands

Giulia Sacco[1], Stefano Pisa[2] & Maxim Zhadobov[1]

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Keywords: Dosimetry (computational), RF/Microwaves, Completed (published)
Presented by: Giulia Sacco

With 5G deployment people of all ages are expected to be exposed at frequencies above 10 GHz, absent from the natural electromagnetic (EM) background, thus requiring an accurate analysis of age-dependent dynamics of EM power deposition and resulting heating at these frequencies. In this study, we analyse for the first time the effect of ageing parameters at 26 GHz and 60 GHz. To this end, we

Session: S10
Session 10: Clinical
Wednesday June 22, 2022 • 10:00 - 11:30
Small Hall 2
Chair: Myles Capstick

S10-1 [10:00]
STUDENT PAPER

Estimating ablation temperature for transcatheter renal denervation using machine learning algorithm

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Keywords: Clinical (therapy), RF/Microwaves, Work in Progress
Presented by: Aditya Rakhmadi

This research introduces an ablation temperature estimation technique using a machine learning algorithm for transcatheter renal denervation (RDN). Machine learning defines the relationship between measurable point A, which is on the balloon surface inside the blood vessel, and the ablated area outside point B, which is the target nerves area. The proposed machine learning algorithm for microwave RDN showed a good estimation compared with the numerical calculation result, with all points are within 1.5 °C to the numerical calculations.

S10-2 [10:15]
STUDENT PAPER

Fully automatized personalized head exposure modeling and application in a brain stimulation treatment modeling platform

Melanie Steiner[1, 2], Esra Neufeld[1], Bryn Lloyd[1], Taylor Newton[1], Antonino Mario Cassara[1], Katie Zhuang[1], Pedro Crespo-Valero[1], Silvia Farcito[1] & Niels Kuster[1, 2]

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Keywords: Clinical (therapy), ELF/LF, Completed (unpublished)
Presented by: Melanie Steiner

developed an age-dependent near-surface tissue model and varied the permittivity, skin thickness and blood flow. Our results indicate that the overall variations of the absorbed power density, SAR and heating are of the order of 10%–15%. These variations are mostly determined by the tissue permittivity and blood flow changes with age.

Recent results have demonstrated the value of personalized brain stimulation. A new approach for generating detailed, personalized head models from medical image data has been developed that distinguishes more tissue classes and offers superior speed, flexibility, and accuracy, when compared with a commonly applied reference solution. It has been integrated in a comprehensive pipeline for fully automatic brain stimulation exposure modeling, and the impact of various personalization measures (e.g., anatomical geometry, level of detail, image-based and anisotropic dielectric property maps) has been assessed. A posteriori modeling reveals correlations between personalized exposure predictions and inter-subject brain response variability.

S09-3 [10:30]
STUDENT PAPER

SAR induced by a near-field radio-frequency source in a 6-year old boy

Maarten Velghe[1], Soufiane Bouchelga[2], Xi Cheng[2], Joe Wiart[2], Mònica Guxens[3], Elisabeth Cardis[3], Luc Martens[1], Wout Joseph[1] & Arno Thielens[1]

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Keywords: Dosimetry (computational), RF/Microwaves, Work in Progress
Presented by: Maarten Velghe

The increased use of mobile devices and other wireless equipment by children exposes them to radio-frequency electromagnetic fields (RF-EMFs). It is important to quantify the specific absorption rate (SAR) in childrens' bodies in a wide range of situations. This study simulates 64 use cases of wireless devices to obtain SAR_{WB}, SAR_{brain}, and $SAR_{genitalia}$ induced by near field RF-EMF sources a 6-year old boy. The highest organ-specific SAR was found for the genitalia when sitting with the device on the lap at 800 MHz (0.228 W/kg) for an input power of 1 W.

S10-3 [10:30]

WITHDRAWN

S09-4 [10:45]

Magnetic resonance-based specific absorption rate estimation via electrical properties tomography at 7 T

Motofumi Fushimi[1] & Masaki Sekino[1]

[1]*Department of Bioengineering, The University of Tokyo, Tokyo, Japan, 113-8656*

Keywords: Dosimetry (computational), RF/Microwaves, Work in Progress
Presented by: Motofumi Fushimi

S10-4 [10:45]

Modeling interictal epileptic discharges in partial epilepsies

Elif Köksal-Ersöz[1], Remo Lazazzera[1], Isabelle Merlet[1], Pascal Benquet[1], Borja Mercadal[2], Giulio Ruffini[2], Fabrice Bartolomei[3, 4] & Fabrice Wendling[1]

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[2]*Brain Modeling Department, Neuroelectrics Barcelona, Barcelona, Spain, 08022*

The specific absorption rate (SAR) is a quantitative criterion to evaluate tissue heating against RF electromagnetic fields, which is a major concern in recent ultra-high field magnetic resonance imaging (MRI). We previously proposed a novel reconstruction method for electrical properties tomography, in which conductivity and permittivity as well as SAR distribution of biological tissues are reconstructed from the RF magnetic field measured by MRI and validated it with a conductivity phantom via 3 T MRI. In this study, we tested our method with a conductivity–permittivity phantom using a 7 T MRI scanner. Phantom experiments showed that the method could estimate the SAR at 7 T for phantoms with different permittivity values.

S09-5 [11:00]
STUDENT PAPER

Micro-scale power absorption at mmWaves in skin appendages

Zain Haider[1], Yves Le Dréan[2], Giulia Sacco[1], Ronan Sauleau[1] & Maxim Zhadobov[1]

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Keywords: Dosimetry (computational), RF/Microwaves, Completed (published)
Presented by: Zain Haider

The objective of this study is to quantify the local micro-scale power losses within realistic models of skin appendages at 60 GHz. The geometric models of the skin appendages were developed based on morphometric data. The complex permittivity of skin substructures was retrieved from their free water content by using mixture equations. Compared to the surrounding skin, the skin appendages with higher water content, such as nerves (37.9%), blood capillary (30.6%), lymph capillary (20%), Pacinian corpuscle (32.5%), acrosyringium (45%), and arrector pili muscle (13.5%), demonstrated higher PLD. This suggests that currently used macro-scale skin models may result in an underestimation of local exposure at the level of skin appendages.

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Keywords: Clinical (diagnostics), Static, Completed (unpublished)
Presented by: Elif Koksal-Ersoz

In partial epilepsies, interictal epileptic discharges (IEDs) are paroxysmal events observed in epileptogenic and irritative zones. Generation and recurrence of IEDs are subject to different hypotheses: they appear through glutamatergic and GABAergic processes; they may both trigger seizures or prevent seizure propagation. The aim of this computational study is to make a link between the spatiotemporal features of three different IED morphologies and underlying pathophysiological mechanisms. Results indicate that synaptic kinetics, cortical organization and network interactions determine the morphology of the simulated local field potential signals and suggest that the IED morphologies are linked to the degree of preserved inhibition.

S10-5 [11:00]

Evaluating the reflectance of water based compounds at THz frequencies using synchrotron radiation, utilizing attenuated total reflection apparatus in both a “true ATR” and partial reflection/partial transmission mode

Zoltan Vilagosh[1], Robert McIntosh[2], Negin Foroughimehr[1] & Andrew Wood[1]

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Keywords: Clinical (diagnostics), THz, Work in Progress
Presented by: Robert McIntosh

A technique that extends the capabilities of attenuated total reflection (ATR) apparatus to an additional partial reflection/partial transmission mode is explored, using water and water based biological tissues as samples at terahertz radiation frequencies (THz). The method uses synchrotron radiation and a diamond crystal in the ATR apparatus to track the temperature dependent changes in reflectance in the 0.5 to 10 THz range. The “thermal crossover and flare” feature in the ATR spectral scan is noted which seems to be characteristic of water dominated compounds. Since many cancers have higher water content than normal tissue, this method promises to establish a new diagnostic modality.

S09-6 [11:15]
STUDENT PAPER

Novel procedure for spatial averaging of absorbed power density on realistic body models at millimeter waves

Ante Lojic Kapetanovic[1], Giulia Sacco[2], Dragan Poljak[1] & Maxim Zhadobov[2]

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Keywords: Dosimetry (computational), RF/Microwaves, Completed (unpublished)
Presented by: Ante Lojic Kapetanovic

In this work, we propose a novel procedure for the spatial averaging of the absorbed power density (APD) on complex conformal anatomical models, which is a crucial step in the advancement of accurate dosimetry. To validate our method, the electromagnetic (EM) dosimetric analysis is performed for an ear model exposed to a plane wave at 60 GHz. We investigate the influence of two factors on the spatial-average APD: (i) the shape of the averaging surface (square and disk), and (ii) the polarization of the incident field. According to analyzed exposure scenarios, the spatial-average APD variations as a function of the averaging surface shape are less significant (tenfold) than those related to the polarization of the incident field.

S10-6 [11:15]

Towards a non-invasive craniospinal compliance biomarker

Fariba Karimi[1, 2], Esra Neufeld[1], Arya Fallahi[1, 2], Myles Capstick[1], Andreas Spiegelberg[3], Andrea Boraschi[3], Jaco J.M. Zwanenburg[4], Vartan Kurtcuoglu[3] & Niels Kuster[1, 2]

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Keywords: Clinical (diagnostics), ELF/LF, Work in Progress
Presented by: Fariba Karimi

Measuring intracranial pressure (ICP) is required for clinical management of several neurological disorders. Of arguably similar value, but more difficult to measure, is craniospinal compliance (CC). Changes in head impedance due to geometry and dielectric properties variation during the cardiac cycle is a promising biomarker for non-invasive CC monitoring. Recently, we developed an efficient computational method to facilitate signal information content analysis and maximization. In this paper, we show how this method is coupled to deformation data to study transient head impedance changes towards optimization of data acquisition and interpretation. Moreover, the first experimental validation data using a prototype device is presented.

Thursday June 23, 2022

Session: P3
Plenary 3: Transient changes in membrane hydration of liposome exposed to nanosecond electric pulses detected by wide-field Coherent anti-Stokes Raman microspectroscopy
Thursday June 23, 2022 • 08:30 - 09:30
Large Hall
Chair: Azadeh Peyman

P3-1 [08:30]

Transient changes in membrane hydration of liposome exposed to nanosecond electric pulses detected by wide-field Coherent anti-Stokes Raman microspectroscopy

Caterina Merla[1, 2], Martina Nardoni[3], Michaël Scherman[4], Stefania Petralito[3], Laura Caramazza[5, 6], Francesca Apollonio[5], Micaela Liberti[5], Patrizia Paolicelli[3], Brigitte Attal-Trétout[4] & Lluis M. Mir[2]

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Biographical sketch

Caterina Merla received her PhD in electronic engineering in 2008 at Sapienza University (Rome, Italy), and the "Young Scientist Award" from the International Union of Radio-Science URSI, (General Assembly Chicago, IL USA) in the same year. Since 2013, she is researcher at ENEA (National Italian Agency for Energy and New Technologies, Rome Italy) working on bioelectromagnetics oriented on medical applications and new technological developments. She leaded and participated in different national and international (EU) projects on electromagnetic-based cancer therapy, treatments of neurodegenerative pathologies and injured spine regeneration (H2020 MSCA Individual-Fellowship g.a. 661041, two H2020-FETOPEN projects, in 2016-2017 g.a. 737164, and 2018-2020 g.a. 964562) to cite only the most relevant. She is author of 57 research articles in peer reviewed international journals (H-index of 21, by Scopus), and over 120 contributions to international and national conferences. She was invited speaker or plenary speaker in different international conferences in the area of bioelectromagnetics, she chaired and organized various sessions, special sessions and workshops at international meetings, she was member of the technical scientific committees of several of these conferences and member of the EBEA council. Caterina Merla has strong multidisciplinary competences concerning the study of interaction mechanisms between electromagnetic fields and biological systems both theoretically and experimentally using various methodologies (e.g. linear and non-linear optical techniques in vitro). In particular, she used Coherent Anti-Stokes Raman micro-spectroscopy to investigate the role of water and lipids during the exposure to electric pulses, in simultaneity with the generation of hydrophilic pores in the membranes.

Lluis M. Mir did his graduate work at Ecole Normale Supérieure (Paris, France) and obtained his D.Sc. at U. of Toulouse, France, in 1983, in cell biology. In 2018, he received three Doctorates Honoris Causa (U. of Buenos Aires, Argentina, U. National Mayor San Marcos of Lima, Peru, and U. of Ljubljana, Slovenia). Lluis M. Mir is DRCE emeritus at CNRS, and fellow of the American Inst. for Medical and Biological Engineering (AIMBE) and of the International Union of RadioScience (URSI). He is the President of the Int. Society of the Electroporation-Based Technologies and Treatments (ISEBTT) and President of URSI-France (CNFRS). He

was visiting professor at the U. of Berkeley, Bielefeld and Jerusalem, served as Treasurer of the Bioelectrochemical Society for 8 years and later as President of the European Bioelectromagnetics Association (2011-2013). Dr. Mir won several awards, including the URSI-France 2012 medal, the 2015 F. Reidy award in Bioelectrics, the 2017 B. van der Pol Gold Medal of the URSI and the 2021 G. Milazzo Prize in Bioelectrochemistry. Dr Mir's scientific production comprises 250+ articles in peer reviewed journals and 26 chapters in books (H index = 71; Sum of the Times Cited: 16 000+ Web of Science). Lluis M. Mir pioneered the therapeutic uses of cell electroporation in biology and medicine. He developed the antitumor electrochemotherapy from the inception of the concept to the first pre-clinical and clinical trials, the development of the technology and medical equipment, and he leaded the establishment of the Standard Operating Procedures of this cancer treatment. His research also focussed in the understanding of the interactions of pulsed electric fields with biological cells or tissues, in particular with the cell membrane, investigating the chemical reactions that occur in simultaneity with the generation of hydrophilic pores in the cell membranes.

Abstract

To deep more insight into basic phenomena occurring during and after electropulsation of biological membranes, a new experimental modality has been used combining a wide field Coherent Anti Stokes Raman Spectroscopy system [1] with a coplanar wave guide able to deliver nanosecond pulsed electric fields to different in vitro samples [2]. This setup allows to acquire i) CARS hyper-spectra at specific Raman bands from 2900 to 3500 cm^{-1} (into the so-called water vibration region) as well as ii) to acquire in real time the CARS signature at specific wavelengths with a temporal resolution of few ns. This time scale is comparable to the duration of the electrical stimulation synchronised to the laser emission. As the biophysical and chemical bases of cells electropulsation are still debated, our setup allows the experimental assessment of the role of water molecules and phospholipid bilayers during and after the occurrence of this phenomenon, which is used in various biotechnological, biological and medical applications.

Our experiments have been conducted on liposome suspensions placed between the central and lateral (ground) electrodes a grounded closed coplanar waveguide (GCCPW) [2], assuring the transmission of short electric pulses (10 ns) to the biological samples without distortions. Liposomes, that is lipid spherical unilamellar vesicles, where chosen as a suitable synthetic system to mimic phospholipid double layers as they are similar to the structure of real cell membranes. The illumination scheme of the CARS microscope followed a non-phase-matched geometry as suggested in [1] especially useful for transparent samples and for fast CARS signal acquisitions. Spectra of liposomes suspensions were acquired immediately after electropulsation. These experiments demonstrated a significant increase of the vibrational modes around 3345 cm^{-1} in the pulsed samples with respect to the non-pulsed ones. The increase of this vibrational signature (3345 cm^{-1}), at a higher Raman shift than the vibrational signature (3145 cm^{-1}) of the symmetric OH stretch modes of the surface water (like the bulk or the interfacial water), reflects an increased presence of water molecules located inside the membrane. Indeed, the intermolecular OH bonds of the so-called lipid associated water molecules are weaker because they reflect asymmetric OH stretch modes, imposed to the water molecules by the vicinity with the lipids [3, 4]. This association makes the pulsed membrane more permeable due to this less organized and persistent structure of the water molecules. The appearance of this vibrational mode has been also verified during the exposure, in real-time specific experiments.

Finally, the effective permeabilization of liposome suspensions after the electric pulses delivery was verified looking at the release of a fluorescent dye (5-6-carboxyfluorescein) preloaded into the liposomes core. Dynamic light scattering measurements (performed before and after the electric pulses exposure) demonstrated the maintenance of the vesicles integrity supporting the permanent hydration of the liposome membranes after electropulsation.

The observed pulse-dependent accumulation of interstitial water molecules in the membranes was theoretically described and a plausible mechanism supported by a computational electrochemical model is discussed.

In summary, CARS, employing nanosecond lasers pulses and the properties of our wide field microscope and its intrinsic ability to sense complex interferences, has provided us with an appropriate diagnostic tool. In a future, the underlined mechanism will be investigated on cells, hence taking into account recovery processes of cell membranes as well as the different interactions elicited by the application of longer ms electric pulses.

Acknowledgments

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Coffee Break
Thursday June 23, 2022 • 09:30 - 10:00
Exhibition Hall

Session: S11
Session 11: Epidemiology
Thursday June 23, 2022 • 10:00 - 11:30
Large Hall
Chairs: Martin Röösli & Anke Huss

S11-1 [10:00]

Panel study on wireless phone use and cognition (SPUTNIC)

Martin Röösli[1, 2], Sophie Pujol[3, 4], Frédéric Mauny[3, 4], Thomas Gehin[3, 4], Gilles Chopard[3, 4], Benjamin Flückiger[1, 2], Nicolas Loizeau[1, 2], Taghrid Mazloum[5], Shanshan Wang[5], Joe Wiart[5] & Marloes Eeftens[1, 2]

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Keywords: Epidemiology, RF/Microwaves, Completed (unpublished)
Presented by: Martin Roosli

In the SPUTNIC study possible associations between wireless phone radiation, cognitive performance and health related quality of life were investigated in a panel of 121 participants from Besançon and from Basel, who completed their assessments over a 14-day period. Self-reported wireless phone use and screen time were sporadically associated with cognitive functions and

Session: S12
Session 12: In vitro
Thursday June 23, 2022 • 10:00 - 11:30
Small Hall 2
Chairs: Satoshi Nakasono & Florence Poulletier De Gannes

S12-1 [10:00]

The effect of combined exposure to radiofrequency LTE signal and mitomycin-C in Chinese Hamster Lung Fibroblast cells

Anna Sannino[1], Stefania Romeo[1], Maria Rosaria Scarfi[1], Loredana Poeta[1], Daniele Pinchera[2], Ciro D'Elia[2], Maria Brigida Lioi[3], Mario Alonzo[1] & Olga Zeni[1]

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Keywords: In vitro, RF/Microwaves, Work in Progress
Presented by: Maria Rosaria Scarfi

This study aims to investigate the effects of 1950 MHz, LTE signal radiofrequency exposure, administered alone and in combination with a well-known genotoxic agent, the mytomycin-C (MMC). In particular, V79 cell cultures were exposed/sham exposed in a waveguide-based system for 3h and 20 h at 0.3 W/kg and 1.25 W/kg specific absorption rate (SAR) to evaluate the chromosomal damage in the micronucleus (MN) assay. We did not reveal

symptoms, which may have occurred by chance, given the explorative character of the analysis with many statistical tests that were conducted.

effects of RF exposure alone, instead a reduction of the MMC-induced damage was detected when cells were pre-exposed for 20 h to 1.25 W/kg SAR. Moreover, we did not evidence alteration of the intracellular levels of HSF1 and PARP1 in western blot preliminary experiments.

S11-2 [10:15]
STUDENT PAPER

Electromagnetic field strength measurements in outdoor environments, public indoor places and public transport in Switzerland in 2021

Nicolas Loizeau[1, 2], Marco Zahner[3, 4], Timon Schmid[3, 4], Jürg Fröhlich[3, 4], Johannes Schindler[5], Simon Burkhard[5], Erik Bühlmann[5], Christa Stephan[5], Felix Schlatter[5], Michal Kovacik[5], Markus Gugler[6], Marloes Eeftens[1, 2], Stefan Dongus[1, 2], Alexander Reichenbach[7], Sebastian Egger[7], Toni Ziegler[5] & Martin Röösli[1, 2]

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[7]*Swiss Confederation, Bern, Switzerland*

Keywords: Epidemiology, All Frequencies, Work in Progress
Presented by: Nicolas Loizeau

Exposure to electromagnetic fields (EMF) is continuously changing in our daily environment. The Federal Office for the Environment (FOEN) has commissioned the SwissNIS consortium to assess the extremely low frequency magnetic fields (ELF-MF) and radiofrequency (RF) EMF exposure of the Swiss population in their everyday life from 2021 to 2025. The EMF exposure is measured in a sample of microenvironments (MEs) (e.g. residential areas, schools, trains) which are considered to be representative of the Swiss population's exposure and include the most relevant EMF sources. In 2021, the ambient levels of EMF were measured in 75 outdoor MEs, 64 indoor MEs and numerous trains, buses and tramways.

S12-2 [10:15]
STUDENT PAPER

Cardiac implants under low frequency EMF exposures: Numerical evaluation of the induced voltage

Mengxi Zhou[1], Djilali Kourtiche[1], Julien Claudel[1], François Deschamps[2], Isabelle Magne[3], Patrice Roth[1], Martine Souques[3] & Mustapha Nadi[1]

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Keywords: In vitro, ELF/LF, Completed (unpublished)
Presented by: Mengxi Zhou

Numerical evaluation of the induced voltage on the lead of bipolar cardiac implant was carried out under three types of low frequency (50 Hz) electric field (EF) and magnetic field (MF) exposure: standard exposure, experimental exposure, and equivalent exposure. The equivalent relations between the exposure systems were studied by determining the equivalent factors and the stand-in coefficients. Thus, a test protocol of cardiac implant under EMF exposure was numerically validated.

S11-3 [10:30]

Mobile phone use and the incidence of cancers of the brain, parotid and other salivary glands in Australia

Chris Brzozek[1] & Ken Karipidis[1]

[1]*Assessment and Advice, Australian Radiation*

S12-3 [10:30]
STUDENT PAPER

Impact of 3.5-GHz 5G radiofrequency fields on molecular-stress responses in human keratinocytes and fibroblasts

Protection and Nuclear Safety Agency, Melbourne, Australia, 3030
Keywords: Epidemiology, RF/Microwaves, Completed (published)
Presented by: Chris Brzozek

There has been a significant increase in the use of mobile phones over the last three decades and a possible association with head cancers has been suggested, including cancers of the brain, parotid and other salivary glands. We examined the incidence time trends of brain, parotid and other salivary gland cancers in Australia to ascertain the influence of improved diagnostic technologies and of increased mobile phone use.

S11-4 [10:45]
STUDENT PAPER

Occupational exposure to radiofrequency electromagnetic fields and the risk of cancer

Rohan Mate[1, 2], Geza Benke[1], Sarah Loughran[2], Michael Abramson[1], Claire Vajdic[3] & Ken Karipidis[2]

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Keywords: Epidemiology, RF/Microwaves, Work in Progress
Presented by: Rohan Mate

In order to investigate whether occupational exposure to radiofrequecy electromagntic fields (RF EMF) are associated with cancer we appliyed, and will apply, two seperate job exposure matrices (JEM)

S12-4 [10:45]

Transcriptome and methylation patterns for human skin cells exposed to 5G electromagnetic fields

Jyoti Jyoti[1], Eda Cakir[1], Alexandra Gronau[1], Vivian Meyer[1], Gernot Schmid[2], Marc-Thorsten Hütt[1] & Alexander Lerchl[1]

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Keywords: In vitro, RF/Microwaves, Work in Progress
Presented by: Alexander Lerchl

Transcriptome and methylation patterns for human skin cells exposed to 5G electromagnetic fields are analyzed for differentially expressed genes and differentially methylated sites, as well as interpreted from the perspective of biological networks. Cells

Alexandre Joushomme[1], Lorenza Patrignoni[1, 4], Rosa Orlacchio[2], Anne Canovi[1], Yann Chappe[1], Annabelle Hurtier[1], Florence Poulletier De Gannes[1], Muriel Cario[3], Delia Arnaud-Cormos[2], Philippe Leveque[2], Isabelle Lagroye[1, 4] & Yann Percherancier[1]

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Keywords: In vitro, RF/Microwaves, Completed (unpublished)
Presented by: Alexandre Joushomme

Taking advantage of published BRET (Bioluminescence Resonance Energy-Transfer) probes, we studied the potential impact of 5G-modulated 3.5 GHz signals at specific absorption rate (SAR) up to 4 W/kg on various cellular stress responses (including Heat Shock Factor (HSF), Promyelocytic Leukemia Protein (PML), and the MAPK/ERK pathway) in live human keratinocytes and fibroblasts cells. Impact of RF co-exposure with chemicals were also considered.We found only sparse evidence that continuous or intermittent RF exposure at constant temperature altered either the basal levels of HSF, RAS/ERK, and PML activity, or the potency or efficacy of chemicals to activate these stress-sensing proteins.

to three different case-control studies of cancer. Current we have the prelimanry results from one of the JEMs has been appliyed to a cancer case-control study of glioma.We found no posistive association between cancer and occupational exposure to RF EMF.The prelimanry findings remain consistent with other studies that have looked at the association between occupational RF EMF exposure and glioma and with the overall overall evidece of RF EMF exposure and cancer.

S11-5 [11:00]

WITHDRAWN

S11-6 [11:15]

Association between child's age at first mobile device use and behavioral problems in the Hokkaido Study on Environment and Children's Health

Chihiro Miyashita[1], Keiko Yamazaki[1], Naomi Tamura[1], Atsuko Ikeda-Araki[1, 2], Satoshi Suyama[3], Takashi Hikage[4], Manabu Omiya[5], Masahiro Mizuta[5] & Reiko Kishi[1]

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are exposed or sham-exposed for 2h or 48h, with a frequency of 27 GHz or 40.5 GHz, and a power flux density of 1mW/cmor 10mW/cm. After exposure, RNA and DNA are analyzed via RNA-Seq and methylation profiling microarray. Initial analysis reveals no clear separation of treated and untreated samples and relatively small sets of differentially expressed genes or methylated sites. Further analysis is required. In particular, we will create methods designed for the detection of small signals.

S12-5 [11:00]

Cav3.2 T-type voltage gated calcium channel (CACNA1H) mediates the anti-proliferative effect of Glioblastoma-specific AM RF EMF

Hugo Jimenez[1, 2], Callum Mcgrath[1, 2], Preeya Achari[1, 2], Alexandre Barbault[3], Glenn Lesser[4], Waldemar Debinski[1, 2], Carl Blackman[1, 2] & Boris Pasche[1, 2]

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Keywords: In vitro, RF/Microwaves, Work in Progress

Presented by: Hugo Jimenez

Summary: We have shown that 27.12 MHz amplitude modulated (AM) radiofrequency (RF) electromagnetic fields (EMF) inhibit the proliferation of tumor growth in patients, in tumor xenografts, and in cancer cell lines. Here we report that Cav 3.2 mediates the anti-proliferative effect of glioblastoma-specific AM RF-EMF thereby establishing CACNA1H as the biological antenna for AM RF EMF among epithelial and glial tumors.

S12-6 [11:15]
STUDENT PAPER

Pulsed Electromagnetic Fields (PEMFs) and Amyotrophic Lateral Sclerosis (ALS): a numerical and experimental study

Sara Fontana[1, 2], Laura Caramazza[1, 2], Giorgia Innamorati[3], Eleonora Cucchiaro[1], Angela D'Anzi[4], Giorgia Ruotolo[4], Simona Salati[5], Ruggero Cadossi[5], Barbara Benassi[3], Francesca Apollonio[1, 2], Micaela Liberti[1, 2], Jessica Rosati[4] & Claudia Consales[3]

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Keywords: Epidemiology, All Frequencies, Work in Progress

Presented by: Chihiro Miyashita

This study focused on children aged 7-17 years participating in the Hokkaido Study on Environment and Children's Health. The outcome variable was behavioral problems according to SDQ score (normal or borderline/high). The independent variable was child's age at first use of a mobile device. In this cross-sectional study, older age at first use of mobile devices was significantly associated with fewer behavioral problems among elementary school children.This study suggests that emotional problems may continue later elemental school children. Longitudinally follow up studies are needed to clarify whether the findings in elementary school aged children disappear as they grow older.

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Keywords: In vitro, ELF/LF, Work in Progress

Presented by: Sara Fontana

Electromagnetic fields are becoming a powerful tool as therapeutic agents,as an alternative to pharmaceuticals for many inflammatory diseases. Low-intensity pulsed electromagnetic fields (PEMFs) can regulate the inflammatory response,as actuators of adenosine receptor A_2A, typically involved in the inflammatory states. Among the neurodegenerative diseases,a study on the A_2A modulation effects on the amyotrophic lateral sclerosis (ALS) progression by exerting PEMFs,could represent a way to understand and treat this disease.In this work authors provide a way to characterize the ALS cells response to PEMFs,with a focus on fine-tuning the cell models to be studied and the experimental setup in place to be used to ensure results reliability.

Lunch
Thursday June 23, 2022 • 11:30 - 13:00

Session: W5
Workshop 5: 2B or not 2B - revisited from the perspectives of animal study
Thursday June 23, 2022 • 13:00 - 15:00
Large Hall
Chair: Masateru Ikehata

W5-1 [13:00]

Workshop Introduction

Carmela Marino[1] & Rene De Seze[2]

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In 2019, the International Agency for Research on Cancer (IARC) received an advice on priorities for IARC Monographs during 2020-2024 in which non-ionizing radiation (radiofrequency fields) was classified as "High priority (and ready for evaluation within 5 years)". The advice mentioned that "new data in experimental animals for exposure to RF-EMF have been published since the previous IARC Monographs evaluation". In this regard, several animal studies are progressing in Japan, Korea and the U.S. Is it an appropriate time to revisit carcinogenicity of RF-EMF?

W5-2 [13:10]

International validation project of the NTP study on carcinogenesis of mobile-phone radiofrequency radiation: Interim report from Japanese team

Katsumi Imaida[1]

[1]*Faculty of Medicine/Graduate School of Medicine, Kagawa University, Kagawa, Japan, 7610793*

The National Toxicology Program (NTP) reported CDMA- and GSM-modulated mobile phone RFR to be carcinogenic to the brain and heart of male rats. In order to verify the NTP study results, Korea and Japan started our collaborative animal carcinogenicity projects using the same animal experiment protocol, the same animal model (Harlan SD, male rats), and the same exposure conditions (900MHs CDMA modulated signal, 4 W/Kg SAR). We have already completed the preliminary 28 days exposure animal study and the in vivo genotoxicity study. The 2 years animal carcinogenicity study is now undergoing.

W5-3 [13:30]

International validation project of the NTP study on carcinogenesis of mobile-phone radiofrequency radiation: Interim report from Korean team

Young Hwan Ahn[1]

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International collaborative animal project as an NTP validation study started concurrently in Japan and Korea in 2019 and will continue through 2023. For this study, the reverberation chamber system was developed by the Electronics and Telecommunications Research Institute (ETRI) and the Nagoya institute of Technology (NITech). The animal study consisted of a 28-day toxicity study and a 2-year carcinogenicity study and was conducted according to the same study protocol. In this presentation, we would like to introduce the research protocol and the current progress of this study in Korea.

W5-4 [13:50]

WITHDRAWN

Session: W6
Workshop 6: Experience from the use of new cellular and tissue models in the lab
Thursday June 23, 2022 • 13:00 - 15:00
Small Hall 2

W6-1 [13:00]

Experience from the use of new cellular and tissue models in the lab

Helena Kandarova[1], Myles Capstick[2] & Maryse Ledent[3, 4]

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Laboratory research in the field of electromagnetic fields uses both cellular (in vitro) and animal (in vivo) models in the study of potential effects of EMF exposure. Particularly inin vitrowork, methods are evolving rapidly. To date, most of the research has been conducted with 2D cell cultures (cell lines), but new techniques and more efficient tools are being developed. These include 3D reconstructed human tissue models, such as the 3D epidermis, full skin models, human reconstructed cornea-like tissues or mini brain's. These models provide a more realistic representation of the target tissues (in these cases the skin, the cornea and the nervous system, that could be EMF targets). In addition, these models could reduce or even replace the use of animals in the study of local effects such as accelerated ageing, inflammability or genotoxicity.

These techniques are already widely used in studies on safety and efficacy of chemicals, cosmetics, pharmaceuticals and medical devices. Several OECD and ISO guidelines cite the use of the 3D tissues for regulatory toxicity testing and screening of effects such as irritation, inflammation, phototoxicity and even genotoxicity, yet the use of advanced 3D tissue models in the field of EMF bioeffect assessment is still uncommon. However, as these techniques are not easy to implement due to technical interdisciplinary (such as generation and quantification of the EM fields, experimental settings that allow optimal conditions for the 3D models etc.) , an exchange of experience would open up the debate and perhaps the door to this work to a wider range of researchers in the field of EMF. This seems particularly appropriate in light of the work that will develop in the coming years in the context of the roll-out of 5G, where the skin and eyes are relevant organs to study.

Two speakers will share their expertise during the workshop session:

- Dr. Helena Kandarova (Center for Experimental Medicine, Slovak Academy of Sciences, Bratislava, Slovakia) specializes in tissue engineering of in vitro reconstructed 3D organotypic models and for 10 years was the executive director of a European facility that manufactured 3D tissues. She has also managed several validation trials in this field and has co-authored four OECD methods and one ISO standard.

She will open the workshop and provide an introduction to 3D technologies. She will discuss the different applications and the positive/negative aspects of their use in regulatory and non-regulatory areas.

She will present a case study in the field of phototoxicity testing with the example of the development of the OECD Tg 498 Phototox (in vitro phototoxicity test with 3D models) - which combines specific requirements on the 3D models and also on the irradiation equipment (dosimetry, spectrum etc...) - and will highlight what needs to be considered when specific technologies are combined.

- Dr Myles Capstick (IT'IS Foundation, Switzerland) will share his expertise in modelling exposed cells or tissues, a field-leading expertise based on his work in developing in vitro/in vivo exposure systems. As partner of "Brain in a dish" with University of Bern (Switzerland), a project investigating the effects of RF-EMF (5G) on neuronal development and neurodegenerations, he will also inform about the precautions to be taken and the reflections to have in the use of mini brain models.

Coffee Break
Thursday June 23, 2022 • 14:30 - 15:00
Exhibition Hall

Session: FB
Student Flash Poster Session B
Thursday June 23, 2022 • 15:30 - 16:30
Large Hall
Chairs: Niels Kuster & Martin Röösli

Session: PB
Poster Session B
Thursday June 23, 2022 • 16:30 - 18:00
Exhibition Hall

Friday June 24, 2022

Session: P4
Plenary 4: The MOBI-Kids study
Friday June 24, 2022 • 08:30 - 09:30
Large Hall
Chairs: Anke Huss & Wout Joseph

P4-1 [08:30]

The MOBI-Kids study: association between wireless phone use in childhood and adolescence and brain tumours

Elisabeth Cardis[1], Gemma Castaño-Vinyals[1] & the MOBI-Kids Study Group

[1]*ISGlobal, Barcelona, Spain*

Biographical sketch

Elisabeth Cardis is Professor of Radiation Epidemiology and Head of the Radiation Program at ISGlobal (previously the Center for Research in Environmental Epidemiology) in Barcelona since 2008. Before that, she led the Radiation Group at the International Center for Cancer Research (IARC) of the WHO in Lyon, where she worked for over 20 years.

She is the author of about 250 peer-reviewed publications and has extensive experience in epidemiological studies on health effects of medical, accidental, environmental and occupational exposures to radiation (ionizing and non-ionizing); in radiation protection; in characterization and modeling of uncertainties in exposure estimates and in health impact assessment.

Her non-ionising radiation work includes coordination of large-scale multinational projects: GERoNiMO, MOBI-Kids, CREST, INTERPHONE, INTEROCC, mainly focusing on effects of RF-EMF. She has been member of the ICNIRP Standing Committee in Epidemiology, the international advisory committee of the WHO International EMF Project, the Rapid Response Team of EMF-Net, the steering committee of the Swiss National Non-Ionising Radiation Programme and the Spanish CCARS (Scientific Advisory Committee on Radiofrequency and Health) and the French ANSES Working Group on RF, as well as an adviser to the Catalonian Parliament, Barcelona city and the Barcelona Public Health Agency.

Abstract

This presentation will focus on the methods and results of the MOBI-Kids study, a multinational case-control study of brain tumours in young people designed to evaluate whether RF and ELF from wireless phone use may affect the risk of brain tumours. The study provides no evidence of a causal association between wireless phone use and brain tumours in young people.

In recent decades, the possibility that use of mobile communicating devices, particularly wireless (mobile and cordless) phones, may increase brain tumour risk, has been a concern, particularly given the considerable increase in their use by young people.

Methods

MOBI-Kids, a 14-country (Australia, Austria, Canada, France, Germany, Greece, India, Israel, Italy, Japan, Korea, the Netherlands, New Zealand, Spain) case-control study, was conducted to evaluate whether wireless phone use (and particularly resulting exposure to radiofrequency (RF) and extremely low frequency (ELF) electromagnetic fields (EMF)) increases risk of brain tumours in young people.

Results

Between 2010 and 2015, the study recruited 899 people with brain tumours aged 10 to 24 years old and 1,910 controls (operated for appendicitis) matched to the cases on date of diagnosis, study region and age. Participation rates were 72% for cases and 54% for controls. The mean ages of cases and controls were 16.5 and 16.6 years, respectively; 57% were males. The vast majority of study participants were wireless phones users, even in the youngest age group, and the study included substantial numbers of long-term (over 10 years) users: 22% overall, 51% in the 20–24-year-olds. Most tumours were of the neuroepithelial type (NBT; n = 671), mainly glioma. The odds ratios (OR) of NBT appeared to decrease with increasing time since start of use of wireless phones, cumulative number of calls and cumulative call time, particularly in the 15–19

years old age group. A decreasing trend in ORs was also observed with increasing estimated cumulative RF specific energy and ELF induced current density at the location of the tumour.

Discussion

Further analyses suggest that the large number of ORs below 1 in this study is unlikely to represent an unknown causal preventive effect of mobile phone exposure: they can be at least partially explained by differential recall by proxies and prodromal symptoms affecting phone use before diagnosis of the cases. We cannot rule out, however, residual confounding from sources we did not measure.

Conclusions

Overall, our study provides no evidence of a causal association between wireless phone use and brain tumours in young people. However, the sources of bias summarised above prevent us from ruling out a small increased risk.

Session: S13
Session 13: Standards
Friday June 24, 2022 • 09:30 - 10:30
Large Hall
Chair: Carolina Calderon

S13-1 [09:30]

5G and Health - A review and meta-analysis of the research into low-level millimetre waves

Ken Karipidis[1, 2], Rohan Mate[1], Rick Tinker[1] & Andrew Wood[2]

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Keywords: Standards, RF/Microwaves, Completed (published)
Presented by: Ken Karipidis

In order to investigate whether low-level millimetre waves such as those produced by the 5G network are associated with any health effects we reviewed the research into the effects of millimetre waves at levels below current international exposure guidelines. Because of the diversity of results in the experimental studies we also conducted a meta-analysis of the experimental results. A review of all the studies provided no substantiated evidence that low-level millimetre waves, like those used by the 5G network, are hazardous to human health. The findings remain consistent with national and international health and safety guidelines, which have deemed low-level 5G millimetre waves safe for public exposure.

S13-2 [09:45]

EONS: Evaluation of non-sinusoidal magnetic fields for electromagnetic safety to intermediate frequencies

Session: S14
Session 14: Computational Dosimetry
Friday June 24, 2022 • 09:30 - 10:30
Conference Room 1101
Chairs: Micaela Liberti & Thomas Tarnaud

S14-1 [09:30]

The role of organelles in electromagnetic microdosimetry based on broadband multiscale skin models of eukaryotic cells

Kevin Jerbic[1], Jan Taro Svejda[1], Benedikt Sievert[1], Andreas Rennings[1], Jürg Fröhlich[2] & Daniel Erni[1]

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[2]*Fields at Work GmbH, Zürich, Switzerland, CH-8032*

Keywords: Dosimetry (computational), THz, Completed (unpublished)
Presented by: Kevin Jerbic

Increasing ambient high-frequency electromagnetic (EM) fields mean EM absorption by skin must be adequately represented by exposure limits, requiring analysis of tissue at its cellular level. Computational (micro)dosimetry provides quantitative determination of EM effects on eukaryotic cells, but suitable methodology and volumetric cell models are needed. Here, generic cell models of differing complexity show the effect of organelles on internal current and loss distributions via a virtual capacitor experiment over a wide frequency range (10Hz-100GHz). The maximum membrane loss density is between 1GHz and 10GHz and organelles have a strong effect on the distributions over the whole range and so, should be considered even at 5G frequencies.

S14-2 [09:45]

A validated spatial averaging scheme for assessing whole body power density exposures

Vitas Anderson[1, 3] & Danie Ludick[2, 3]

[1]*School of Psychology, University of Wollongong,*

Thomas Tarnaud[1], Florian Soyka[2], Ruben Schoeters[1], Tom Plovie[1], Wout Joseph[1], Luc Martens[1] & Emmeric Tanghe[1]

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Keywords: Standards, IF, Work in Progress
Presented by: Thomas Tarnaud

Safety guidelines and standards report frequency-dependent reference levels. For non-sinusoidal waveforms, exposure indices are specified by the IEEE International Committee on Electromagnetic Safety and the International Commission on Non-Ionizing Radiation Protection guidelines. Although conservative, Fourier-domain exposure indices are linear in the spectral components, while excitation thresholds have been observed to depend non-linearly on the spectral content. Here, we provide a tool EONS for the evaluation of exposure to non-sinusoidal magnetic fields, based on an axon model. As an example, the conservativeness of exposure indices to temporal interference waveforms is confirmed (minimal observed EU directive exposure index is 91%).

S13-3 [10:00]

Absorbed power density calculation using specific absorption rate in dipole and patch antennas in the 6-10 GHz band

Changmin Lee[1], Jangyong Ahn[1], Sungryul Huh[1], Hyukchoon Kwon[2], Yongho Park[2], Minbeom Ko[2] & Seungyoung Ahn[1]

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Keywords: Standards, RF/Microwaves, Work in Progress
Presented by: Changmin Lee

In this paper, the power density and Specific Absorption Rate (SAR) distribution in the phantom provided by IEC TC 106 is analyzed for the integration of the measurement methods and the improvement of the output power APD is derived by two different methods based on incident power density (IPD) and peak spatial SAR (psSAR), which is calculated using the finite-difference time-domain (FDTD) method in the 6-10 GHz. A dipole and a patch antenna designed to have resonant frequencies at five frequencies, intervals of 1 GHz for the 6-10 GHz band, are considered as electromagnetic fields (EMF) radiation sources.

Wollongong, Australia, 2522

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Keywords: Dosimetry (computational), RF/Microwaves, Work in Progress
Presented by: Vitas Anderson

The aim of this study was to develop a standardised and easy-to-apply spatial averaging scheme for the assessment of whole-body power density (S) reference level limits. Candidate schemes were validated against conformance with the underlying whole-body average (WBA) SAR basic restrictions. We calculated WBA SAR and S over a large grid (~690,000 points) around a 200W 900 MHz panel antenna. We compared 3D compliance zones generated by the spatial averaging schemes with the corresponding WBA SAR compliance zone, and the statistical distributions of the compliance ratio of the limit normalised values of S and WBA SAR. Our data indicates 5 equidistant points spaced over a vertical 1.6m line as the preferred spatial averaging scheme.

S14-3 [10:00]

Capacitive coupling of local electromagnetic sources with biological bodies

Andreas Christ[1], Arya Fallahi[1, 2], Esra Neufeld[1], Quirino Balzano[3] & Niels Kuster[1, 2]

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Keywords: Dosimetry (computational), RF/Microwaves, Completed (unpublished)
Presented by: Andreas Christ

The dominant coupling of electromagnetic sources with biological tissue in the proximal near-field is inductive. Recent tests of mobile phones showed that capacitive coupling can dominate the exposure when these devices are evaluated in touch. This study investigates the absorption mechanism of the induced electric fields (E-fields) in homogeneous tissue exposed to highly localized sources at very close proximity of the body. We derive an approximation for the decay of the induced E-field as a function of distance and charge of the antenna tip. The absorption is then quantified in terms of the local specific absorption rate (SAR). The approximation predicts the induced surface SAR with an accuracy that lies generally below 1.5dB.

Comparisons of results in the phantom according to frequency and antenna type are presented.

S13-4 [10:15]

Analysis of EMF effect evaluation for human implantable medical devices of electric vehicle wireless changing device

Jaewon Rhee[1], Jangyong Ahn[1], Haerim Kim[1], Changmin Lee[1] & Seungyoung Ahn[1]

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Keywords: Standards, ELF/LF, Work in Progress
Presented by: Jaewon Rhee

In this paper, a basic research was conducted on the effect of the leakage electromagnetic field (EMF) generated from the EV wireless charging device on implantable medical devices (IMD). Electric Vehicles (EV) wireless charging technology has high commercialization value. However, the generated EMF can affect human IMDs. Therefore, it is necessary to evaluate the EMF effect of IMDs due to EV wireless charging to ensure the safety of users of IMDs. In this paper, the effect of active IMDs using external power was analyzed. As a result of the research, it was possible to confirm the coupling path of noise induced in each implantable medical device, and to analyze the effect on the actual operation.

S14-4 [10:15]

Fast prediction of RF-induced heating in passive medical implantable devices using a Chebyshev parametric model based deep learning algorithm

Aiping Yao[1], Yunfeng Pei[1], Junchen He[1] & Mingjuan Ma[1]

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Keywords: Dosimetry (computational), RF/Microwaves, Work in Progress
Presented by: Aiping Yao

This paper provides a novel and efficient RF heating evaluation approach for patients with passive medical implantable devices.Through the combination of classical electromagnetic theory and deep learning algorithm, the geometry and electromagnetic properties of the medical implants are characterized as a Chebyshev parametric model and optimized by a three layer artificial neural network. The preliminary results shows that the proposed approach has the potential to provide an efficient evaluation for the RF-induced power deposition near the implant devices.

Award Session
Friday June 24, 2022 • 10:30 - 11:00
Large Hall

Closing Ceremony
Friday June 24, 2022 • 11:00 - 11:30
Large Hall

Session: M3
BioEM Board Meeting
Friday June 24, 2022 • 13:30 - 16:30
Conference Room 1108

Session: FA
Student Flash Poster Session A
Monday June 20, 2022 • 15:30 - 16:30
Large Hall
Chairs: Niels Kuster & Martin Röösli

FA-1 [15:30]
STUDENT PAPER

Effect of 1800 MHz radio-frequency electromagnetic fields and low-dose chemicals co-exposure on DNA damage in mouse embryonic fibroblast

Longtao Zhu[1], Kunhong Zhong[1], Chuan Sun[2] & Guangdi Chen[1]

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Keywords: Behavioural, RF/Microwaves, Work in Progress
Presented by: Longtao Zhu

RF-EMF is emitted by radio and television towers, base stations and mobile phones with frequency ranging from 100 kHz to 300 GHz. As relatively weak physical factors, environmental electromagnetic fields induced biological effects are often accompanied by co-exposures to other environmental factors. In this study, we investigated the combined effect of RF-EMF and low-dose cadmium, heavy chromium, 4NQO andH_2O_2 on DNA damage in mouse embryonic fibroblasts (MEFs). We observed synergistic effect of RF-EMF and low-dose cadmium or heavy chromium co-exposure on DNA damage, while no combined effect of RF-EMF and 4NQO or H_2O_2 in MEFs.

FA-2 [15:33]
STUDENT PAPER

Specific absorption rate assessments of the interaction of high-frequency EM waves with the children eyes

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Keywords: Dosimetry (computational), RF/Microwaves, Work in Progress
Presented by: Fatima Alzaabi

This paper focuses on numerical dosimetry techniques which can be applied to enable accurate and efficient modelling of the human eye when exposed to electromagnetic waves operating across the frequency band up to mm-waves. The current study focuses on the analysis of human eye within a virtual child model whole-body and other parts of the body examined separately (head and shoulder) according to the numerical results for the induced electric field, the distribution of SAR were determined. Also, simplifying the models by applying dielectric averaging using separate parts of the child's body in assessing the SAR allows to focus on the calculations of the desired parts (skin and eye).

FA-3 [15:37]
STUDENT PAPER

Coupling factor calculation method for wireless power transfer system in low frequency band

Jangyong Ahn[1], Seon-eui Hong[2], Haerim Kim[1], Kyunghwan Song[1], Hyung-Do Choi[2] & Seungyoung Ahn[1]

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Keywords: Dosimetry (computational), ELF/LF, Completed (published)
Presented by: Jangyong Ahn

The coupling factor (CF) was introduced to evaluate the effects of electromagnetic fields (EMFs) on the human body model (HBM) for local exposure. The CF is calculated based on the maximum peak for current density and internal electric field, which are internal quantities in the HBM. However, computational artifacts occur in the low-frequency band. Such abnormal peaks cause calculation errors or huge CF differences

between HBMs so that the HBM effect of EMFs in a specific system can be dominantly influenced by the HBM to be evaluated rather than the system characteristics. Therefore, in this paper, we propose an improved CF calculation method for uniform evaluation between HBMs without underestimating using the 99.99th percentile.

FA-4 [15:40]
STUDENT PAPER

User and non-user RF-EMF exposure to the downlink Zero-Forcing transmission of distributed Massive MIMO in an industrial environment

Sergei Shikhantsov[1], Arno Thielens[1], Gunter Vermeeren[1], Luc Martens[1], Piet Demeester[1] & Wout Joseph[1]

[1]*Department of Information Technology, Ghent University/IMEC, Ghent, Belgium, 9000*
Keywords: Dosimetry (computational), RF/Microwaves, Completed (unpublished)
Presented by: Sergei Shikhantsov

This contribution presents the first numerical study of the human Radio-Frequency (RF) Electromagnetic field (EMF) exposure to a distributed massive MIMO array system (6G) deployed in an industrial indoor setting. A set of environment models is generated stochastically, in which the EMF propagation is calculated using the Ray-Tracing (RT) method at 3.5 GHz. The RF-EMF distribution in proximity of a realistic human phantom's head is calculated using the Finite-Difference Time-Domain (FDTD) method coupled with the RT output. Multi-user scenarios with the Zero-Forcing downlink precoding are investigated. It is shown that the 10g-average peak Specific Absorption Rate of users that is nearly 8 times higher than the one experienced by non-users.

FA-5 [15:44]
STUDENT PAPER

Effect of averaging shapes of incident and absorbed power density above 6 GHz

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Keywords: Dosimetry (computational), RF/Microwaves, Work in Progress
Presented by: Ryota Morimoto

In the international guidelines and standards for human protection, the incident and absorbed power density averaged over the specific area are used as the physical quantity of reference level and basic restriction. Though the square shape is defined in the guidelines and standards, the product safety community discussed circular shape. Therefore, this study investigates the effect of averaging shape for incident and absorbed power density computationally. The results showed that the effect of different averaging shapes became large for the elliptical beam pattern formed by a 4 × 1 dipole array. Our computational results show that the heating factors for a circular shape are more conservative than those for a square shape.

FA-6 [15:47]
STUDENT PAPER

Radio-frequency absorption of a western honey bee in the near field of antennas

David Toribio[1], Wout Joseph[1], Gunter Vermeeren[1], David Plets[1] & Arno Thielens[1]

[1]*Department of Information Technology, Waves Research Group, Ghent University - IMEC, Ghent, Belgium, 9052*
Keywords: Dosimetry (computational), RF/Microwaves, Completed (unpublished)
Presented by: David Toribio

The wireless network evolution to smaller carrier wavelengths from (2G to 5G) could increase the RF-EMF absorption in insects. Near field RF-EMF exposure of insects to antennas' radiation has only been studied near a single antenna element. However, nearly all realistic base station antennas are multi-element arrays. In this research, we show using FDTD that at a separation distance of 10 cm from a dipole, the RF-EMF absorbed power (Pabs), in the range of 6-120 GHz in a western honey bee, maximizes at 12 GHz. Moreover, our results show that when irradiated by a phased array operating at 60 GHz, Pabs maximizes in the separation distance range of 0.1-2 cm, at which ¼ of the input power into the array can be absorbed by the honey bee.

FA-7 [15:51]
STUDENT PAPER

Assessment of road-user exposure from ITS-5.9 GHz vehicular connectivity technology

Martina Benini[1, 2], Marta Bonato[1], Silvia Gallucci[1, 2], Emma Chiaramello[1], Serena Fiocchi[1], Marta Parazzini[1] & Gabriella Tognola[1]

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Keywords: Dosimetry (computational), RF/Microwaves, Completed (unpublished)
Presented by: Martina Benini

This study aims to assess the Radio-Frequency Electromagnetic Field exposure in road users emitted by the technologies operated in the vehicle-to vehicle (V2V) communication. To this purpose, two monopole antennas operating at the Intelligent Transport System (ITS) 5.9 GHz band, used in V2V connectivity, were mounted on a CAD model of a city car; a human phantom was modelled in ten different positions nearby the car. The software Sim4Life was used to perform the simulations using the FDTD approach. The exposure assessment was performed computing the estimation of the Specific Absorption Rate (SAR) over 10 g. The results suggest a higher exposure level nearby the rear antenna. In any case exposure was well below the ICNIRP and IEEE limits.

FA-8 [15:54]
STUDENT PAPER

Realistic human exposure from a 28 GHz and 3.5 GHz base station using a hybrid Ray-Tracer/FDTD method

Robin Wydaeghe[1], Sergei Shikhantsov[1], Emmeric Tanghe[1], Gunter Vermeeren[1], Luc Martens[1], Piet Demeester[1] & Wout Joseph[1]

[1]*Department of Information Technology, Ghent University | imec, Ghent, Belgium, 9052*
Keywords: Dosimetry (computational), RF/Microwaves, Completed (unpublished)
Presented by: Robin Wydaeghe

A hybrid Ray-Tracing/Finite-Difference-Finite-Time (RT/FDTD) method is used to evaluate realistic human exposure to 28 GHz 5G base stations, and compared with 3.5 GHz 5G base stations. Computational costs are drastically increased at 28 GHz. An analysis is made possible by speed optimizations and decreasing the number of simulations. The worst-case scenario (in LOS at 6 m from the base station) is studied. The influence of UE-to-base-station distance, whether the UE is in line-of-sight (LOS) or not (NLOS), and the frequency band is investigated. In the worst-case scenario, the exposure levels did not exceed 9% of its maximum permissible values. The surface absorbed power density at 28 GHz is at most 2.3% of the basic restriction.

FA-9 [15:58]
STUDENT PAPER

Investigation of dielectric permittivity preservation after freezing and thawing the bovine brain, porcine brain and bovine liver

Andjela Matkovic[1], Anton Kordic[2] & Antonio Sarolic[1]

[1]*Chair of Applied Electromagnetics, University of Split, FESB, Split, Croatia, HR-21000*

[2]*Department of Neurosurgery, University Hospital Centre Zagreb, Zagreb, Croatia, HR-10000*
Keywords: Dosimetry (measurements), RF/Microwaves, Completed (unpublished)
Presented by: Andjela Matkovic

The aim of this study was to investigate if the dielectric permittivity can be entirely preserved by freezing the biological tissue sample, which could significantly facilitate our measurement campaigns on excised tissues. For this purpose, we measured the permittivity of ex-vivo biological tissues: bovine brain white and grey matter, porcine brain white and grey matter, and the bovine liver, at 25°C, before and after they were frozen below -18°C and thawed back to 25°C. The liver permittivity was well preserved by the used freezing and

thawing protocol. Unfortunately, the used protocol cannot be reliably used to prolong the life of the excised brain samples, as their permittivity changed after freezing and thawing.

FA-10 [16:01]
STUDENT PAPER

Measurement of the absorbed power density of 5G millimeter wave mobile devices

Fariba Karimi[1, 2], Sven Kühn[1], Arya Fallahi[1, 2], Andreas Christ[1] & Niels Kuster[1, 2]

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Keywords: Dosimetry (measurements), RF/Microwaves, Completed (unpublished)
Presented by: Fariba Karimi

The latest safety guidelines for the protection of humans from electromagnetic fields (EMF) define new basic restrictions for the millimeter-wave (mm-wave) frequency range in terms of absorbed power density (APD). Therefore, demonstrating the compliance of 5G communication systems requires the assessment of this new figure of merit. In this study, we propose a method for measuring APD in the 5G mm-wave bands that can be integrated into commercially available specific absorption rate (SAR) scanners.

FA-11 [16:05]
STUDENT PAPER

Estimating physiological responses to transcranial magnetic stimulation with dosimetric models

Noora Matilainen[1] & Ilkka Laakso[1]

[1]*Department of Electrical Engineering and Automation, Aalto University, Espoo, Finland, 02150*

Keywords: Dosimetry (measurements), Pulsed, Work in Progress
Presented by: Noora Matilainen

This study aims to validate anatomically realistic computational models with transcranial magnetic stimulation and investigate whether we can use the computed electric fields to predict the motor threshold values.

FA-12 [16:08]
STUDENT PAPER

Interference compatibility tests on critical medical devices against 5G mobile radio for indoor coverage

Anna-Malin Schiffarth[1] & Dirk Heberling[1, 2]

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[2]*Fraunhofer Institute for High Frequency Physics and Radar Techniques, Wachtberg, Germany*

Keywords: Dosimetry (measurements), RF/Microwaves, Work in Progress
Presented by: Anna-Malin Schiffarth

In the project "GIGA FOR HEALTH" 5G mobile radio for indoor coverage is planned in the 3.5 GHz band, which represents a new potential source of interference for medical devices in a hospital environment. So far there have been no studies or research on the compatibility of medical devices with 5G, and the regulatory framework does not contain any requirements in this regard. Therefore, provocation tests to a 5G signal were performed on 31critical medical devices under worst-case conditions. The tests showed no relevant impact of 5G on the medical devices.

FA-13 [16:12]
STUDENT PAPER

Detection of red blood cell movement in whole blood in ELF electric field exposure

Miki Kanemaki[1], Hisae O. Shimizu[2], Hiroshi Inujima[1], Takeo Miyake[1] & Koichi Shimizu[3]

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Keywords: Human, ELF/LF, Work in Progress

Presented by: Miki Kanemaki

For the study of biological effects of extremely low frequency (ELF) electric field, we investigated the movement of red blood cells (RBCs) in whole blood when they were exposed to electric field. Video images of RBCs were recorded under a microscope using specially designed electrode systems. Apparent change in RBCs movement was detected even in the high-viscosity of whole blood. The direction of the movement was opposite to that of the electric field as long as RBCs could follow the direction change of the field. The minimum electric field value for the detectable movement was more than three orders larger than that estimated from the basic restrictions for the public in the ICNIRP guideline.

FA-14 [16:15]
STUDENT PAPER

Investigation of suitable frequency bands for wireless transmission of ECoG to surface of head

Seiya Fumita[1] & Jianqing Wang[1]

[1]*Wang, Anzai and Yano Laboratory, Nagoya Institute of Technology, Nagoya, Japan, 466-8555*

Keywords: Human, RF/Microwaves, Work in Progress

Presented by: Seiya Fumita

In this paper, we propose a wireless transmission system from the surface of the brain tissue to the surface of head to measure Electro cortico graphy (ECoG) for the application of Brain machine interface. The transmission characteristics of the human head were analyzed using the finite difference time domain method, and the frequency bands to be used were investigated.
We conclude that the frequency band suitable for wireless transmission of Electro cortico graphy (ECoG) signal to the surface of head is around 1600 MHz. Future work will include the design of transceiver that can be used in this frequency band.

FA-15 [16:19]
STUDENT PAPER

Study of wireless power transmission for subcutaneous implantable application

Xiao Fang[1], Ruoyu Chen[1], Qiong Wang[1] & Dirk Plettemeie[1]

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Keywords: In vitro, Static, Completed (published)

Presented by: Xiao Fang

In this paper, the influence of the magnetic sheet on the power transmission efficiency (PTE) of the wireless power transmission (WPT) of the subcutaneous implantable device is investigated by numerical simulation and experimental measurement. The magnetic sheet can be utilized to improve the PTE between two coils, especially when the separation distance is less than 10 mm. Based on the practical application scenario, the 29.4 % of PTE of the on-body to in-body WPT system working at 2 MHz and with the separation distance of 10 mm is achieved and verified in the gel-phantom.

FA-16 [16:22]
STUDENT PAPER

Effect of 500 kHz electric current application on osteoblastic bone regeneration

Rika Saito[1], Masatake Akutagawa[1], Hiromichi Yumoto[2], Kouji Hirao[2], Takahiro Emoto[1], Hiroo Tarao[3], Toshihiko Tominaga[4], Toshitaka Ikehara[5], Emiko Yasuno[6] & Yohsuke Kinouchi[1]

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Keywords: In vitro, Pulsed, Completed (published)
Presented by: Rika Saito

The current standard treatments for apical periodontitis are chemicals and cleaning the root canals by specialized equipment. Recently, EM-RCT(electro-magnetic root therapy), an advanced treatment method using electromagnetic waves, has been proposed. it is known that EM-RCT promotes alveolar bone regeneration. However, the optimal electrical conditions for this have not yet been elucidated.Therefore, in this study, we investigate the effect of applying electric current to osteoblasts to promote bone formation. The results of the experiments showed that the enzymes and proteins involved in osteogenesis of osteoblasts increased under the electrical conditions in this study, which may promote bone formation.

FA-17 [16:25]
STUDENT PAPER

Development of a simultaneous heating system for both legs to treat knee osteoarthritis

Chen Liang[1] & Yasuhiro Shindo[2]

[1]*Course of Advanced Mechatronics Systems, Toyo University, Kawagoe, Japan, 3508585*

[2]*Department of Mechanical Engineering, Toyo University, Kawagoe, Japan, 3508585*
Keywords: Mechanistic/Theoretical, RF/Microwaves, Work in Progress
Presented by: Chen Liang

We proposed a new deep heating system using a resonant cavity applicator for thermal rehabilitation of osteoarthritis. In our previous study, order to provide deep heating, the number of dielectrics that could be placed in the applicator were limited to one knee. However, in order to save treatment time and cost, it was essential to develop an applicator that could heat both legs in one time. The human knees are placed between the inner electrodes and heated by electromagnetic energy. We also discussed the effectiveness of this applicator with estimated results of 3D human models using finite element method (FEM). It can be confirmed that the electromagnetic energy was concentrated on the both knee joint cavities effectively.

FA-18 [16:28]
STUDENT PAPER

Analysis of the effect of bone tissue on sound pressure distribution in HIFU treatment

Shinnosuke Nabetani[1] & Yasuhiro Shindo[2]

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Keywords: Mechanistic/Theoretical, Ultrasound, Work in Progress
Presented by: Shinnosuke Nabetani

The HIFU is one of the cancer treatment methods. In this method, ultrasound waves which generated from a transducer are focused on cancerous tissue, and the heat energy generated at the focal point of the ultrasound is used to cause necrosis of cancerous tissue. In this study, we analyzed the effect of bone tissue on sound pressure distribution using a 3D model of an anatomical skull. The analysis results showed that when the distance was closer, the ultrasonic waves could be focused inside the model and heat the target more accurately. As a result, it was found that the power of ultrasonic wave reflection changed depending on the distance between the transducer and the skull.

FA-19 [16:31]
STUDENT PAPER

An attempt to extract EEG signal component related to hand closing movement

Reo Shoji[1], Jianqing Wang[1], Daisuke Anzai[1] & Motoshi Tanaka[2]

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Keywords: Human, RF/Microwaves, Completed (published)
Presented by: Reo Shoji

In this study, we attempted to identify the EEG related to hand movement by converting each of the EMG and wavelet-transformed EEG into energy and calculating the correlation coefficient. As a result, we found a change in the EEG component of 10 ~ 35 Hz at F3, F4, C4, Cz, and Fz when imagining closing hand and performing the movement. In addition, the result also suggested that there may be a change in the EEG component of 10 ~ 35 Hz at -0.5s to 0s, which is the time the brain issues a command to move a muscle to the time the person starts the movement.

Session: PA
Poster Session A
Monday June 20, 2022 • 16:30 - 18:00
Exhibition Hall

PA-1 [16:30]
STUDENT PAPER

Effect of 1800 MHz radio-frequency electromagnetic fields and low-dose chemicals co-exposure on DNA damage in mouse embryonic fibroblast

Longtao Zhu[1], Kunhong Zhong[1], Chuan Sun[2] & Guangdi Chen[1]

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Keywords: Behavioural, RF/Microwaves, Work in Progress
Presented by: Longtao Zhu

RF-EMF is emitted by radio and television towers, base stations and mobile phones with frequency ranging from 100 kHz to 300 GHz. As relatively weak physical factors, environmental electromagnetic fields induced biological effects are often accompanied by co-exposures to other environmental factors. In this study, we investigated the combined effect of RF-EMF and low-dose cadmium, heavy chromium, 4NQO andH_2O_2 on DNA damage in mouse embryonic fibroblasts (MEFs). We observed synergistic effect of RF-EMF and low-dose cadmium or heavy chromium co-exposure on DNA damage, while no combined effect of RF-EMF and 4NQO or H_2O_2 in MEFs.

PA-2 [16:30]

WITHDRAWN

PA-3 [16:30]

Interictal spike-waves shapes are predictive of epileptogenicity of brain networks

Remo Lazazzera[1], Elif Köksal-Ersöz[1], Maxime Yochum[1], Isabelle Merlet[1], Julia Scholly[3], Giulio Ruffini[2], Fabrice Bartolomei[3], Pascal Benquet[1] & Fabrice Wendling[1]

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Keywords: Clinical (diagnostics), All Frequencies, Work in Progress
Presented by: Remo Lazazzera

Several shapes of interictal epileptic discharges (IEDs) can be recorded by stereoelectroencephalography (SEEG) in the same patient on different recording sites. This paper focuses on a specific class of IEDs, spike-waves (SWs), characterized by a short-duration spike followed by a longer duration wave, both of the same polarity. Two classes of SWs were identified according to subtle differences in morphology and timing of the spike and wave component. Results showed that type 1 SWs are generated in epileptogenic regions also involved at seizure onset, while type 2 SWs are produced in the propagation or non-involved areas.

PA-4 [16:30]

Real-time calculation of induced electrical field for arbitrary Transcranial Magnetic Stimulation coils

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[1]*Department of Electrical Engineering and Information Systems, The University of Tokyo, Tokyo, Japan, 1130032*

Keywords: Clinical (therapy), Pulsed, Completed (unpublished)
Presented by: Shuang Liu

Transcranial magnetic stimulation (TMS) is used extensively in clinical applications pertaining to psychiatric and neurological disorders. Closed loop TMS provides feedback through real-time electric field calculation to adjust stimulation parameters. However, current real-time electric field calculation algorithm has not yet been extended to arbitrary TMS coil shapes. we proposed a Gaussian quadrature based method to calculate magnetic flux on triangular mesh, which makes the induced electrical field can be calculated in real-time with reciprocity theorem. Our verification result shows the calculation time reduced from nearly 2hours to few seconds and with an error of less than 5%.

PA-5 [16:30]

Faster reduction of the lower limb edema with 50 Hz magnetic fields

Akifumi Harada[1], Hideyuki Okano[2], Hiromi Ishiwatari[3] & Keiichi Watanuki[1, 2]

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Keywords: Clinical (therapy), ELF/LF, Work in Progress
Presented by: Hideyuki Okano

This study focuses on the acute effects of 50 Hz magnetic fields (MF; B_{max} 180 mT for 10 min) on recovery of cutaneous blood flow volume in the lower limb after tourniquet pressure in healthy adults. The MF or sham exposure of the right calf together with the right sole was performed for 10 min immediately after tourniquet pressure release. The blood flow volume was significantly reduced from baseline immediately after compression hemostasis. MF exposure significantly recovered the change rate of blood flow volume compared with sham exposure. MF exposure maintained skin temperature and decreased edema volume relative to sham exposure. These results suggest that MF exposure improves the edema caused by circulatory disturbance.

PA-6 [16:30]

Eliminating the geometric error in tissue conductivity measurements by increasing the sample size

Niko Ištuk[1], Cristoforo DeCaro[1], Hamza Benchakroun[1], Eoghan Dunne[1], Adnan Elahi[1] & Martin O'Halloran[1]

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Keywords: Dosimetry (computational), Pulsed, Work in Progress
Presented by: Niko Istuk

In this study we simulated the tissue conductivity measurement with two-electrode probe in contact with the samples of different size. We found that after the sample reaches about twice the size of the probe, further increase in the size of the sample does not affect the resulting conductance. For smaller sizes of the sample we found that conductance decreases significantly. This decrease in conductance causes the underestimation of the conductivity of the sample. This error is caused by the limited geometry of the sample hence the geometric error. The geometric error can be avoided by ensuring the size of the sample is sufficiently larger than the probe, either by having large enough samples or by decreasing the size the probe.

PA-7 [16:30]

Assessment of human EMF exposure to a 5G wearable antenna

Silvia Gallucci[1, 2], Martina Benini[1, 2], Marta Bonato[2], Emma Chiaramello[2], Serena Fiocchi[2], Gabriella Tognola[2] & Marta Parazzini[2]

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Keywords: Dosimetry (computational), All Frequencies, Work in Progress
Presented by: Silvia Gallucci

This work aims to assess the exposure of a male human model to the electromagnetic field emitted by a patch wearable antenna tuned at f = 26 GHz, included in the 5G spectrum. The wearable devices have an important role in the future of the telecommunication structure because they are the basic elements of the Body-Area-Network. Because of the vicinity of the antenna from the user, an exposure assessment is

needed. The parameter of interest to assess the exposure is the power density averaged over 4 $cm^2$of surface with an input power of the antenna set as 1W. The obtained results show a peak value of the power density equal to 27.7 W/m^2but only the 0.2% of the data is higher than the 90% of the peak value.

PA-8 [16:30]
STUDENT PAPER

Specific absorption rate assessments of the interaction of high-frequency EM waves with the children eyes

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Keywords: Dosimetry (computational), RF/Microwaves, Work in Progress
Presented by: Fatima Alzaabi

This paper focuses on numerical dosimetry techniques which can be applied to enable accurate and efficient modelling of the human eye when exposed to electromagnetic waves operating across the frequency band up to mm-waves. The current study focuses on the analysis of human eye within a virtual child model whole-body and other parts of the body examined separately (head and shoulder) according to the numerical results for the induced electric field, the distribution of SAR were determined. Also, simplifying the models by applying dielectric averaging using separate parts of the child's body in assessing the SAR allows to focus on the calculations of the desired parts (skin and eye).

PA-9 [16:30]

Wave interference in curved body parts modifies absorbed power density and heating at 26 GHz and 60 GHz

Giulia Sacco[1], Zain Haider[1] & Maxim Zhadobov[1]

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Keywords: Dosimetry (computational), RF/Microwaves, Completed (published)
Presented by: Giulia Sacco

This study investigates the impact of the body curvature on the absorbed power density (APD) and heating at frequencies upcoming for 5G. A cylindrical tissue-equivalent model is used to calculate the APD and heat in the finger and the APD in the ear. An extended model is used to account for heat conduction in the tissue connecting the ear to the head. Our results show that APD_{max} remains lower than for a planar interface for transverse electric (TE) polarization (up to −38.2% at 26 GHz and −18.7% at 60 GHz). However, it is higher for transverse magnetic (TM) polarization (up to 72.3% at 26 GHz and 15% at 60 GHz). The induced heat exceeds the one for the planar model and reaches 93.11% (TM) at 26 GHz and 103.62% (TE) at 60 GHz.

PA-10 [16:30]
STUDENT PAPER

Coupling factor calculation method for wireless power transfer system in low frequency band

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Keywords: Dosimetry (computational), ELF/LF, Completed (published)
Presented by: Jangyong Ahn

The coupling factor (CF) was introduced to evaluate the effects of electromagnetic fields (EMFs) on the human body model (HBM) for local exposure. The CF is calculated based on the maximum peak for current density and internal electric field, which are internal quantities in the HBM. However, computational artifacts occur in the low-frequency band. Such abnormal peaks cause calculation errors or huge CF differences between HBMs so that the HBM effect of EMFs in a specific system can be dominantly influenced by the HBM to be evaluated rather than the system characteristics. Therefore, in this paper, we propose an improved CF calculation method for uniform evaluation between HBMs without underestimating using the 99.99th percentile.

PA-11 [16:30]
STUDENT PAPER

User and non-user RF-EMF exposure to the downlink Zero-Forcing transmission of distributed Massive MIMO in an industrial environment

Sergei Shikhantsov[1], Arno Thielens[1], Gunter Vermeeren[1], Luc Martens[1], Piet Demeester[1] & Wout Joseph[1]

[1]*Department of Information Technology, Ghent University/IMEC, Ghent, Belgium, 9000*

Keywords: Dosimetry (computational), RF/Microwaves, Completed (unpublished)
Presented by: Sergei Shikhantsov

This contribution presents the first numerical study of the human Radio-Frequency (RF) Electromagnetic field (EMF) exposure to a distributed massive MIMO array system (6G) deployed in an industrial indoor setting. A set of environment models is generated stochastically, in which the EMF propagation is calculated using the Ray-Tracing (RT) method at 3.5 GHz. The RF-EMF distribution in proximity of a realistic human phantom's head is calculated using the Finite-Difference Time-Domain (FDTD) method coupled with the RT output. Multi-user scenarios with the Zero-Forcing downlink precoding are investigated. It is shown that the 10g-average peak Specific Absorption Rate of users that is nearly 8 times higher than the one experienced by non-users.

PA-12 [16:30]
STUDENT PAPER

Effect of averaging shapes of incident and absorbed power density above 6 GHz

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Keywords: Dosimetry (computational), RF/Microwaves, Work in Progress
Presented by: Ryota Morimoto

In the international guidelines and standards for human protection, the incident and absorbed power density averaged over the specific area are used as the physical quantity of reference level and basic restriction. Though the square shape is defined in the guidelines and standards, the product safety community discussed circular shape. Therefore, this study investigates the effect of averaging shape for incident and absorbed power density computationally. The results showed that the effect of different averaging shapes became large for the elliptical beam pattern formed by a 4 × 1 dipole array. Our computational results show that the heating factors for a circular shape are more conservative than those for a square shape.

PA-13 [16:30]
STUDENT PAPER

Radio-frequency absorption of a western honey bee in the near field of antennas

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Keywords: Dosimetry (computational), RF/Microwaves, Completed (unpublished)
Presented by: David Toribio

The wireless network evolution to smaller carrier wavelengths from (2G to 5G) could increase the RF-EMF absorption in insects. Near field RF-EMF exposure of insects to antennas' radiation has only been studied near a single antenna element. However, nearly all realistic base station antennas are multi-element arrays. In this research, we show using FDTD that at a separation distance of 10 cm from a dipole, the RF-EMF absorbed power (Pabs), in the range of 6-120 GHz in a western honey bee, maximizes at 12 GHz. Moreover, our results show that when irradiated by a phased array operating at 60 GHz, Pabs maximizes in the separation distance range of 0.1-2 cm, at which ¼ of the input power into the array can be absorbed by the honey bee.

PA-14 [16:30]
STUDENT PAPER

Assessment of road-user exposure from ITS-5.9 GHz vehicular connectivity technology

Martina Benini[1, 2], Marta Bonato[1], Silvia Gallucci[1, 2], Emma Chiaramello[1], Serena Fiocchi[1], Marta Parazzini[1] & Gabriella Tognola[1]

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Keywords: Dosimetry (computational), RF/Microwaves, Completed (unpublished)
Presented by: Martina Benini

This study aims to assess the Radio-Frequency Electromagnetic Field exposure in road users emitted by the technologies operated in the vehicle-to vehicle (V2V) communication. To this purpose, two monopole antennas operating at the Intelligent Transport System (ITS) 5.9 GHz band, used in V2V connectivity, were mounted on a CAD model of a city car; a human phantom was modelled in ten different positions nearby the car. The software Sim4Life was used to perform the simulations using the FDTD approach. The exposure assessment was performed computing the estimation of the Specific Absorption Rate (SAR) over 10 g. The results suggest a higher exposure level nearby the rear antenna. In any case exposure was well below the ICNIRP and IEEE limits.

PA-15 [16:30]

SAR evaluation of electromagnetic exposure using 5G Sub-6 GHz and LTE band frequencies

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Keywords: Dosimetry (computational), RF/Microwaves, Work in Progress
Presented by: Keisuke Kimura

Conventional SAR evaluations of electromagnetic (EM) exposure have been conducted at a single frequency, and only few evaluations have been done performed multiple frequencies, including 5G frequency bands. In this study, we calculated SAR based on the assumption of EM exposure with two frequency components: Long Term Evolution (LTE) band (1.95 GHz) and 5G Sub-6 GHz band (3.7 GHz). In order to calculate SAR with multiple frequencies, SAR calculations were conducted for each frequency component, and added together. As a result, the peak value of SAR varied by changing the ratio of frequency components in the input power. In case of EM exposure with multiple frequencies, we will evaluate it by varying the ratio of power.

PA-16 [16:30]

Numerical study of military crew near field exposure to a HF vehicular antenna

Micol Colella[1], Marianna Biscarini[1], Marco de Meis[2], Roberto Patrizi[2], Tino Ciallella[2], Marta Cavagnaro[1], Francesca Apollonio[1] & Micaela Liberti[1]

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Keywords: Dosimetry (computational), RF/Microwaves, Completed (published)
Presented by: Micol Colella

In this work a realistic near-field exposure scenario of the military crew to a vehicular antenna was simulated. The aim was to deepen knowledge of both induced the electric (E-)field and SAR inside the human body (i.e. Duke, ViP, v.3) when standing partially outside the vehicle, where the intensity of the radiated electromagnetic field may exceed the guideline limits. Dosimetric results showed that SAR and E-field values induced inside the body from a vehicular antenna working in the frequency range [2-30]MHz remained well below the safety limits.

PA-17 [16:30]

Exposure to low-frequency electric fields: the effects of the ground plane and variations between anatomical models

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Keywords: Dosimetry (computational), ELF/LF, Completed (unpublished)
Presented by: Ilkka Laakso

Exposure to a low-frequency external electric field produces an internal electric field in the body. However, only limited dosimetry data are available for external electric field exposure in the extremely low and intermediate frequency ranges. In this study, the internal electric fields were modelled in seven anatomically realistic body models that were exposed to uniform external electric fields at 50 Hz and 100 kHz. The studied exposure scenarios included grounded conditions and multiple isolated conditions with varying depth of the ground plane. The internal and external electric field strengths were compared to the limits provided in the ICNIRP guidelines and the IEEE ICES standard.

PA-18 [16:30]

Advanced microdosimetric investigations through a realistic modelling of cells and intracellular organelles

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Keywords: Dosimetry (computational), Pulsed, Work in Progress
Presented by: Laura Caramazza

Biomedical applications based on electromagnetic (EM) fields have risen great attention to treat a variety of diseases, such as tumors, inflammatory states, nerve damages. To this regard, microdosimetric studies on realistic cell model are necessary to have an accurate evaluation of the local EM quantities induced. In this workauthors provide a semi-automatic procedure for an ad hoc 3D reconstruction of cell models including intracellular organelles from microscope images, together with a preliminary microdosimetric study on the μsPEFs application, delivered by a planar exposure system, on a stem cell. A 3D realistic cell model with subcellular structures is used to quantitatively estimate the induced EM quantities on cell and organelles.

PA-19 [16:30]
STUDENT PAPER

Realistic human exposure from a 28 GHz and 3.5 GHz base station using a hybrid Ray-Tracer/FDTD method

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Keywords: Dosimetry (computational), RF/Microwaves, Completed (unpublished)
Presented by: Robin Wydaeghe

A hybrid Ray-Tracing/Finite-Difference-Finite-Time (RT/FDTD) method is used to evaluate realistic human exposure to 28 GHz 5G base stations, and compared with 3.5 GHz 5G base stations. Computational costs are drastically increased at 28 GHz. An analysis is made possible by speed optimizations and decreasing the number of simulations. The worst-case scenario (in LOS at 6 m from the base station) is studied. The influence of UE-to-base-station distance, whether the UE is in line-of-sight (LOS) or not (NLOS), and the frequency band is investigated. In the worst-case scenario, the exposure levels did not exceed 9% of its maximum permissible values. The surface absorbed power density at 28 GHz is at most 2.3% of the basic restriction.

PA-20 [16:30]

Human exposure to electromagnetic fields from 5G fixed wireless access points at 60 GHz

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Keywords: Dosimetry (computational), RF/Microwaves, Completed (published)
Presented by: Gunter Vermeeren

We evaluated the human exposure to electromagnetic fields induced in a layered phantom and the realistic human body model Duke (Virtual Population body model) by a generic 8x8 phased array operating at 60 GHz at short distances (< 1m) of the human body. The array radiated with an EIRP of 38 dBm. We observed that the exposure was more than two times below the ICNIRP limits for occupational exposure. For general public exposure, a compliance distance of 10 cm and 9.4 cm was observed for the incident power density and absorbed power density averaged over 1cm2, respectively.

PA-21 [16:30]

EMF Exposure Measurements of 5G Base Stations operating at 28 GHz band in Japan

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Keywords: Dosimetry (measurements), RF/Microwaves, Work in Progress
Presented by: Sen Liu

In this paper, focusing on FR2 frequency band, electric-field strengths resulting from 5G base stations are measured, analyzed, and compared with different traffic load profiles. A 5G terminal is either in its stand-by mode or ping test mode to mimic a broadcasting situation or a traffic load situation. All the results are well below the exposure limits. Further investigations, such as with realistic data traffic, are required and will be conducted in near future.

PA-22 [16:30]

Electromagnetic field observatory, an answer to the societal debate

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Keywords: Dosimetry (measurements), RF/Microwaves, Work in Progress
Presented by: Philippe Pinel

Keywords: EMF monitoring, human exposure, sensors, IoT

The purpose of this article is to present the «Observatoire des Ondes (in French)» project (OdO - ElectroMagnetic Fields (EMF) observatory project) and its technical solution. The «OdO» project aims at transparency and the access right to information to the public. It is a support of the societal debate on exposure to electromagnetic fields (radio, TV, 2G/3G/4G/5G mobile telephony...). To achieve this, the technical solution consists in deploying on overall territory broadband E-field probes (250 kHz – 6 GHz) to monitor electromagnetic fields exposure levels.

PA-23 [16:30]

A verification of SAR measurement test reduction method of a compliance test for wireless communication devices

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Keywords: Dosimetry (measurements), RF/Microwaves, Work in Progress

Presented by: Yuto Shimizu

In recent years, wireless devices are widespread. Wireless devices used near the human body should demonstrate a compliance for a human exposure. However, due to the development of the wireless devices, it takes huge amount of time for the compliance test. In this study, the SAR (specific absorption rate) measurement test reduction method based on the antenna position inside the smart phone is verified in the range including above 2 GHz, which is not reported well in the measurement standard. From the results of ten types of smart phones measurement, the test reduction method can reduce the number of test condition in the range of 25 % to 50 % from the ordinally SAR measurement protocol.

PA-24 [16:30]

Review of studies of possible effects of radiofrequency radiation on environmental fauna and flora – a progress report

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Keywords: Dosimetry (measurements), RF/Microwaves, Work in Progress
Presented by: Ken Karipidis

In 2020 a joint project between the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) and Swinburne University of Technology was commenced to catalogue and review studies relating to possible effects of radiofrequency (RF) on fauna and flora in the environment. A database of studies has been constructed and this presentation will give an overview of the types of study, the RF exposure levels and characteristics of exposure, also the broad categories of the types of organisms studied.

PA-25 [16:30]

Simulating TMS axon activation characteristics with realistic axon morphologies

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Keywords: Dosimetry (measurements), Pulsed, Work in Progress
Presented by: Juhani Kataja

Activation characteristics of giant corticospinal axons under transcranial magnetic stimulation are studied. Axon morphology and stimulating electric fields are derived from measurements as well as stimulation intensity from measured active motor threshold. Based on these simulations we find that field intensities as low as 50 V/m may cause axons to activate.

PA-26 [16:30]

Exposure assessments in the near-field accounting for antenna/body interactions at millimeter waves: absorbed power density reconstruction from E-field vector

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Keywords: Dosimetry (measurements), RF/Microwaves, Work in Progress
Presented by: Massinissa Ziane

In this study we explored a novel technique for absorbed power density (APD) assessment in the near-field accounting for antenna/body coupling above 6 GHz. This method is based on an*ad hoc*semi-transparent skin-equivalent structure optimized to reproduce the reflection coefficient from human skin at one interface and providing the possibility to sense the field at the opposite interface. APD is retrieved from the tangential component of the E-field vector at the phantom interface opposite to the wireless device under test (DUT). Results showed a very good agreement between the reconstructed and simulated APD (maximum relative differences for the APD peak, averaged over 1 cm^2, and 4 cm^2 are 3.62%, -6.28%, and -5.65%, respectively).

PA-27 [16:30]
STUDENT PAPER

Investigation of dielectric permittivity preservation after freezing and thawing the bovine brain, porcine brain and bovine liver

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Keywords: Dosimetry (measurements), RF/Microwaves, Completed (unpublished)
Presented by: Andjela Matkovic

The aim of this study was to investigate if the dielectric permittivity can be entirely preserved by freezing the biological tissue sample, which could significantly facilitate our measurement campaigns on excised tissues. For this purpose, we measured the permittivity of ex-vivo biological tissues: bovine brain white and grey matter, porcine brain white and grey matter, and the bovine liver, at 25°C, before and after they were frozen below -18°C and thawed back to 25°C. The liver permittivity was well preserved by the used freezing and thawing protocol. Unfortunately, the used protocol cannot be reliably used to prolong the life of the excised brain samples, as their permittivity changed after freezing and thawing.

PA-28 [16:30]

A comparison of 1-, 6- and 30-minute averaging time length for RF-EMF spot measurements: A Pilot Study

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Keywords: Dosimetry (measurements), RF/Microwaves, Work in Progress
Presented by: Chhavi Bhatt

Different averaging time lengths (ATLs) have been used in conducting radiofrequency-electromagnetic field (RF-EMF) spot measurements. However, there is limited data regarding the measurement accuracy associated with these ATLs, in particular 1-minute ATL. We compared measurement accuracies of RF-EMF measurements for 1- vs 30-minute compared to 6- vs 30-minute ATLs. RF-EMF spot measurement data (AM Radio to Wi-Fi) were collected in consecutive one-minute blocks over 30-minutes. The measurement accuracies were compared for 1-minute and 6-minute values versus the corresponding 30-minute value. Our results indicate that spot measurement data using 1-minute ATL may be sufficient to accurately characterise environmental level RF-EMF exposures.

PA-29 [16:30]

WITHDRAWN

PA-30 [16:30]
STUDENT PAPER

Measurement of the absorbed power density of 5G millimeter wave mobile devices

Fariba Karimi[1, 2], Sven Kühn[1], Arya Fallahi[1, 2], Andreas Christ[1] & Niels Kuster[1, 2]

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Keywords: Dosimetry (measurements), RF/Microwaves, Completed (unpublished)
Presented by: Fariba Karimi

The latest safety guidelines for the protection of humans from electromagnetic fields (EMF) define new basic restrictions for the millimeter-wave (mm-wave) frequency range in terms of absorbed power density (APD). Therefore, demonstrating the compliance of 5G communication systems requires the assessment of this new figure of merit. In this study, we propose a method for measuring APD in the 5G mm-wave bands that can be integrated into commercially available specific absorption rate (SAR) scanners.

PA-31 [16:30]
STUDENT PAPER

Estimating physiological responses to transcranial magnetic stimulation with dosimetric models

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Keywords: Dosimetry (measurements), Pulsed, Work in Progress
Presented by: Noora Matilainen

This study aims to validate anatomically realistic computational models with transcranial magnetic stimulation and investigate whether we can use the computed electric fields to predict the motor threshold values.

PA-32 [16:30]

Parameterization of dielectric properties of adipose tissue with respect to its water content at frequencies from 1 to 100 GHz

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Keywords: Dosimetry (measurements), RF/Microwaves, Completed (unpublished)
Presented by: Kensuke Sasaki

Adipose tissue is one of the tissues distributed throughout the body and its dielectric properties have been investigated in research fields concerning the radiation safety of human exposure to electromagnetic fields and the medical applications. Previous studies revealed very large variations in dielectric properties with respect to the adipose content (or the water content). From these backgrounds, the objective of this study is the parameterization of the dielectric properties of adipose tissue with respect to the water content. To accomplish this, dielectric measurements were conducted using excised porcine tissue at body temperature, and then the dielectric properties were parameterized by the formula based on Cole-Cole model.

PA-33 [16:30]

Monitoring leakage electromagnetic field around 77 GHz megawatt-class gyrotron oscillators at a large fusion test facility

Masahiro Tanaka[1], yasuo yoshimura[1], Satoshi Ito[1], Kensuke Sasaki[2], Jianqing Wang[3], Hiroshi Hirayama[3], Tatsuhiko Uda[1] & Osamu Fujiwara[3]

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Keywords: Dosimetry (measurements), RF/Microwaves, Completed (unpublished)
Presented by: Masahiro Tanaka

The leakage electromagnetic field around 77 GHz megawatt-class gyrotron oscillators used in a nuclear fusion facility was observed. As a result, a leakage electromagnetic field was detected around the oscillators. At the location where the oscillator was installed, there were various devices and equipment, so the leakage electromagnetic field was reflected by the devices, floor and so on. Therefore, the electromagnetic field was almost uniform in the horizontal direction at the observation site. The intensity of the observed electromagnetic fields is significantly below the 2020 ICNIRP guidelines under the controlled environment.

PA-34 [16:30]

Evaluation of exposure to electromagnetic fields from smart utility meters: 868 MHz laboratory measurements

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Keywords: Dosimetry (measurements), RF/Microwaves, Work in Progress
Presented by: Carolina Calderon

UKHSA has started a programme of research, commissioned by Smart Energy GB, to assess the radiofrequency (RF) exposures from 868 MHz home area network (HAN), Zigbee transmissions emitted by typical smart meter devices. In the UK, these systems transmit primarily at 2.4 GHz, but some dual band systems are now being deployed which transmit in both 2.4 GHz and 868 MHz. Electric field strength measurements have been made in an anechoic chamber, under laboratory controlled conditions. The resulting power densities will be compared with ICNIRP 1998 guidelines as well as with previous HAN measurements made at 2.4 GHz. The study will include an assessment of total exposure, taking into account the exposure contributions at both frequencies.

PA-35 [16:30]

Development of a low cost sensor network for measurement of 5G signals in the Netherlands

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Keywords: Dosimetry (measurements), RF/Microwaves, Completed (unpublished)
Presented by: John Bolte

We aim to set up a continuous low cost monitoring system for electromagnetic fields in the Netherlands, so that a trend in exposure to 5G signals can be observed. A number of options will be explored for this, such as software-defined radio and measurement nodes for specific 5G frequencies. We developed and tested low cost dedicated measurement nodes for four 5G bands: the 800, 1400, 2100 and 3500 MHz bands. Generally, the error is less than 1 dB and close to dynamic range limits (-65 to 5 dBm) the error increases to 3 dB.

PA-36 [16:30]
STUDENT PAPER

Interference compatibility tests on critical medical devices against 5G mobile radio for indoor coverage

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Keywords: Dosimetry (measurements), RF/Microwaves, Work in Progress
Presented by: Anna-Malin Schiffarth

In the project "GIGA FOR HEALTH" 5G mobile radio for indoor coverage is planned in the 3.5 GHz band, which represents a new potential source of interference for medical devices in a hospital environment. So far there have been no studies or research on the compatibility of medical devices with 5G, and the regulatory framework does not contain any requirements in this regard. Therefore, provocation tests to a 5G signal were performed on 31critical medical devices under worst-case conditions. The tests showed no relevant impact of 5G on the medical devices.

PA-37 [16:30]

Validation of XMobiSensePlus, a smartphone app for the assessment of human exposure to RF-EMFs

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Keywords: Epidemiology, RF/Microwaves, Work in Progress
Presented by: Emmanuelle Conil

The recently updated Android operating system application (app) XMobiSensePlus aims at easing assessment of exposure to RF-EMFs from mobile telephony in epidemiological studies. We tested the app

prior to fieldwork for general functioning, accuracy of RF-EMFs received power levels, and other parameters. In preliminary data on 2 smartphones, only one corrupt data log was detected (1.3%), and when the app was effectively working, recording of voice calls was accurate. The power levels registered by the app on the LTE network were accurate. The updated XMobiSensePlus records a wealth of information on the smartphone telecom traffic on 2G, 3G and 4G networks and can therefore be useful in some epidemiological settings.

PA-38 [16:30]

Human perception of AC-DC hybrid electric fields and the importance of the AC component

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Keywords: Human, Static, Completed (published)
Presented by: Kathrin Jankowiak

Global energy demand has increased continuously. Meeting this demand, efficient high voltage direct current (HVDC) overhead power lines will be mounted on existing alternating current (AC) structures leading to electric fields (EFs) from both AC and DC transmission lines in hybrid configurations. Because these configurations are found in residential areas, the investigation of human hybrid EF perception is essential. Using a method based on the signal detection theory, we exposed 51 participants with an above-average EF detection ability. Participants perceived very low EF strengths. Detection thresholds were significantly lower with increased AC EF strengths, emphasizing the key role of the AC component in the human hybrid EF perception.

PA-39 [16:30]
STUDENT PAPER

Detection of red blood cell movement in whole blood in ELF electric field exposure

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Keywords: Human, ELF/LF, Work in Progress
Presented by: Miki Kanemaki

For the study of biological effects of extremely low frequency (ELF) electric field, we investigated the movement of red blood cells (RBCs) in whole blood when they were exposed to electric field. Video images of RBCs were recorded under a microscope using specially designed electrode systems. Apparent change in RBCs movement was detected even in the high-viscosity of whole blood. The direction of the movement was opposite to that of the electric field as long as RBCs could follow the direction change of the field. The minimum electric field value for the detectable movement was more than three orders larger than that estimated from the basic restrictions for the public in the ICNIRP guideline.

PA-40 [16:30]

Human detection thresholds of various electric fields

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Keywords: Human, Static, Completed (published)
Presented by: Michael Kursawe

In terms of the ongoing transition of electric energy systems, transmission corridors are often upgraded to higher voltages and other technologies leading to another quality of human exposure. The current study[1] aimed to determine human detection thresholds of direct current (DC), alternating current (AC), and hybrid electric fields. In total, 203 participants were exposed to electric fields (EFs) in a whole-body exposure laboratory. Detection thresholds of hybrid EF were lower than those of single DC or AC EF presentation. This systematic investigation can help improve the construction processes of energy transmission systems and support the prevention of unwanted sensory perception by contributing to the determination of limit values.

PA-41 [16:30]

Analysis of civil complaints trend and measured values related to electromagnetic waves at mobile communication base stations in Korea

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Keywords: Human, RF/Microwaves, Completed (published)
Presented by: JongSil Park

KoreaRadioPromotionAssociation(RAPA)has been responding to civil complaints about electromagnetic waves since 2016. And now RAPA is responding to almost all electromagnetic waves complaints in Korea. In this paper, the measured values and types were classified based on the first half of 2021, which is the analysed latest data. First, the types were classified based on the spot of civil complaint and the installation location of the mobile communication base station. Second, measured values were classfied maximum and median. In conclusion, the spot where the most complaints occurred was the apartment and it's accounted for 63% of the total.In the case of the measured value, 15.72 [V/m] was the maximum value.

PA-42 [16:30]
STUDENT PAPER

An attempt to extract EEG signal component related to hand closing movement

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Keywords: Human, RF/Microwaves, Completed (published)
Presented by: Reo Shoji

In this study, we attempted to identify the EEG related to hand movement by converting each of the EMG and wavelet-transformed EEG into energy and calculating the correlation coefficient. As a result, we found a change in the EEG component of 10 ~ 35 Hz at F3, F4, C4, Cz, and Fz when imagining closing hand and performing the movement. In addition, the result also suggested that there may be a change in the EEG component of 10 ~ 35 Hz at -0.5s to 0s, which is the time the brain issues a command to move a muscle to the time the person starts the movement.

PA-43 [16:30]
STUDENT PAPER

Investigation of suitable frequency bands for wireless transmission of ECoG to surface of head

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Keywords: Human, RF/Microwaves, Work in Progress
Presented by: Seiya Fumita

In this paper, we propose a wireless transmission system from the surface of the brain tissue to the surface of head to measure Electro cortico graphy (ECoG) for the application of Brain machine interface. The transmission characteristics of the human head were analyzed using the finite difference time domain

method, and the frequency bands to be used were investigated.
We conclude that the frequency band suitable for wireless transmission of Electro cortico graphy (ECoG) signal to the surface of head is around 1600 MHz. Future work will include the design of transceiver that can be used in this frequency band.

PA-44 [16:30]

Human body impedance measurement for current perception experiment in VHF band

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Keywords: Human, IF, Work in Progress
Presented by: Yoshitsugu Kamimura

The authors have conducted current perception threshold experiments from 100 kHz to 10 MHz for Japanese, and are planning experiments in the VHF band above 30 MHz. In the current exposure device used in future experiments, the current path needs to be as short as possible, so the current flows between the fingertip and the base of the finger. This study measures the human impedance between the fingertip and the base of the finger and its statistical variability, which is required to develop a VHF band current exposure device.

PA-45 [16:30]

Effects of wide area exposure to 28 GHz-plane waves on back skin in human volunteer

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Keywords: Human, RF/Microwaves, Work in Progress
Presented by: Miyako Inoue

There is little information about the biological effects of millimeter-waves (MMW) such as 5th generation wireless systems (5G) and WiGig (IEEE 802.11ad) on human body. Aim of this study was to evaluate whether exposure to a 28 GHz-plane wave changes temperature and blood flow on the human back skin. We designed the systems to widely expose the human back to 28 GHz-plane wave and observed the two parameters under the exposure at an incident power density of 1,047 W/㎡. The increases in temperature and blood flow were simultaneously found in the exposed back skin, suggesting that the exposure to 28 GHz-plane wave could rise the blood flow via the local heat generation in the human back skin.

PA-46 [16:30]

A tri-band low SAR wearable textile antenna for GSM, Sub-6 GHz 5G, and ISM band applications

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Keywords: Human, RF/Microwaves, Completed (published)
Presented by: Md. Abu Sufian

In this article, a tri-band wearable textile antenna with a very low specific absorption rate (SAR) is presented. The proposed antenna operates at the 1.9 GHz GSM, 3.5 GHz fifth-generation (5G) sub-6 GHz, and 5.8 GHz ISM radio bands, respectively, with -10 dB impedance bandwidth of 7.34%, 3.4%, and 5.03%, and radiation efficiency of 64.2%, 76.2 %, and 75.9%. The proposed antenna offers a maximal simulated free-space gain of 5.04, 6.35, and 6.9 dBi at 1.9 GHz, 3.5 GHz, and 5.8 GHz, respectively, with a very low SAR value of 0.7,

1.04, and 0.532 W/kg, averaged over 1 g of tissue, with 250 mW input power. All properties of the proposed textile antenna are excellently suited for wearable on-body systems.

PA-47 [16:30]

Design of a wearable antenna on jeans substrate for 2.45 applications with wideband harmonic rejection

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Keywords: Human, RF/Microwaves, Work in Progress
Presented by: Anees Abbas

A wearable textile antenna is designed to operate at ISM band of 2.45GHz for wireless systems is presented. The antenna consists of a fractal patch, and a rectangular stub added on the feedline. The rectangular stub is used to minimize the harmonic over higher frequency bands 3.3–11.0 GHz. The wearable textile antenna is compact with omnidirectional radiation patterns and the total size is 28 mm×33 mm. Due to its small size, the proposed antenna may have practical applications in the smart wearable textile fields. The simulated results show that the antenna offers an operating band 2.364 – 2.588 GHz, which covers the ISM band (2.4–2.5 GHz). The specific absorption rate (SAR) values are analyzed and found to be 1.81 W/kg at 2.45 GHz.

PA-48 [16:30]

Pulse modulated intermediate frequency magnetic fields (80 mTrms at 82.4 kHz) did not have genotoxicity, co-genotoxicity or genome-wide gene expression

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Keywords: In vitro, IF, Completed (unpublished)
Presented by: Satoshi Nakasono

We have investigated the effects of pulse modulated intermediate frequency (IF) magnetic field (MF) of 80 mTrms at 82.4 kHz on genotoxicity (only MF) or co-genotoxicity (both MF and known genotoxic agents) by using both bacterial mutation tests and micronucleus formation assays. We have also investigated the genome-wide analysis of gene expression, including cancer related genes by using human primary astrocyte. The results suggest that the high intensity pulse modulated IF-MF does not have the effect on mutagenicity, micronucleus formation, enhancement of the function of genotoxic agents, or genome-wide gene expression, which were related potential carcinogenicity.

PA-49 [16:30]

The effect of 28 GHz 5G electromagnetic waves exposure on the skin cells

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Keywords: In vitro, Static, Work in Progress
Presented by: Hee Jin

With the introduction of 5G wireless communication due to the development of wireless communication technology, there is also a controversy over whether electromagnetic waves are harmful to the human body. The whole scientific evidence on the possible effects of 5G electromagnetic waves on the skin and skin cells has not been clarified. This study investigated the cellular effects of 28 GHz 5G electromagnetic waves on skin cells, the human keratinocyte cell line HaCaT and the murine melanoma cell line B16. These

observations suggest that 28 GHz 5G electromagnetic waves alone may not affect cellular viability, cell cycle, and DNA damage in skin cells, even though performing more detailed experiments will be needed in the future.

PA-50 [16:30]

An *in vitro* protocol for evaluation of biological effect by exposure to 28 GHz Radio wave

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Keywords: In vitro, RF/Microwaves, Work in Progress
Presented by: Masateru Ikehata

An in vitro experimental protocol targeted epidermal or cornea tissue model for 28 GHz radio wave exposure was proposed. Developed exposure system is able to operate double blinded manner by controlling in-house software.

PA-51 [16:30]

Biological effects of acute exposure to high power electromagnetic waves on human monocytes

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Keywords: In vitro, Pulsed, Work in Progress
Presented by: Samir Dekali

The aim of the study was to investigate potential biological effects of high power electromagnetic waves mimicking electromagnetic Directed Energy Weapons (EM-DEW) exposure. Non adherent monocytes (THP-1 cell line) were exposed at different times (pulsed discontinuous exposures of 13 shots of 30 s spaced 4 min apart, or 1 hour of pulsed continuous exposures), at frequency 1.6 GHz and deposited fields of 4.6 kV/m or 7.3 kV/m. Results show that no cell death or lysis were induced after exposures. However, acute pro-inflammatory secretion (angiopoietin-1, IL-16 and uPAR) was measured in cell supernatants immediately after 1h exposure at the highest field level.

PA-52 [16:30]
STUDENT PAPER

Study of wireless power transmission for subcutaneous implantable application

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Keywords: In vitro, Static, Completed (published)
Presented by: Xiao Fang

In this paper, the influence of the magnetic sheet on the power transmission efficiency (PTE) of the wireless power transmission (WPT) of the subcutaneous implantable device is investigated by numerical simulation and experimental measurement. The magnetic sheet can be utilized to improve the PTE between two coils, especially when the separation distance is less than 10 mm. Based on the practical application scenario, the 29.4 % of PTE of the on-body to in-body WPT system working at 2 MHz and with the separation distance of 10 mm is achieved and verified in the gel-phantom.

PA-53 [16:30]

In vitro experimental systems for 5G FR1 and FR2 exposures

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Keywords: In vitro, RF/Microwaves, Work in Progress
Presented by: Young Seung Lee

In vitro experimental systems for fifth-generation (5G) frequency range (FR) 1 and FR 2 exposures are presented. The structures of two 5G in vitro set-ups of a radial transmission line and a radiative chamber are based on their operating wavelength with respect to a cell-culture dish. The outer incubator enables the optimal environmental control for cell cultures necessary for long-time 5G experiments. The features of 5G exposure systems, such as real-time feedback and monitoring, are also discussed.

PA-54 [16:30]

Increase and decrease of human adult stem cell proliferation by the exposure to 1.7 GHz LTE electromagnetic field at 0.4 and 4 SAR

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Keywords: In vitro, RF/Microwaves, Completed (unpublished)
Presented by: Kiwon Song

Human ASCs and HCC Huh7 cells containing liver CSC population were exposed to 1.7 GHz LTE RF-EMF for 24 h at 0.4 and 4 SAR. The proliferation of these adult stem cells was activated by 0.4 SAR and decreased by 4 SAR exposure. The 0.4 SAR exposure increased the proliferation of ASCs and Huh7 cells by around 30% compared with the unexposed controls. The MEK-ERK signaling pathway was activated in the 0.4 SAR-exposed cells with increased proliferation. Conversely, cell proliferation was decreased by 7% in ASCs and 20% in Huh7 cells in the 4 SAR exposure, and we observed cellular senescence. Altogether, the exposure of adult stem cells to 1.7 GHz LTE RF-EMF promoted the opposite physiological effects on proliferation depending on the SAR values.

PA-55 [16:30]

Neuroblastoma cell proliferation is inhibited by RF-EMF exposure due to Akt/mTOR-mediated cellular senescence

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Keywords: In vitro, RF/Microwaves, Completed (published)
Presented by: Hak Rim Kim

The potential impacts of LTE RF-EMF on cell proliferation were investigated. SH-SY5Y neuronal cells were exposed to 1760 MHz RF-EMF at 4 W/kg for 4d. Cell cycle was delayed in the G0/G1 phase. DNA damage or apoptosis were not involved but a significant increase in Akt and mTOR phosphorylation. Furthermore, the total amount of p53 and phosphorylated-p53 increased considerably. The transcriptional activation of p53 increased production of the p21 and p27. Inhibition of CDK2 and CDK4 led to a decrease in phosphorylated

pRb at Ser807/811. These findings imply that RF-EMF may cause Akt/mTOR-mediated cellular senescence in SH-SY5Y neuroblastoma cells, which could postpone the cell cycle without causing DNA damage.

PA-56 [16:30]
STUDENT PAPER

Effect of 500 kHz electric current application on osteoblastic bone regeneration

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Keywords: In vitro, Pulsed, Completed (published)
Presented by: Rika Saito

The current standard treatments for apical periodontitis are chemicals and cleaning the root canals by specialized equipment. Recently, EM-RCT(electro-magnetic root therapy), an advanced treatment method using electromagnetic waves, has been proposed. it is known that EM-RCT promotes alveolar bone regeneration. However, the optimal electrical conditions for this have not yet been elucidated.Therefore, in this study, we investigate the effect of applying electric current to osteoblasts to promote bone formation. The results of the experiments showed that the enzymes and proteins involved in osteogenesis of osteoblasts increased under the electrical conditions in this study, which may promote bone formation.

PA-57 [16:30]

A scoping review of *in vitro* studies on radiofrequency electromagnetic fields effects on apoptosis

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Keywords: In vitro, RF/Microwaves, Completed (published)
Presented by: Olga Zeni

We performed a scoping review of in vitro studies investigating the effects of radiofrequency (RF) electromagnetic fields (EMF) on apoptosis. We defined inclusion criteria based on quality requirements (sham, three independent experiments, dosimetry analysis and temperature monitoring), and set up queries for systematic literature search in PubMed and Web of Science. We included 42 studies, extracted and pooled data regarding exposure (frequency, exposure level and duration) and biological parameters (cell type, endpoint), and highlighted some qualitative trends with respect to the detection of significant effect of RF-EMF on apoptosis. Our analysis highlighted that the quality of experimental methodology still needs to be highly improved.

PA-58 [16:30]

Evaluation of the effects of power-frequency magnetic fields on the differentiation of hematopoietic stem/progenitor cells into human B-cell lineages

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Keywords: In vitro, ELF/LF, Completed (unpublished)
Presented by: Masayuki Takahashi

In this study, we imitated the differentiation of human hematopoietic stem/progenitor cells into B-cell lineages in vitro and evaluated the effects of power-frequency magnetic fields (MFs) on this differentiation process. There was no significant change in the rate of emergence of human B-cell lineages with MF exposure, and no effects were detected with exposure to 50-Hz MFs at 300 mT.

PA-59 [16:30]

Smart magnetotactic bacteria enable the tumor inhibition under applied magnetic fields

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Keywords: In vivo, IF, Completed (unpublished)

Presented by: Xue Wang

Magnetotactic bacteria synthesize chains of magnetosomes with a stable magnetic moment at physiological temperature. As a result, they can interact with different kinds of applied magnetic fields, producing the stimulation of heat and mechanical force. We showed that intact magnetotactic bacteria AMB-1 has potential as a natural magnetic material under an alternating or swing magnetic fields to induce heat or mechanical force for tumor treatment.

PA-60 [16:30]

A regional electromagnetic environment characterization method based on BP neural network interpolation

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Keywords: Mechanistic/Theoretical, RF/Microwaves, Completed (unpublished)

Presented by: Xiaoya Zhou

Summary - In this paper, the BP Neural Network interpolation algorithm is applied to the electromagnetic environment, especially when the study area is large.This paper innovatively considers the influence of temperature and humidity in addition to latitude and longitude, when the precise interpolation is needed, the BP Neural Network interpolation algorithm in electromagnetic numerical calculation has better interpolation effect than the existing spatial interpolation algorithm.

PA-61 [16:30]
STUDENT PAPER

Development of a simultaneous heating system for both legs to treat knee osteoarthritis

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Keywords: Mechanistic/Theoretical, RF/Microwaves, Work in Progress

Presented by: Chen Liang

We proposed a new deep heating system using a resonant cavity applicator for thermal rehabilitation of osteoarthritis. In our previous study, order to provide deep heating, the number of dielectrics that could be placed in the applicator were limited to one knee. However, in order to save treatment time and cost, it was essential to develop an applicator that could heat both legs in one time. The human knees are placed between the inner electrodes and heated by electromagnetic energy. We also discussed the effectiveness of

this applicator with estimated results of 3D human models using finite element method (FEM). It can be confirmed that the electromagnetic energy was concentrated on the both knee joint cavities effectively.

PA-62 [16:30]
STUDENT PAPER

Analysis of the effect of bone tissue on sound pressure distribution in HIFU treatment

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Keywords: Mechanistic/Theoretical, Ultrasound, Work in Progress
Presented by: Shinnosuke Nabetani

The HIFU is one of the cancer treatment methods. In this method, ultrasound waves which generated from a transducer are focused on cancerous tissue, and the heat energy generated at the focal point of the ultrasound is used to cause necrosis of cancerous tissue. In this study, we analyzed the effect of bone tissue on sound pressure distribution using a 3D model of an anatomical skull. The analysis results showed that when the distance was closer, the ultrasonic waves could be focused inside the model and heat the target more accurately. As a result, it was found that the power of ultrasonic wave reflection changed depending on the distance between the transducer and the skull.

PA-63 [16:30]

Occupational non-ionizing radiation exposure during image acquisition – evaluation of exposure frequency and exposure location inside the MRI scanner room

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Keywords: Occupational, All Frequencies, Work in Progress
Presented by: Sachiko Yamaguchi-Sekino

The present study focuses on the occupational non-ionizing radiation (NIR) exposure during magnetic resonance image (MRI) acquisition. The results of questionnaire survey (N=3009) indicated that 13.0 % (male: 14.5 % and female 9.6 %) of respondents had opportunities to enter to the scanner room during image acquisition more than once in a week and 48.5 % of them were exposed to NIR at the vicinity of MRI scanner (<50 cm from the bore). These results revealed the actual NIR exposure conditions during image acquisition. Although the stray fields (pulse magnetic field and radio frequency) near the bore are considered to be small, it would be necessary to implement the quantitative analysis of exposure in the future.

PA-64 [16:30]

WITHDRAWN

PA-65 [16:30]

5G base station electromagnetic radiation power density test and estimation method

Jian Gong[1]

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Keywords: Standards, RF/Microwaves, Completed (unpublished)
Presented by: Jian Gong

Due to the special characteristics of 5G signals, which are very different from the previous 2G, 3G and 4G base station signals, the test methods for electromagnetic radiation to Human body measurement are very different. And it is impossible to distinguish the emission of different base stations by using traditional test instruments and test methods. Based on this, we propose the electromagnetic radiation power density test and estimation method for 5G base stations.

Session: FB
Student Flash Poster Session B
Thursday June 23, 2022 • 15:30 - 16:30
Large Hall
Chairs: Niels Kuster & Martin Röösli

FB-1 [15:30]

WITHDRAWN

FB-2 [15:33]
STUDENT PAPER

Effect of permittivity on temporal interference modeling

Gabriel Gaugain[1], Julien Modolo[2], Maxim Zhadobov[3], Ronan Sauleau[3] & Denys Nikolayev[1]

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Keywords: Dosimetry (computational), ELF/LF, Completed (unpublished)
Presented by: Gabriel Gaugain

Temporal interference (TI) is a recent development in brain stimulation aiming to target deep brain regions using transcranial alternating current stimulation (tACS). This technique is under investigation to estimate its ability to provide non-invasive deep brain stimulation. Modeling studies have been conducted to quantify the potential of this method. However, modeling is commonly performed using the quasi-static approximation, together with purely ohmic tissues. Here, we studied the impact of neglecting the capacitive effect of tissues on the electric field (EF) estimation in deep brain regions. The results show a relative error below 10% at the brain level, demonstrating a good approximation using purely ohmic tissues for this purpose.

FB-3 [15:37]
STUDENT PAPER

Development of noninvasive temperature measurement system using generative adversarial networks for the radio frequency capacitive applicator

Keito Yanagisawa[1] & Yuya Iseki[1]

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Keywords: Dosimetry (computational), Ultrasound, Work in Progress
Presented by: Keito Yanagisawa

In this study, we developed a noninvasive temperature distribution measurement system using Generative Adversarial Networks (GAN) for hyperthermia treatment. First, we conducted heating experiments using agar phantom and hot plate to acquire temperature distributions and ultrasound images. Second, we created a dataset by combining the ultrasound images and temperature distributions. Third, we trained and validated the GAN using the dataset. Moreover, comparing the ground truth temperature distribution and estimated result, it was confirmed that the minimum mean absolute error (MAE) is 0.73°C. Our results showed that the proposed method can effectively provide noninvasive temperature measurements.

FB-4 [15:40]
STUDENT PAPER

Numerical study on the effective thermal conductivity measurements of human skin using a guard-heated probe using thin-film thermistors

Koujiro Kurosawa[1], Yuya Iseki[1], Takuma Kogawa[1], Takashi Nonaka[1], Yasushi Hsokawa[1], Fuhui Guo[1], Takahiro Okabe[2], Yutaro Tabata[3], Tadashi Matsudate[3], Shuji Inamura[3], Masaya Higashi[3], Manabu Orito[3] & Shigenao Maruyama[1]

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Keywords: Dosimetry (computational), Pulsed, Work in Progress
Presented by: Koujiro Kurosawa

This study describes the numerical analysis of the effective thermal conductivity measurement for skin with a guard-heated probe using thin-film thermistors. In previous studies, the effective thermal conductivity of tumors is slightly different from that of healthy skin. In this study, we investigated whether the guard-heated thermistor probe developed by our research group could detect slight difference in thermal conductivity. We performed a numerical analysis of the effective thermal conductivity measurement by varying the thickness and thermal conductivity of the epidermis. The results indicated that the guard-heated thermistor probe allows to detect slight differences of thermal conductivity of the epidermis.

FB-5 [15:44]
STUDENT PAPER

Estimation of number of heat-related illness patients transported in eight prefectures - Computational simulation approach

Akito Takada[1], Sachiko Kodera[1], Ryusuke Egawa[2], Hiroyuki Takizawa[3] & Akimasa Hirata[1, 4]

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Keywords: Dosimetry (computational), Optical, Work in Progress
Presented by: Akito Takada

The number of patients due to heat-related illness has been increasing with global warming and aging society in Japan. If the number of patients can be estimated, it may be helpful to estimate ambulance demand in addition to the public awareness. This study examined the method estimating the number of patients owing to heat-related illness in eight prefectures of Japan. The results show that accurate prediction was achieved when the perspiration and body core temperature were estimated by the multiphysics computation.

FB-6 [15:47]
STUDENT PAPER

Synaptic effect of small skin fibers to pulse-train electrical stimulation

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Keywords: Dosimetry (computational), Pulsed, Work in Progress
Presented by: Yuki Niimi

In recent years, there has been a lot of interest in selective stimulation of small peripheral nerve fibers (Aδ-fiber and C-fiber) for pain research and diagnosis of neuropathies. Intraepidermal electrical stimulation (IES) injects a weak and focalized current in the skin through needle electrodes for selective stimulation of small fibers. In this study, IES was used to investigate synaptic responses during the measurement of pain thresholds. Also, a proposed computational model agreed with experimental pain thresholds by combining electromagnetic field analysis, neural model, and synaptic model. The results showed that pain thresholds for Aδ-fiber and C-fiber decreased with the number of stimulation pulses reaching an asymptote value.

FB-7 [15:51]
STUDENT PAPER

Individual variation of cardiac potential based on electric field analysis

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Keywords: Dosimetry (computational), ELF/LF, Work in Progress
Presented by: Kiyoto Sanjo

It is essential to evaluate the electrode position sensitivity to improve the robustness and accuracy for detecting abnormal waveforms in the electrocardiogram (ECG) measurement using wearable devices. In this study, the scalar-potential finite-difference method is used to reproduce the cardiac potential using different realistic human bodies. Furthermore, we then evaluated the individual variation of cardiac potential with a dynamic time warping for computed ECG waveform. Our computer simulation shows that the ECG waveform by individual differences becomes significant around two electrodes of 12-lead ECG system on the chest.

FB-8 [15:54]
STUDENT PAPER

Effect of IoT device arrangement on local SAR at 2.45 GHz and 920 MHz

Hidetoshi Saeki[1], Daisuke Anzai[1], Yuto Shimizu[2], Tomoaki Nagaoka[2] & Jianqing Wang[1]

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Keywords: Dosimetry (computational), RF/Microwaves, Completed (unpublished)
Presented by: Hidetoshi Saeki

In this paper, we investigated the arrangement of internet of things (IoT) devices effects on 10g-averaged peak SAR in 2.45 GHz and 920 MHz bands, which are commonly used for IoT devices. The finite-difference time-domain (FDTD) analysis results indicate the sum of SARs for two transmit antenna was higher at 2.45 GHz than 920 MHz, on the other hand, the increasing rate at 920 MHz was larger than 2.45 GHz due to the different SAR distributions.

FB-9 [15:58]
STUDENT PAPER

Comparison of assessment methods for in-situ 5G NR base station exposure

Kenneth Deprez[1], Leen Verloock[1], Loek Colussi[2], Sam Aerts[1], Matthias Van Den Bossche[1], Jos Kamer[2], John Bolte[3, 4], Luc Martens[1], David Plets[1] & Wout Joseph[1]

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Keywords: Dosimetry (measurements), RF/Microwaves, Completed (published)
Presented by: Kenneth Deprez

This paper provides an overview of different measurement setups and optimal settings that can be used to correctly perform in-situ 5G NR electromagnetic field exposure assessment at *3.5 GHz*. Both time-averaged exposure and maximum extrapolated field exposure assessment are proposed and investigated with in-situ measurements in different countries. The maximum electric field values satisfy the ICNIRP 2020 limit (i.e. maximum 7.7%). The difference between E_{max} and E_{avg} is $< 3\ dB$ for the different measurement equipment at multiple sites. Hence, the current setups are to be recommended in 5G-NR exposure assessment in the current low-traffic scenarios.

FB-10 [16:01]
STUDENT PAPER

In vivo electrical conductivity of human anisotropic skeletal muscle and fat in the frequency range of 10 kHz to 1MHz

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Keywords: Dosimetry (measurements), ELF/LF, Completed (unpublished)
Presented by: Otto Kangasmaa

Non-invasive bioimpedance measurements and computational methods were used to derive electrical conduc-tivity values for anisotropic skeletal muscle and fat. The newly derived conductivities were also used to study the induced electric field strengths in anatomically realistic voxelized models of human legs and compared toICNIRP (2010, 2020) guidelines.

FB-11 [16:05]
STUDENT PAPER

Surrogate modelling for irreversible electroporation treatment in oncology

Prashanth Lakshmi Narasimhan[1, 2], Zoi Tokoutsi[1], Davide Baroli[3], Marco Baragona[1], Karen Veroy[2] & Ralph Maessen[1]

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Keywords: Electroporation, Static, Completed (unpublished)
Presented by: Prashanth LakshmiNarasimhan

This work compares the different surrogate modeling techniques for uncertainty quantification in irreversible electroporation (IRE) treatment. To quantify the effect of uncertainties in the treatment parameters on the treatment outcome we develop a surrogate estimator which approximates the mapping between them. Three different class of surrogate modelling techniques namely Gaussian process regression, polynomial chaos expansion and polynomial chaos kriging are considered in this work. The different surrogate models are benchmarked against biophysics based predictive model, so as to replace the latter in treatment planning strategies.

FB-12 [16:08]
STUDENT PAPER

Experimental evaluation of body water content estimation based on complex relative permittivity measurement

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Keywords: Human, RF/Microwaves, Completed (unpublished)
Presented by: Takuto Asai

This paper has proposed a water content estimation method based on relative permittivity measured at a certain part of a human body. We have conducted experiment to investigate the feasibility of the proposed method, as compare with the body water content obtained by the conventional bioelectrical impedance method. As a result, the relative error is 0.37% for the forearm and 0.79% for the calf, and high correlation with the body water content is confirmed in these two parts. Future subjects include to investigate a possibility to realize simultaneous estimation of all parameters α, $\Delta\varepsilon$, and τ.

FB-13 [16:12]
STUDENT PAPER

Performance evaluation on UWB implant device localization based on frequency-domain information

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Keywords: Human, RF/Microwaves, Completed (unpublished)
Presented by: Yasuhito Ishikawa

In this paper, we proposed a method to estimate the position of implantable devices by using frequency-domain information of the received signals at ultra wideband (UWB) The performance evaluation via the finite-difference time-domain (FDTD) analysis demonstrated that the proposed method can achieve a location

estimation accuracy of 0.1 cm at a sampling frequency of 10 GHz in a two-layered model composed of high- and low-water contents with an incident plane wave at 3.4-4.8 GHz, as compared with that of 1.1 cm for the conventional TOA method, which indicates the effectiveness of the proposed method.

FB-14 [16:15]
STUDENT PAPER

Study of the effects of 5G technology on the mitochondrial stress response

Lorenza Patrignoni[1, 2], Alexandre Joushomme[2], Florence Poulletier De Gannes[2], Annabelle Hurtier[2], Philippe Leveque[3], Delia Arnaud-Cormos[3], Rosa Orlacchio[3], Yann Percherancier[2] & Isabelle Lagroye[1, 2]

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Keywords: In vitro, RF/Microwaves, Work in Progress
Presented by: Lorenza Patrignoni

Whether exposure to environmental radiofrequency (RF) signals may impact cell stress response such as oxidative stress remains an open question. Here, we focused on the mitochondrial activity with regards to alteration in ROS production and membrane potential.So far, our investigation testing the 5G signal at 3.5 GHz and 0.25 W/Kg suggested that a 24h-exposure has no impact on these responses.Data obtained after exposure at higher SAR (1 and 4 W/Kg) will be reported at the conference.

FB-15 [16:19]
STUDENT PAPER

Effects of 5G RF signals at 3.5 GHz on the activity of neuronal networks in vitro

Anne Canovi[1], Florence Poulletier De Gannes[1], Annabelle Hurtier[1], Rosa Orlacchio[2], Delia Arnaud-Cormos[2], Philippe Leveque[2], Isabelle Lagroye[1, 3], André Garenne[1], Yann Percherancier[1] & Noëlle Lewis[1]

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Keywords: In vitro, RF/Microwaves, Work in Progress
Presented by: Anne Canovi

The recent deployment of the fifth generation (5G) of wireless communications raises new questions about potential health effects related to exposure to radiofrequency (RF) fields. This study aimed to characterize the effects of 5G at 3.5 GHz on neuronal cultures, at specific absorption rate (SAR) of 2 and 6 W/kg. So far, we found no evidence that the 5G RF-exposure impacts the activity of neurons in vitro.

FB-16 [16:22]
STUDENT PAPER

Repetitive exposure to low-intensity radiofrequency fields changes the sensitivity of TRPM8 to its antagonists

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Keywords: In vivo, RF/Microwaves, Work in Progress
Presented by: Jennifer Maalouf

The involvement of TRPM8, the main cold-sensitive receptor, by injecting its specific antagonist, AMG2850, shows a decrease in body and peripheral temperatures in control animals (without RF exposure) while, injection of the antagonist AMG2850, did not induce a decrease in temperature in animals exposed to RF. This suggests that the TRPM8 receptors of the exposed animals are no longer sensitive to the antagonist after exposure to RF The objective of the present study was to investigate the specificity of the antagonist on TRPM8 effect, the impact of RF on thermal receptors TRPM2, TRPM5, TRPV1, TRPV4, on thermogenic organs (white fat, liver, thyroid…) and on thermoregulatory biomolecular pathways.

FB-17 [16:25]
STUDENT PAPER

A study of electrode arrangement for electromagnetic wave therapy of periapical periodontitis using electro-thermal coupled analysis

Yusuke Kuroda[1], Masatake Akutagawa[1], Takahiro Emoto[1], Hiroo Tarao[2], Hiromichi Yumoto[3], Kouji Hirao[3], Toshihiko Tominaga[4], Toshitaka Ikehara[5], Emiko Yasuno[6] & Yohsuke Kinouchi[1]

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Keywords: Mechanistic/Theoretical, IF, Work in Progress
Presented by: Yusuke Kuroda

Currently, root canal treatment using high-frequency voltage has been proposed as a new treatment method. In this treatment, an AC voltage is applied between the root canal and the inner cheek to sterilize the root canal and promote alveolar bone regeneration. However, the optimal conditions for treatment have not yet been elucidated, and it is necessary to study the endodontic temperature. In this study, the temperature in the tooth during electric current heating was calculated by computer simulation, and the effects of the temperature on the applied voltage conditions and electrode placement were investigated. As a result of the calculation, the optimal electrode arrangement for treatment was confirmed.

FB-18 [16:28]
STUDENT PAPER

Cross sectional survey on risk perception about health effects of electromagnetic fields

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Keywords: Public Health Policy, RF/Microwaves, Work in Progress
Presented by: Hiroaki Miyagi

We conducted cross sectional survey to general public via online questionnaires in order to elucidate the levels of their risk perception on EMF exposure and the influential factors to them, and to test hypothesis that evidence-based information would mitigate the levels. The levels of knowledge were inversely related to the levels of risk perception. However, in some cases, providing information was not necessarily linked to mitigation of the levels of risk perception.

FB-19 [15:30]
STUDENT PAPER

Multi-physics technique for absorbed power density measurement above 6 GHz

Massinissa Ziane[1], Maxim Zhadobov[2] & Ronan Sauleau[1]

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Keywords: Dosimetry (measurements), RF/Microwaves, Work in Progress
Presented by: Massinissa Ziane

This paper introduces a novel technique for absorbed power density (APD) measurement at millimeter waves (mmW) accounting for antenna/body coupling in the near field. The proposed method employs skin-equivalent structure reproducing the reflection coefficient from human skin and efficiently converting the absorbed power into heating. The heating profile is recorded using infrared imaging. An in-house algorithm is employed to retrieve equivalent APD at the air/skin interface from the temperature dynamics on the phantom.

A very good agreement is found between the APD retrieved from the thermal dynamics and the APD predicted by simulations. Results demonstrate a promising potential of the technique for exposure assessments above 6 GHz.

Session: PB
Poster Session B
Thursday June 23, 2022 • 16:30 - 18:00
Exhibition Hall

PB-1 [16:30]

The ARPANSA "Talk to a Scientist" Program: Radiation risk perception trends identified via our public engagement program

Chris Brzozek[1] & Ken Karipidis[1]

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Keywords: Behavioural, All Frequencies, Other
Presented by: Chris Brzozek

The Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) engages with the public via The Talk to a Scientist Program which is a key forum in helping to deliver its mission for a safe radiation environment within Australia. Through this program data is also gathered on radiation topics of interest to the public (e.g. the 5G mobile network), which provides ARPANSA with valuable insight on community concerns and risk perception trends.

PB-2 [16:30]

WITHDRAWN

PB-3 [16:30]

Wireless deep brain stimulation in freely moving mice with non resonant powering of magnetoelectric nanoparticles

Ali Jahanshahi[1], Kristen Kozielski[2], Metin Sitti[2] & Yasin Temel[1]

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Keywords: Behavioural, Static, Completed (published)
Presented by: Ali Jahanshahi

We have shown that we can stimulate MENPs with a magnetic field to remotely generate electric polarization of the MENPs. We have shown evidence that nonresonant magnetic powering of MENPs locally modulates neuronal activity invitro and invivo. We have also demonstrated that this modulation is sufficient to change animal behavior and to modulate other regions of the corticobasal ganglia-thalamocortical circuit.

PB-4 [16:30]

Effects of exposure to 50 Hz magnetic fields on the human nerve conduction velocity

Nur Izyana Faradila Binti Azmi[1], Hideyuki Okano[2], Hiromi Ishiwatari[3] & Keiichi Watanuki[1, 2]

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Keywords: Clinical (therapy), ELF/LF, Work in Progress
Presented by: Hideyuki Okano

This study focuses on the acute effects of 50 Hz magnetic fields (MF; B_{max} 180 mT for 15 min) on nerve conduction velocity, i.e., motor nerve conduction velocity (MCV) and sensory nerve conduction velocity (SCV) in healthy adults. The MF or sham exposure of the right forearm was performed for 15 min during the immobilization of the forearm. In sham exposure, the MCV values significantly decreased in post-exposure relative to pre-exposure during the immobilization. In contrast, the MCV values of MF exposure in post-exposure were significantly higher than those of sham exposure. MF exposure did not significantly change the SCV values. These results suggest that MF exposure could suppress the reduction of the MCV during the immobilization.

PB-5 [16:30]

Development of microwave energy devices for application to robotic surgery

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Keywords: Clinical (therapy), RF/Microwaves, Work in Progress
Presented by: Tsugumi Nishidate

In this study, we propose a double-loop antenna for miniaturization and generation of localized heating to adapt microwave energy device for the robotic surgery. Proposed antenna has a rod that is equipped for changing antenna length. To evaluate optimal combination of double-loop and rod length, numerical analysis was performed for calculating the SAR distribution. From the results of the SAR distribution, it was confirmed that 10 and 15 mm rod can achieve uniform heating. From this result, the combination of the double-loop and the 10 and 15 mm rod enables local heating in the heating region along the loop shape.

PB-6 [16:30]

Analysis of uncertainty in the modeling of treatment performance and safety for non-invasive brain stimulation techniques

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Keywords: Dosimetry (computational), ELF/LF, Work in Progress
Presented by: Niels Kuster

The treatment performances of several non-invasive brain stimulation (NIBS) techniques such as Transcranial electric (tES) and temporal interference (TI) stimulation depend on the accurate delivery of the therapeutical dose (either electric fields or derived quantities of interests (QoIs) such as the maximum amplitude modulation) within targets. In this work i*n silico* models of brain stimulation based on finite-element method (FEM) simulations centered on simplified and anatomical human head models are used to generate uncertainty spatial maps of treatment dose due to the variability of the dielectric properties of tissues and the inaccuracy of electrode placement.

PB-7 [16:30]

FDTD analyses of anatomical human bodies exposed to broadband electromagnetic pulses

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Keywords: Dosimetry (computational), RF/Microwaves, Work in Progress
Presented by: Jerdvisanop Chakarothai

Human exposures to ultra-wideband (UWB) electromagnetic (EM) pulses in the microwave region is assessed using a frequency-dependent FDTD method. Complex permittivity functions of biological tissues are expressed by four-term Cole–Cole model. FDTD update equations are derived via the use of fast inverse Laplace transform and Prony method. We calculate reflection coefficients of biological tissues and confirm the validity of the proposed scheme by comparison with analytical results. Numerical dosimetry of various human bodies exposed to EM pulses from the front in the microwave frequency range is performed, and the specific energy absorption is evaluated and compared with that prescribed in international guidelines.

PB-8 [16:30]

Assessment of spatial-average power density for human corneal model under electromagnetic exposure above 30 GHz

Negin Foroughimehr[1, 2], Robert McIntosh[3], Zoltan Vilagosh[1, 2] & Andrew Wood[1, 2]

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Keywords: Dosimetry (computational), THz, Work in Progress
Presented by: Robert McIntosh

Mobile communication has achieved enormous technology innovations over various generations of progression. Currently, new cellular technology (5G cellular systems) is being deployed that makes use of the Millimetre Wave (MMW) range (30-300 GHz) of the radio frequency (RF) region of the electromagnetic spectrum. This study aims to demonstrate an accurate computational simulation system to study the interaction of the human cornea with electromagnetic radiation in the 30 to 300 GHz MMW frequency radiation band. The impact of meshing size constraints on computational results is assessed. Furthermore, the spatial average power density is computed considering recent safety guidelines for near-field exposure scenarios.

PB-9 [16:30]

Assessment of EMF exposure in 5G connected vehicles

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Keywords: Dosimetry (computational), RF/Microwaves, Completed (unpublished)
Presented by: Marta Bonato

In this work, a specific case of forthcoming 5G exposure from connected vehicles is evaluated. Two array antennas for 5G-V2X communication based on 5G technology at 3.5 GHz were modelled and mounted on a realistic 3D car model, to evaluate the exposure levels of a human model representing a person on the road in close proximity to the car. The simulations are conducted using the FDTD solver implemented in Sim4Life platform; different positions between the car and the model are assessed. The analyzed quantities are the Specific Absorption Rate averaged over 10g, as indicated in the basic restrictions of ICNIRP guidelines. This work will further expand the knowledge about the exposure levels in the forthcoming use of 5G in connected vehicles.

PB-10 [16:30]

Dosimetric comparison of nursing staff exposure to deep transcranial magnetic stimulation using different coil configurations

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Keywords: Dosimetry (computational), Pulsed, Work in Progress
Presented by: Mai Lu

This study presented dosimetry analysis for nursing staff exposed to magnetic pulses from H-, Halo-circular assembly (HCA) and double cone coils during deep transcranial magnetic stimulation (dTMS) applications. The magnetic field and the induced electric field in realistic human body model exposure to these dTMS coils have been obtained by employing the impedance method. It was found the H-coil generates higher exposure to nursing staff compared to that of HCA and double cone coils.

PB-11 [16:30]

Effect of body surface profile on power absorption of electromagnetic field exposure

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Keywords: Dosimetry (computational), RF/Microwaves, Work in Progress
Presented by: Yujiro Kushiyama

This study investigates the effect of body surface profile on power absorption under electromagnetic field exposure. The macroscopic surface profiles, such as large-scale wrinkles around the forehead and joints, are modeled as a Chebyshev shape with a small deformation parameter. The power absorption on the surface of the shape under plane wave illumination is computed by means of the transition-matrix (T-matrix) method. The various combinations of the parameters of the shape, incident angles and polarizations are studied for the frequencies ranging from 6 to 30GHz. We found that the estimation of the absorbed power density (APD) by a human model with a smooth surface can lead an underestimation of the APD for the human body.

PB-12 [16:30]
STUDENT PAPER

Effect of permittivity on temporal interference modeling

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Keywords: Dosimetry (computational), ELF/LF, Completed (unpublished)
Presented by: Gabriel Gaugain

Temporal interference (TI) is a recent development in brain stimulation aiming to target deep brain regions using transcranial alternating current stimulation (tACS). This technique is under investigation to estimate its ability to provide non-invasive deep brain stimulation. Modeling studies have been conducted to quantify the potential of this method. However, modeling is commonly performed using the quasi-static approximation, together with purely ohmic tissues. Here, we studied the impact of neglecting the capacitive effect of tissues on the electric field (EF) estimation in deep brain regions. The results show a relative error below 10% at the brain level, demonstrating a good approximation using purely ohmic tissues for this purpose.

PB-13 [16:30]

Micro-scale cell model for multi-physics dosimetry in emerging WPT and 5G bands

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Keywords: Dosimetry (computational), RF/Microwaves, Completed (published)
Presented by: Zain Haider

In this study, for the first time we designed a micro-scale realistic model of a keratinocyte cell which contains nucleus, endoplasmic reticulum, mitochondria, Golgi apparatus and vesicles in realistic surface area fractions. It was employed to quantitatively evaluate the micro-scale power deposition (*PLD*) at the subcellular level at HF (6.78 MHz) and millimeter-wave (60 GHz) frequencies using finite element method. The results demonstrate that the local *PLD* in the vicinity of organelles within the cytoplasm can be up to 91.9% (6.78 MHz) and 53.1% (60 GHz) higher than the average *PLD* in the cytoplasm. This suggests that currently employed macro-scale models may result in a significant underestimation of local micro-scale exposure levels.

PB-14 [16:30]
STUDENT PAPER

Development of noninvasive temperature measurement system using generative adversarial networks for the radio frequency capacitive applicator

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Keywords: Dosimetry (computational), Ultrasound, Work in Progress
Presented by: Keito Yanagisawa

In this study, we developed a noninvasive temperature distribution measurement system using Generative Adversarial Networks (GAN) for hyperthermia treatment. First, we conducted heating experiments using agar phantom and hot plate to acquire temperature distributions and ultrasound images. Second, we created a dataset by combining the ultrasound images and temperature distributions. Third, we trained and validated the GAN using the dataset. Moreover, comparing the ground truth temperature distribution and estimated result, it was confirmed that the minimum mean absolute error (MAE) is 0.73°C. Our results showed that the proposed method can effectively provide noninvasive temperature measurements.

PB-15 [16:30]
STUDENT PAPER

Numerical study on the effective thermal conductivity measurements of human skin using a guard-heated probe using thin-film thermistors

Koujiro Kurosawa[1], Yuya Iseki[1], Takuma Kogawa[1], Takashi Nonaka[1], Yasushi Hsokawa[1], Fuhui Guo[1], Takahiro Okabe[2], Yutaro Tabata[3], Tadashi Matsudate[3], Shuji Inamura[3], Masaya Higashi[3], Manabu Orito[3] & Shigenao Maruyama[1]

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Keywords: Dosimetry (computational), Pulsed, Work in Progress
Presented by: Koujiro Kurosawa

This study describes the numerical analysis of the effective thermal conductivity measurement for skin with a guard-heated probe using thin-film thermistors. In previous studies, the effective thermal conductivity of tumors is slightly different from that of healthy skin. In this study, we investigated whether the guard-heated thermistor probe developed by our research group could detect slight difference in thermal conductivity. We performed a numerical analysis of the effective thermal conductivity measurement by varying the thickness and thermal conductivity of the epidermis. The results indicated that the guard-heated thermistor probe allows to detect slight differences of thermal conductivity of the epidermis.

PB-16 [16:30]

Evaluation of temperature rise using the human models with non-uniform thermal parameters

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Keywords: Dosimetry (computational), RF/Microwaves, Work in Progress
Presented by: Sachiko Kodera

The restrictions for human protection exposed to electromagnetic fields were set with the reduction factor. It is essential to evaluate the inter-subject variability for better understanding reduction factors. Human models are generated through a segmentation of medical images and an assignment of properties to each tissue uniformly. However, the properties can vary even within same tissue. This study computed temperature rise for local exposure in human models generated using deep learning approach that can estimate non-uniform properties without segmentation. The results of non-segmented models are highly consistent with that of segmented models. The application of non-segmented models may further reduce the inter-subject variability.

PB-17 [16:30]
STUDENT PAPER

Estimation of number of heat-related illness patients transported in eight prefectures - Computational simulation approach

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Keywords: Dosimetry (computational), Optical, Work in Progress
Presented by: Akito Takada

The number of patients due to heat-related illness has been increasing with global warming and aging society in Japan. If the number of patients can be estimated, it may be helpful to estimate ambulance demand in addition to the public awareness. This study examined the method estimating the number of patients owing to heat-related illness in eight prefectures of Japan. The results show that accurate prediction was achieved when the perspiration and body core temperature were estimated by the multiphysics computation.

PB-18 [16:30]
STUDENT PAPER

Synaptic effect of small skin fibers to pulse-train electrical stimulation

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Keywords: Dosimetry (computational), Pulsed, Work in Progress
Presented by: Yuki Niimi

In recent years, there has been a lot of interest in selective stimulation of small peripheral nerve fibers (Aδ-fiber and C-fiber) for pain research and diagnosis of neuropathies. Intraepidermal electrical stimulation (IES) injects a weak and focalized current in the skin through needle electrodes for selective stimulation of small fibers. In this study, IES was used to investigate synaptic responses during the measurement of pain thresholds. Also, a proposed computational model agreed with experimental pain thresholds by combining electromagnetic field analysis, neural model, and synaptic model. The results showed that pain thresholds for Aδ-fiber and C-fiber decreased with the number of stimulation pulses reaching an asymptote value.

PB-19 [16:30]

Brain function mapping by TMS combining computational dosimetry and experiments

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Keywords: Dosimetry (computational), Pulsed, Work in Progress
Presented by: Keigo Hikita

Transcranial Magnetic Stimulation (TMS) is a non-invasive neuromodulation scheme that induces an electric current in the brain below the stimulating coil. With the development of computational dosimetry, it is possible to estimate the induced electric field for different motor responses. In this study, electromagnetic dosimetry based on experimental measurements of TMS was used to map the brain site representation of two finger muscles.

PB-20 [16:30]
STUDENT PAPER

Individual variation of cardiac potential based on electric field analysis

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Keywords: Dosimetry (computational), ELF/LF, Work in Progress
Presented by: Kiyoto Sanjo

It is essential to evaluate the electrode position sensitivity to improve the robustness and accuracy for detecting abnormal waveforms in the electrocardiogram (ECG) measurement using wearable devices. In this study, the scalar-potential finite-difference method is used to reproduce the cardiac potential using different realistic human bodies. Furthermore, we then evaluated the individual variation of cardiac potential with a dynamic time warping for computed ECG waveform. Our computer simulation shows that the ECG waveform by individual differences becomes significant around two electrodes of 12-lead ECG system on the chest.

PB-21 [16:30]

Computational human models representing the Japanese population for EMF dosimetry

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Keywords: Dosimetry (computational), RF/Microwaves, Work in Progress
Presented by: Tomoaki Nagaoka

Anatomical human models based on medical image data are a powerful tool for electromagnetic field (EMF) dosimetry. Various research groups have developed various age or body shape models. However, these models, in addition to individual difference, number of tissues and resolution are also difference. On the other hand, the body-types and anatomical structures of the models generated by simple scaling original models are greatly different from realistic people. In this study, we developed novel computational human models representing the Japanese population on the basis of a pair of adult male and adult female models.

PB-22 [16:30]

Evaluation of stimulation in different functional cerebellum regions by transcranial temporal interference stimulation

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Keywords: Dosimetry (computational), ELF/LF, Work in Progress
Presented by: Yukika Tashiro

Temporal interference (TI) is a non-invasive brain stimulation technique that produces interferential currents in the brain aiming for focal stimulation of deep brain regions without the cost of stimulating superficial regions. We used a high-resolution computational model to evaluate TI applied to the cerebellum for the first time, which demonstrates that TI can selectively stimulate deep functional areas of the human cerebellum.

PB-23 [16:30]
STUDENT PAPER

Effect of IoT device arrangement on local SAR at 2.45 GHz and 920 MHz

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Keywords: Dosimetry (computational), RF/Microwaves, Completed (unpublished)
Presented by: Hidetoshi Saeki

In this paper, we investigated the arrangement of internet of things (IoT) devices effects on 10g-averaged peak SAR in 2.45 GHz and 920 MHz bands, which are commonly used for IoT devices. The finite-difference time-domain (FDTD) analysis results indicate the sum of SARs for two transmit antenna was higher at 2.45 GHz than 920 MHz, on the other hand, the increasing rate at 920 MHz was larger than 2.45 GHz due to the different SAR distributions.

PB-24 [16:30]

Selective measurements in 5G NR frequency range 2 at 24 - 29 GHz with directive and omnidirectional antenna design

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Keywords: Dosimetry (measurements), RF/Microwaves, Work in Progress
Presented by: Holger Schwarz

There are different approaches for selective measurements in the 5G NR frequency range 2 at 24 - 29 GHz. This paper describes the advantages and disadvantages of measurements with a directive antenna compared to measurements with an omnidirectional antenna.

PB-25 [16:30]

Assessment of microenvironmental personal RF-EMF exposures in Victoria, Australia

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Keywords: Dosimetry (measurements), RF/Microwaves, Work in Progress
Presented by: Chhavi Bhatt

This project aims to measure personal radiofrequency electromagnetic field (RF-EMF) exposures from various RF-EMF sources, including sub-6 GHz 5G-NR, across different microenvironments in Melbourne CBD.The ExpoM-RF4™ exposimeter will be used to RF-EMF levels in 32 frequency bands (including 3.5 GHz 5G) across 12 microenvironments. Pre-defined walking paths and directions will be used while undertaking outdoor assessment. The statistics of microenvironmental personal exposure will be calculated in terms of: i) total exposure, ii) the mobile phone base station downlink (DLs); iii) mobile phone base station uplink (ULs) exposure, iv) broadcast exposure, v) Others (WLANs, paging, ISM and DECT), LTE TDD (2.3 GHz), and 5G-NR TDD (3.5 GHz).

PB-26 [16:30]
STUDENT PAPER

Multi-physics technique for absorbed power density measurement above 6 GHz

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Keywords: Dosimetry (measurements), RF/Microwaves, Work in Progress
Presented by: Massinissa Ziane

This paper introduces a novel technique for absorbed power density (APD) measurement at millimeter waves (mmW) accounting for antenna/body coupling in the near field. The proposed method employs skin-equivalent structure reproducing the reflection coefficient from human skin and efficiently converting the absorbed power into heating. The heating profile is recorded using infrared imaging. An in-house algorithm is employed to retrieve equivalent APD at the air/skin interface from the temperature dynamics on the phantom. A very good agreement is found between the APD retrieved from the thermal dynamics and the APD predicted by simulations. Results demonstrate a promising potential of the technique for exposure assessments above 6 GHz.

PB-27 [16:30]
STUDENT PAPER

Comparison of assessment methods for in-situ 5G NR base station exposure

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Keywords: Dosimetry (measurements), RF/Microwaves, Completed (published)
Presented by: Kenneth Deprez

This paper provides an overview of different measurement setups and optimal settings that can be used to correctly perform in-situ 5G NR electromagnetic field exposure assessment at *3.5 GHz*. Both time-averaged exposure and maximum extrapolated field exposure assessment are proposed and investigated with in-situ measurements in different countries. The maximum electric field values satisfy the ICNIRP 2020 limit (i.e. maximum 7.7%). The difference between E_{max} and E_{avg} is < *3 dB* for the different measurement equipment at multiple sites. Hence, the current setups are to be recommended in 5G-NR exposure assessment in the current low-traffic scenarios.

PB-28 [16:30]

Exposure of children living close to HV power lines and transformer substations to magnetic fields in Slovenia

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Keywords: Dosimetry (measurements), ELF/LF, Completed (unpublished)
Presented by: Peter Gajsek

The purpose of the study was to obtain data on the personal exposure to extremely low-frequency (ELF) magnetic fields (MF) of 50 children under 18 years of age living near high-voltage power lines (PL) and transformer substations (TS) in different micro-environment settings in Slovenia.

PB-29 [16:30]

The study on the EMF measurement method of the reference signal in time domain for finding the maximum power of the 5G NR base station

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Keywords: Dosimetry (measurements), RF/Microwaves, Work in Progress
Presented by: Dong Geun Choi

In this paper, we are proposed the proper setting conditions with the ratio between VBW and RBW for measuring the 5G reference signal using spectrum analyzer in time domain. The measurement result can be affected by detector type and VBW and RBW setting ratio. As a result of comparing the three different types of equipment, we could get the similar results each other when the VBW was set equal to the RBW. We also got the same results when the VBW was set higher than the RBW. In conclusion, we are proposed that the VBW should either be equal to or higher than the RBW to avoid underestimation when spectrum analyzer use the RMS detector in zero span mode. It intends no VBW effect to the measurement in RMS mode.

PB-30 [16:30]

Radio frequency exposure levels in a house in Japan

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Keywords: Dosimetry (measurements), RF/Microwaves, Work in Progress
Presented by: Miwa Ikuyo

The project of acquisition, accumulation, and application of electromagnetic fields exposure monitoring data in Japan has started since 2019. The aims of this study are to clarify actual human exposure levels to EMF in daily lives. It is therefore necessary to evaluate radio frequency (RF) exposure levels in a house. We recruited 48 participants to conduct the measurement of RF exposure levels in a house. The results show that the RF exposure levels inside the house from the wireless LAN devices are approximately 50 % compared to those from the mobile phone systems. It is also confirmed that the RF exposure levels of all houses is about 0.04% or lower than those of the Japanese radio radiation protection guidelines.

PB-31 [16:30]
STUDENT PAPER

In vivo electrical conductivity of human anisotropic skeletal muscle and fat in the frequency range of 10 kHz to 1MHz

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Keywords: Dosimetry (measurements), ELF/LF, Completed (unpublished)
Presented by: Otto Kangasmaa

Non-invasive bioimpedance measurements and computational methods were used to derive electrical conduc-tivity values for anisotropic skeletal muscle and fat. The newly derived conductivities were also used to study the induced electric field strengths in anatomically realistic voxelized models of human legs and compared toICNIRP (2010, 2020) guidelines.

PB-32 [16:30]
STUDENT PAPER

Surrogate modelling for irreversible electroporation treatment in oncology

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Keywords: Electroporation, Static, Completed (unpublished)
Presented by: Prashanth LakshmiNarasimhan

This work compares the different surrogate modeling techniques for uncertainty quantification in irreversible electroporation (IRE) treatment. To quantify the effect of uncertainties in the treatment parameters on the treatment outcome we develop a surrogate estimator which approximates the mapping between them. Three different class of surrogate modelling techniques namely Gaussian process regression, polynomial chaos expansion and polynomial chaos kriging are considered in this work. The different surrogate models are benchmarked against biophysics based predictive model, so as to replace the latter in treatment planning strategies.

PB-33 [16:30]

WITHDRAWN

PB-34 [16:30]

Depression and anxiety symptoms in 10 years-old children associated with prenatal maternal mobile phone usage

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Keywords: Epidemiology, RF/Microwaves, Work in Progress
Presented by: Hyunjoo Joo

We examined an association between maternal mobile phone use and children's depression and anxiety at 10 years, considering children's own mobile phone usage. This study showed that prenatal maternal mobile phone use for longer time affect the 10-years old girls' symptoms of depression and traits of anxiety.

PB-35 [16:30]

Personal measurement of radio frequency wave exposure in Japan: The Hokkaido study on environment and children's health

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Keywords: Epidemiology, RF/Microwaves, Work in Progress
Presented by: Keiko Yamazaki

We recorded children's personal radio frequency electromagnetic fields (RF-EMF) exposure using dosimetry and examined related factor for the exposure. 101 children at 10-15 years old, who participated in Hokkaido Study cohort, recorded RF-EMF in the 700 MHz-5.8GHz range for 3 days. The questionnaire for internet environmental at home and mobile phone usage was collected. Personal RF-EMF exposure in Japanese children is lower than in previous studies in Europe. Downlink was the most contributor in the total exposure in everywhere, while WiFi and digital TV was higher only in the home. Although internet environment and mobile phone usage was associated with several RF-EMF bands, further studies with additional number of data are needed.

PB-36 [16:30]

Association between children's screen time and behavioral problems in Hokkaido Study on Environmental and Children's Health

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Keywords: Epidemiology, All Frequencies, Work in Progress
Presented by: Naomi Tamura

This study examined the relationship between length of screen time (ST) based on intended usage and behavioral problems. The study participants were 3,332 children in the Hokkaido Study on Environment and Children's Health. Children and their parents completed questionnaires of ST and the Strengths and Difficulties Questionnaire (SDQ). The logistic regression was used to analyze association between ST and behavioral problems. In the adjusted model, the Odds Ratio of SDQ's case was 3.05 (95% CI: 1.66–5.62) for children who used games for more than 3 hours on weekdays compared with children who never used games. This study was a cross-sectional study, so the longitudinal follow-up is needed to further examine ST and problem behavior.

PB-37 [16:30]

Temporal pattern of received RF power measured by smartphone application in the mothers of Korean CHildren's ENvironmental health Study (Ko-CHENS)

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Keywords: Epidemiology, RF/Microwaves, Work in Progress
Presented by: Jong Hyuk Choi

During 2017 to 2020, we measured the Rx EMF power (3G, 4G, WiFi 2.4G, and WiFi 5G) through the mobile phone use via the smartphone App. The mean values of the received power were -80.2 dBm (3G), -93.3 dBm (4G-RSRP), -87.9 dBm (4G-SUM), -49.5 dBm (WiFi 2.4G-SUM), and -62.9 dBm (WiFi 5G-SUM).The received 3G and 4G power gradually decreased over the years.

PB-38 [16:30]

An overview of the RF and ELF dose assessment for wireless phones in the MOBI-Kids case-control study

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Keywords: Epidemiology, All Frequencies, Completed (unpublished)
Presented by: Carolina Calderon

Wireless phones emit both radio frequency (RF) and extremely low frequency (ELF) electromagnetic fields (EMF), yet epidemiological studies looking into the possible adverse health effects of such devices have only considered RF exposure, typically quantified by phone usage. This work presents an algorithm designed to estimate the individual lifetime localised RF and ELF dose for all wireless phone users in the multi-national MOBI-Kids case-control study. It considers dosimetry modelling, information on prevalence of communication systems, phone usage data, and tumour location. The level of agreement between dose and self-reported use of mobile phone, as well as correlation between RF and ELF dose, was investigated.

PB-39 [16:30]

Field perceptions and symptom reports in a provocation protocol: Results of the ExpoComm & Envi-EHS projects

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Keywords: Human, All Frequencies, Completed (unpublished)
Presented by: Maryse Ledent

Experimentation remains the privileged instrument to identify the accuracy of attributions in the idiopathic environmental intolerance attributed to electromagnetic fields (IEI-EMF). Despite the fear of some to undergo laboratory exposure, most people with IEI-EMF are convinced of the usefulness of provocation tests, but based on innovative protocols considering their specific condition. A protocol was codesigned with people experiencing IEI-EMF and implemented. Several measurements were taken before, during and after the double-blind exposure. Here we present the results of field perceptions and symptom reports according to the groups studied: self-reported IEI-EMF, non-IEI-EMF and people with non-specific symptoms not attributed to EMF.

PB-40 [16:30]

Results of cognitive tests following double blind exposures to electromagnetic fields in controlled settings

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Keywords: Human, All Frequencies, Completed (unpublished)
Presented by: Maryse Ledent

Many of the symptoms described by people suffering from what they attribute to electromagnetic waves are directly linked to cognitive capacities. However, although the majority of studies seem to attest to the absence of any effect of electromagnetic waves on the cognitive performance of human beings, some results are nevertheless contradictory, demonstrating the interest for research to continue investigating this field. This study proposes to explore these effects on people declaring themselves electrohypersensitive in an experimental context performed in double blind. Results will be described and analyzed and the discussion will allow to compare our results with the literature and to identify the limits of cognitive testing.

PB-41 [16:30]
STUDENT PAPER

Experimental evaluation of body water content estimation based on complex relative permittivity measurement

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Keywords: Human, RF/Microwaves, Completed (unpublished)
Presented by: Takuto Asai

This paper has proposed a water content estimation method based on relative permittivity measured at a certain part of a human body. We have conducted experiment to investigate the feasibility of the proposed method, as compare with the body water content obtained by the conventional bioelectrical impedance method. As a result, the relative error is 0.37% for the forearm and 0.79% for the calf, and high correlation

with the body water content is confirmed in these two parts. Future subjects include to investigate a possibility to realize simultaneous estimation of all parameters α, Δε, and τ.

PB-42 [16:30]

Perception threshold and types of produced sensations when exposed to intermediate-frequency contact current in healthy adults

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Keywords: Human, IF, Completed (unpublished)
Presented by: Akiko Yuasa

We investigated the current perception threshold and types of produced sensations in healthy adults when the fingertip was exposed to contact current in the intermediate-frequency band from 300 kHz to 10 MHz. The results showed that the current perception threshold at frequencies higher than 300 kHz, mainly producing a warmth sensation, was significantly higher than that at the low frequency of 100 kHz which mainly produced a tingling/pricking sensation. The transition of the produced sensations and its dependent perception threshold would exist between 100 and 300 kHz. The intermediate-frequency currents consistently produce a warmth sensation with the threshold higher than those at 100 kHz.

PB-43 [16:30]
STUDENT PAPER

Performance evaluation on UWB implant device localization based on frequency-domain information

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Keywords: Human, RF/Microwaves, Completed (unpublished)
Presented by: Yasuhito Ishikawa

In this paper, we proposed a method to estimate the position of implantable devices by using frequency-domain information of the received signals at ultra wideband (UWB) The performance evaluation via the finite-difference time-domain (FDTD) analysis demonstrated that the proposed method can achieve a location estimation accuracy of 0.1 cm at a sampling frequency of 10 GHz in a two-layered model composed of high- and low-water contents with an incident plane wave at 3.4-4.8 GHz, as compared with that of 1.1 cm for the conventional TOA method, which indicates the effectiveness of the proposed method.

PB-44 [16:30]

The effect of exposure to radiofrequency electromagnetic fields on cognitive performance in human experimental studies: a systematic review

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Keywords: Human, RF/Microwaves, Work in Progress
Presented by: Blanka Pophof

The main objective of this systematic review is to evaluate the associations between the exposure to RF-EMF and cognitive performance in human experimental studies.

PB-45 [16:30]

Effect of 2 W/kg 1800 MHz radio-frequency electromagnetic fields on mitochondrial function of SRA cells

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Keywords: In vitro, RF/Microwaves, Work in Progress
Presented by: Kunhong Zhong

In this study, SRA cells was used as research model to explore the changes of mitochondria function in response to 1800 MHz RF radiation. Our result demonstrated that 2.0 W/kg 1800 MHz RF-EMF could not affect the function of SRA mitochondria, but mitochondrial ROS increased significantly, and the expression of mitochondrial membrane transporter genes changed significantly too.

PB-46 [16:30]

Effect of 10 Hz pulsed magnetic field exposure on primary human gingival fibroblasts

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Keywords: In vitro, Pulsed, Completed (unpublished)
Presented by: Zheng Huang

This study aimed to investigate the effect of 10 Hz pulsed MF exposure on primary human gingival fibroblasts (HGFs).Cell apoptosis rate, cell cycle progression, and intracellular reactive oxygen species (ROS) level were determined by flow cytometry after exposure. DNA damage was determined by alkaline comet assay after exposure. The results revealed that exposure to 10 Hz pulsed MFs at 1.0 mT for 24 h has an individual- and/or gender-dependent effect on cellular apoptosis, cell cycle progression and DNA damage in primary HGFs.

PB-47 [16:30]

Effect of nanosecond pulsed electric fields on Coronavirus survival

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Keywords: In vitro, RF/Microwaves, Completed (published)
Presented by: Jody Cantu

The present study investigates the ability of nanosecond pulsed electric fields (nsPEFs) to neutralize bovine coronavirus (BCoV), as a surrogate for the SARS-CoV-2 virus. Results showed an appreciable reduction in BCoV infectivity with increasing number of pulses, even under conditions where pulsing did not increase the

sample temperature to a neutralizing heat (< 55 oC). In summary, our results show the ability of 600 nsPEFs to neutralize coronaviruses at various amplitudes, pulse numbers, and pulse polarity.

PB-48 [16:30]

Beyond conventional neurostimulation: effects of TMS-like magnetic fields on cells and nanomaterials and their potential applications in oncology and regenerative medicine

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Keywords: In vitro, Pulsed, Work in Progress
Presented by: Anna Guller

Transcranial magnetic stimulation (TMS) is a non-invasive pain-free clinically technology used for the control of neuronal activity. Here, we demonstrate a series of effects of TMS-like magnetic fields on healthy and cancerous non-neuronal cells and drug-loaded polymer nanoparticles in vitro. Our findings reveal the potential of applications of TMS in oncology, regenerative medicine and nanomedicine.

PB-49 [16:30]

Identifying cellular stress response of HT-1080 human fibrosarcoma and human dermal fibroblast cells in the presence of radio frequency fields

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Keywords: In vitro, RF/Microwaves, Work in Progress
Presented by: Hakki Gurhan

The relationship between Oxidative Stress, Radio Frequency Fields and biological implications are explored. Experimental data is used to show the changes that are observed due to presence of external radio frequency fields on fibrosarcoma and fibroblast cells.

PB-50 [16:30]
STUDENT PAPER

Study of the effects of 5G technology on the mitochondrial stress response

Lorenza Patrignoni[1, 2], Alexandre Joushomme[2], Florence Poulletier De Gannes[2], Annabelle Hurtier[2], Philippe Leveque[3], Delia Arnaud-Cormos[3], Rosa Orlacchio[3], Yann Percherancier[2] & Isabelle Lagroye[1, 2]

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Keywords: In vitro, RF/Microwaves, Work in Progress
Presented by: Lorenza Patrignoni

Whether exposure to environmental radiofrequency (RF) signals may impact cell stress response such as oxidative stress remains an open question. Here, we focused on the mitochondrial activity with regards to alteration in ROS production and membrane potential.So far, our investigation testing the 5G signal at 3.5 GHz and 0.25 W/Kg suggested that a 24h-exposure has no impact on these responses.Data obtained after exposure at higher SAR (1 and 4 W/Kg) will be reported at the conference.

PB-51 [16:30]
STUDENT PAPER

Effects of 5G RF signals at 3.5 GHz on the activity of neuronal networks in vitro

Anne Canovi[1], Florence Poulletier De Gannes[1], Annabelle Hurtier[1], Rosa Orlacchio[2], Delia Arnaud-Cormos[2], Philippe Leveque[2], Isabelle Lagroye[1, 3], André Garenne[1], Yann Percherancier[1] & Noëlle Lewis[1]

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Keywords: In vitro, RF/Microwaves, Work in Progress
Presented by: Anne Canovi

The recent deployment of the fifth generation (5G) of wireless communications raises new questions about potential health effects related to exposure to radiofrequency (RF) fields. This study aimed to characterize the effects of 5G at 3.5 GHz on neuronal cultures, at specific absorption rate (SAR) of 2 and 6 W/kg. So far, we found no evidence that the 5G RF-exposure impacts the activity of neurons in vitro.

PB-52 [16:30]

Investigation of changes in tubulin post-modifications (PTMs) following radiofrequency (RF) exposure in cultured neuronal cells

Ibtissam Echchgadda, Anna Sedelnikova & Jody C. Cantu

Keywords: In vitro, RF/Microwaves, Work in Progress
Presented by: Ibtissam Echchgadda

The present study investigated the effect of radiofrequency (RF) exposure on tubulin post-modifications (PTMs) in neuronal cells, potentially linking tubulin PTMs to changes in microtubule (MT) dynamics and neuronal cell excitably following RF exposure.

PB-53 [16:30]

Mitochondrial dysfunction changes cellular homeostasis in response to 1800 MHz radio-frequency electromagnetic fields exposure on DNA damage

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Keywords: In vitro, RF/Microwaves, Work in Progress
Presented by: Chuan Sun

In this study, MEFs was used as research model to explore the role of mitochondria function in cellular homeostasis in respond to 1800 MHz RF-EMF exposure on DNA damage. The results showed that mitochondria specific inhibitor Ru360 and Oligomycin pre-treatment enhanced the DNA damage effect of 1800 MHz RF-EMF exposure in MEFs. Considering the function of Ru360 and Oligomycin, we thought mitochondria calcium signal and energy metabolism might play an important role in cellular homeostasis in response to RF-EMFs exposure.

PB-54 [16:30]
STUDENT PAPER

Repetitive exposure to low-intensity radiofrequency fields changes the sensitivity of TRPM8 to its antagonists

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Keywords: In vivo, RF/Microwaves, Work in Progress
Presented by: Jennifer Maalouf

The involvement of TRPM8, the main cold-sensitive receptor, by injecting its specific antagonist, AMG2850, shows a decrease in body and peripheral temperatures in control animals (without RF exposure) while, injection of the antagonist AMG2850, did not induce a decrease in temperature in animals exposed to RF. This suggests that the TRPM8 receptors of the exposed animals are no longer sensitive to the antagonist after exposure to RF The objective of the present study was to investigate the specificity of the antagonist on TRPM8 effect, the impact of RF on thermal receptors TRPM2, TRPM5, TRPV1, TRPV4, on thermogenic organs (white fat, liver, thyroid…) and on thermoregulatory biomolecular pathways.

PB-55 [16:30]

Influence of water content in porcine skin tissues on dielectric property in a Terahertz region

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Keywords: In vivo, THz, Work in Progress
Presented by: Shota Yamazaki

Terahertz (THz) waves are expected to be used for next-generation wireless communications and the EMF safety in the frequency region has been studied. The dielectric properties of skin tissues are crucial for the estimation of the power absorption in the human body. However, the dielectric properties of the monolayer in side of the skin are poorly clarified. In this study, the complex relative permittivity of the porcine epidermis and dermis were measured by the THz TD-ATR spectroscopy. The complex relative permittivities of epidermis were significantly lower than that of dermis in the 0.1THz-1.0 THz region. Moreover, we revealed that the differences of the complex relative permittivity depend on the water content in each layer of the skin.

PB-56 [16:30]

5G millimeter-wave exposure of rat dorsal skin regulates body temperature and distal blood flow

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Keywords: In vivo, RF/Microwaves, Work in Progress
Presented by: Etsuko Ijima

Aim of this study was to evaluate the changes in skin temperature and skin blood flow under wide exposure of the rat dorsal skin to 28 GHz-MMW. The MMW exposure increased temperatures in the target skin and rectum in an intensity-dependent manner. However, no increase in blood flow was observed at the dorsal skin under the same exposure conditions. In contrast, significant increase in blood flow was found at the tail skin, which was under little exposure level. These results suggest that exposure of the dorsal skin to 28 GHz-MMW causes an increase in body temperature and that the heat accumulated in the body is dissipated through the tail under this exposure condition.

PB-57 [16:30]

Monitoring of body temperature changes during RF exposure with iButton data logger in rats

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Keywords: In vivo, RF/Microwaves, Completed (unpublished)
Presented by: Hye Sun Kim

The body temperature change during RF-exposure was real-time monitored with an intraperitoneally-implanted iButton. The body temperature remained stable during RF-exposure at 4 W/kg wbSAR in healthy

rats.

PB-58 [16:30]

Effect of long-term evolution radiofrequency electromagnetic fields and lead exposure on thyroid hormones and the hypothalamic-pituitary-thyroid axis in adolescent mice

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Keywords: In vivo, RF/Microwaves, Work in Progress
Presented by: Hae-June Lee

We determined the effects of LTE or Pb exposure on thyroid hormones and the HPT axis in adolescent mice. LTE altered plasma thyroid hormone T3 level and thyroid hormone-regulating gene expressions in the hypothalamus and thyroid gland. These results suggest that LTE exposure in adolescents may negatively affect the endocrine system, including the HPT axis.

PB-59 [16:30]

Effects of near null magnetic field and PEMF on plants for life support on planetary bodies

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Keywords: In vivo, Pulsed, Completed (published)
Presented by: Gilbert Cauthorn

This study outlines the results and effects from a 6-month experiment of the near null magnetic Field (NNMF) and PEMF on (i) photosynthetic organisms such as plants and spirulina algae inside a helm holtz coil. Experiment goals are to evaluate genes that are upregulated/downregulated after hypomagnetic field (HMF) exposure or pulsed fields ,to identify top three phenotypes most impacted in HMF and potentially impactable from PEMF, and (iii) to determine the effect and relationship of HMF or Crustal Field on ion accumulation and biochemical reactions.

PB-60 [16:30]
STUDENT PAPER

A study of electrode arrangement for electromagnetic wave therapy of periapical periodontitis using electro-thermal coupled analysis

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Keywords: Mechanistic/Theoretical, IF, Work in Progress

Presented by: Yusuke Kuroda

Currently, root canal treatment using high-frequency voltage has been proposed as a new treatment method. In this treatment, an AC voltage is applied between the root canal and the inner cheek to sterilize the root canal and promote alveolar bone regeneration. However, the optimal conditions for treatment have not yet been elucidated, and it is necessary to study the endodontic temperature. In this study, the temperature in the tooth during electric current heating was calculated by computer simulation, and the effects of the temperature on the applied voltage conditions and electrode placement were investigated. As a result of the calculation, the optimal electrode arrangement for treatment was confirmed.

PB-61 [16:30]

Theoretical analysis of classical pulsed electromagnetic field excitation applied in the frame of cell differentiation

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Keywords: Mechanistic/Theoretical, All Frequencies, Other

Presented by: Saba Harke

Various studies have provided valuable insights into EMF-mediated possibilities of in vitro cell differentiation. However, the question of key mechanisms of action of EMFs on treated cells have not been answered, yet. A promising approach to investigate the mechanisms of action can be a structured analysis of the exposure parameters and, based thereon, the investigation of possible entry points of EMFs into exposed cells. In this present work, an analysis of typical pulsed EMF excitation is conducted in order to gain a differentiated understanding of the frequency term in the context of cell differentiation. The aim is to make a contribution to research into EMF mechanisms of action on cells.

PB-62 [16:30]
STUDENT PAPER

Cross sectional survey on risk perception about health effects of electromagnetic fields

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Keywords: Public Health Policy, RF/Microwaves, Work in Progress

Presented by: Hiroaki Miyagi

We conducted cross sectional survey to general public via online questionnaires in order to elucidate the levels of their risk perception on EMF exposure and the influential factors to them, and to test hypothesis that evidence-based information would mitigate the levels. The levels of knowledge were inversely related to the levels of risk perception. However, in some cases, providing information was not necessarily linked to mitigation of the levels of risk perception.

PB-63 [16:30]

Average values of ELF MF due to HV power lines in Slovenia

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Keywords: Public Health Policy, ELF/LF, Completed (published)

Presented by: Blaz Valic

The average values of extremely low-frequency magnetic fields (ELF MF) generated by high-voltage power lines (HV PL) were determined for the entire territory of Slovenia using a novel approach since existing

methods are not feasible for such large areas. The results were determined for the average loads of HV PL in the period from 2006 to 2017. The average ELF MF was higher than 0.1μT in 1 percent of the territory of Slovenia. After initial calculation of the ELF MF for each HV PL separately the new method enables relatively fast calculation for arbitrary loads or changes in the power distribution network such as reconstruction of a HV PL.

PB-64 [16:30]

Global questionnaire survey to researchers on standardization of experimental protocol for safety assessment of radiofrequency electromagnetic fields

Akira Ushiyama[1], Kenji Hattori[2], Masateru Ikehata[3], Keiji Wada[4] & Yukihisa Suzuki[4]

[1]*Department of Environmental Health, National Institute of Public Health, Saitama, Japan, 3510197*

[2]*Environmental Toxicology Lab., Meiji pharmaceutical University, Tokyo, Japan, 2048588*

[3]*Biotechnology laboratory, Railway Technical Research Institute, Tokyo, Japan*

[4]*Department of Electrical and Electric Engineering, Tokyo Metropolitan University, Tokyo, Japan*

Keywords: Standards, RF/Microwaves, Work in Progress
Presented by: Akira Ushiyama

There is no unified method for evaluating the toxicity of electromagnetic fields and assessing health risks. To develop standardization of experimental protocol for the safety assessment of EMFs, we conducted an internet survey of researchers to investigate their attitudes toward the standardization method. In this presentation, we report the results of a survey conducted on the radio frequency range. As a result, most of the researchers agreed that there should be a standardized method. However, it also became clear that some opinions overlapped, and opinions differed on what each respondent considered to be the standardized method.

Author Index

From: info@icnirp.org <info@icnirp.org>
Sent: 17-06-2022 11:26:59 (UTC +01)
To: Anders Ravnsborg Beierholm <anrb@sis.dk>
Subject: ICNIRP Mini-Symposium Access

Dear All,

Thank you for attending the ICNIRP Mini-Symposium, 19 June 2022 (2pm-6pm JST)

The program is accessible at https://www.icnirp.org/en/workshops/article/mini-symposium-2022.html

The onsite venue is Aichi Industry and Labor Center (WINC AICHI)
4-4-38 Meieki, Nakamura-ku, Nagoya, Aichi, Japan

The online access is via Zoom meeting with the following access data:

https://zoom.us/j/99710480930?pwd=Qmozbkd3a3lqUzI0dTFrOVBuK204QT09
Meeting ID: 997 1048 0930
Password: 636050

Note that the recordings will be available later in the days following the event. We will send a separate email on the accessibility of the recordings.

If you have any questions, please send us an email at minisymposium@icnirp.org.

Regards,
ICNIRP Secretariat

From: BioEM 2022 Secretariat <secretariat@bioem2022.org>
Sent: 16-06-2022 15:43:58 (UTC +01)
To: Anders Ravnsborg Beierholm <anrb@sis.dk>
Cc: secretariat@bioem2022.org <secretariat@bioem2022.org>
Subject: BioEM 2022: Zoom Links for Online Sessions (R1095)

[Registration ID: R1095]

Dear Mr. Anders Ravnsborg Beierholm,

Thank you for having registered for the upcoming BioEM 2022!

Your Attendance Type: Online Attendance

[How to Attend BioEM 2022 Online]
Please go into the following page to attend the online sessions
on Zoom, view the poster presentation PDF files, etc.
https://www.bioem2022.org/url_links/

You will be required to enter a password for each URL:
-Attend BioEM 2022 Sessions on Zoom
Password: alhdajorwiurkajjsklakeupaire89klfajre

-Download BioEM 2022 Abstract Book
Password: lhlksae7wau63jljk2h34rpoeifadj293uj

-View Poster Presentation PDF Files (No Download Available)
Password: jckns98y3rqjdkj82qrkmndaqo2ierqdjd

-View Oral Sessions Recorded on Zoom (mp4) (No Download Available)
Password: 98345jhfw9p8fdjkajay43qqj9ppiuhab3

Some of the pages are not ready as of today, June 16, but should be ready soon.
The passwords above are very important, so please do not lose them!

We hope to see you soon on Zoom platform, or in Nagoya in person!

Best regards,

Keisuke

Keisuke Hisause (Mr.)
BioEM 2022 Secretariat
c/o Dupler Corp.
3F Sun-Arch Bldg., 3-1 Nemoto, Matsudo, Chiba 271-0077, Japan
Email: secretariat@bioem2022.org

From: ICNIRP <info@icnirp.org>
Sent: 31-05-2022 09:22:18 (UTC +01)
To: Anders Ravnsborg Beierholm <anrb@sis.dk>
Subject: Order ICNIRP

Dear Anders Ravnsborg Beierholm,

Thank you for your registration. Your participation is now confirmed.

If you have any questions please contact the ICNIRP Secretariat at info@icnirp.org

Your ICNIRP Secretariat

t. +49 89 31603 2156
info@icnirp.org
www.icnirp.org

ICNIRP
INTERNATIONAL COMMISSION ON
NON-IONIZING RADIATION PROTECTION

ICNIRP e.V. c/o BfS - Ingolstädter Landstr. 1 - 85764 Oberschleißheim - Germany

Anders Ravnsborg Beierholm
Danish Health Authority, Radiation Protection
Knapholm 7
2730 DK-2730 Herlev
Denmark

Oberschleißheim, 31.05.2022

INVOICE No. 31052022/593

Workshop:	
ICNIRP Mini-Symposium / 19 June 2022, 14.00-18.00 JST	
Standard-Price	0,00 €
Amount	0,00 €

From: DPGsendasSST <>
Sent: 20-05-2022 15:56:51 (UTC +01)
To: 'minisymposium@icnirp.org' <minisymposium@icnirp.org>
Subject: SV: ICNIRP Mini-Symposium: Recording of session?

Dear ICNIRP Secretariat,

That sounds good. Thank you very much for the fast response.

Best regards,

_____

Anders Ravnsborg Beierholm
Specialist Consultant
T (dir.) +45 4454 3455
anrb@sis.dk

Danish Health Authority
Radiation Protection
T +45 4454 3454
sis@sis.dk

DANISH HEALTH AUTHORITY
Radiation Protection

Fra: Webex ICNIRP <minisymposium@icnirp.org>
Sendt: 20. maj 2022 15:45
Til: Anders Ravnsborg Beierholm <anrb@sis.dk>
Emne: Re: ICNIRP Mini-Symposium: Recording of session?

Dear Anders Ravnsborg Beierholm,

Thank you for your interest. It is our expectation that the sessions will be livestreamed and available for viewing after the event via the ICNIRP website. As soon as we have final information regarding formal registration and technical details we will contact you again.

Regards,
ICNIRP Secretariat

> anrb@sis.dk hat am 20.05.2022 12:09 geschrieben:

Dear ICNIRP,

I am attending the BioEM 2022 congress online, and I might also be interested in the topics covered by the mini-symposium to be held prior to the congress.

Will the mini-symposium be recorded (as is the case with the conference itself), so that the sessions can be viewed after the 19th of June?

Best regards

_____

Anders Ravnsborg Beierholm
Specialist Consultant
T (dir.) +45 4454 3455
anrb@sis.dk

Danish Health Authority
Radiation Protection
T +45 4454 3454
sis@sis.dk

DANISH HEALTH AUTHORITY
Radiation Protection

From: BioEM 2022 Secretariat <secretariat@bioem2022.org>
Sent: 11-05-2022 05:55:18 (UTC +01)
To: Anders Ravnsborg Beierholm <anrb@sis.dk>
Cc: secretariat@bioem2022.org <secretariat@bioem2022.org>
Subject: BioEM 2022: Receipt (Payment Confirmattion) (R1095_PMT1)

Dear Mr. Anders Ravnsborg Beierholm,

Attached please find the Receipt (Payment Confirmation) for your registration at BioEM 2022.

Best regards,

BioEM 2022 Secretariat
c/o Dupler Corp.
3F Sun-Arch Bldg., 3-1 Nemoto, Matsudo, Chiba 271-0077, Japan
Email: secretariat@bioem2022.org

BioEM 2022
June19-24 Nagoya Japan

May 11, 2022

Receipt
(Payment Confirmation)

Payer: Mr. Anders Ravnsborg Beierholm

(All the fees are untaxable according to the laws of Japan.)

Payment ID			R1095_PMT1
Application Date and Time			May 03, 2022 17:41:11
Payment Item	Unit Price	Number	Sub Total
Registration Fee	93,000 JPY	1	93,000 JPY
Accompanying Person's Registration Fee	14,000 JPY	0	0 JPY
Grand Total			93,000 JPY
		Paid Amount:	93,000 JPY
		Payment Date:	May 03, 2022

Paid

The amount of the Grand Total above has been paid by the payer.

Jianqing Wang

Jianqing Wang
BioEM 2022 Local Organizing Committee Chair

BioEM 2022 Local Organizing Committee
c/o BioEM 2022 Secretariat
Dupler Corp.
3F Sun-Arch Bldg., 3-1 Nemoto, Matsudo, Chiba 271-0077, JAPAN
Phone: +81-47-361-6030 / FAX: +81-47-308-5272 / E-mail: secretariat@bioem2022.org

From: BioEM 2022 Secretariat <secretariat@bioem2022.org>
Sent: 03-05-2022 10:44:09 (UTC +01)
To: Anders Ravnsborg Beierholm <anrb@sis.dk>
Subject: Notification of payment completion(card settlement)

This is an auto-generated email.
Please do not reply this email.

Dear Mr. Anders Ravnsborg Beierholm (R1095_PMT1)

Thank you for your order at BioEM 2022.

Seller	: BioEM 2022
Payment Method	: Credit Card
Order ID	: R1095_PMT1_174259
Date of purchase	: 2022/05/03 17:44:09
Cost of item(s) purchased	: JPY 93,000
Shipping charges	: JPY 0
Total amount paid	: JPY 93,000

Order Details

Product Name	Unit Price	Quantity
Registration Fee	93,000	1

We hope to see you soon!

BioEM 2022 Secretariat
Email： secretariat@bioem2022.org

From: secretariat@bioem2022.org <secretariat@bioem2022.org>
Sent: 03-05-2022 10:41:12 (UTC +01)
To: Anders Ravnsborg Beierholm <anrb@sis.dk>
Cc: secretariat@bioem2022.org <secretariat@bioem2022.org>
Subject: BioEM 2022: Confirmation and Invoice for Registration (R1095)

==========
This is an automatic message from the BioEM 2022 Registration System.
==========

Dear Mr. Anders Ravnsborg Beierholm,

Thank you for having registered for BioEM 2022.

You have created a Registration ID as follows:

Registration ID: R1095

Please check your Registration information below.

* If you have not completed the payment for the Registration Fee yet,
please log in to your account and complete the payment.

****
1. Account Information
****

* Registration ID: R1095
* Email Address: anrb@sis.dk
* Password: B10EMf2022

****
2. Registrant's Information
****

* Registrant's Name and Country/Region
 - Title: Mr.
 - Given Name: Anders Ravnsborg
 - Family Name/Surname: Beierholm
 - Country/Region: Denmark
 - Country Code & Phone Number: + 45 - 44543455

* Organization (Affiliation):
 - Organization Name (Full Name): Danish Health Authority
 - Organization Name (Short Name): SST
 - Department/Division: Radiation Protection
 - Mailing Address: Knapholm 7, DK-2730, Herlev, Denmark

****
3. Registration Options
****

- Registration Period: Early

- Registration Code: OE02
- Registration Fee: 93,000 JPN
- Attendance Type: Online Attendance
- Registration Type: Full Registration (Non-Members)

- Membership (Members only):
- Member ID:

- Supervisor's Name (Students only):

- "Presenter" or "Audience": Audience
- Abstract ID(s) (for Presenters):

- Participation in the "Welcome Reception": No
- Participation in the "Conference Banquet": No
- Food Restrictions:

****
4. Accompanying Person(s) ("Physical Attendees" only)
****

- Accompanying Person's Registration: No
- Title:
- Full Name (for Name Badge):
- Participation in the "Welcome Reception":
- Participation in the "Conference Banquet":
- Food Restrictions:

****
5. Payment Information
****

* Payment ID: R1095_PMT1
- Application Year/Month/Day: 2022/05/03
- Application Time: 17:41:11

- Registration Fee: 93,000 JPN
- Accompanying Person's Registration Fee: 0 JPN

- Grand Total: 93,000 JPN

* Payer's Name (on Receipt)
- Registration Fee Payer: Mr. Anders Ravnsborg Beierholm
- Accompanying Person's Registration Fee Payer: Mr. Anders Ravnsborg Beierholm

****

In order to go on to your payment procedure, please log in to your
"Account" from the following link:
https://ksconference.com/bioem2022/regist/add?id=YWMzNWU4OTcyZjAzNDk3M2FiODkwMTkzMGI4MTc2ZTA=

* Password: B10EMf2022

NOTE:
You will receive another email after you complete your payment.
The Registration ID for this email will be invalid if you do not

complete the payment above!!

---

* This is an automatic message.
* If you find this e-mail message irrelevant to you or if you have
any questions, please e-mail to the following address.

--

2022-05-03 17:41:12.02

==========

<< BioEM 2022 Secretariat >>
E-mail: secretariat@bioem2022.org

==========

From: secretariat@bioem2022.org <secretariat@bioem2022.org>
Sent: 03-05-2022 10:44:09 (UTC +01)
To: Anders Ravnsborg Beierholm <anrb@sis.dk>
Cc: secretariat@bioem2022.org <secretariat@bioem2022.org>
Subject: BioEM 2022: Payment Completed (Credit Card)(R1095_PMT1)

##
Thank you! Payment Completed by Credit Card: [R1095_PMT1]
##

Dear Mr. Anders Ravnsborg Beierholm,

We have checked your online credit card payment.
Your payment for the "Grand Total" shown below is now completed.

---
* Payment ID: R1095_PMT1
- Application Date (Year/Month/Day): 2022/05/03
- Application Time: 17:41:11

- Registration Fee: 93,000 JPN
- Accompanying Person's Registration Fee: 0 JPN

- Grand Total: 93,000 JPN

The receipt(s) will be emailed to you from the BioEM 2022 Secretariat
later. Until then, please use this email message as a temporary
receipt, if necessary.

****
1. Account Information
****

* Registration ID: R1095
* Email Address: anrb@sis.dk
* Password: B10EMf2022

****
2. Registrant's Information
****

* Registrant's Name and Country/Region
- Title: Mr.
- Given Name: Anders Ravnsborg
- Family Name/Surname: Beierholm
- Country/Region: Denmark
- Country Code & Phone Number: + 45 - 44543455

* Organization (Affiliation):
- Organization Name (Full Name): Danish Health Authority
- Organization Name (Short Name for Name Tag): SST
- Department/Division: Radiation Protection
- Mailing Address: Knapholm 7, DK-2730, Herlev, Denmark

****

Please log in to your "Account" if you wish to update your
registration information.

You can also make additional applications ("adding accompanying
persons" or "change to physical attendance") in your "Account."

https://ksconference.com/bioem2022/regist/add?id=YWMzNWU4OTcyZjAzNDk3M2FiODkwMTkzMGI4MTc2ZTA=

* Password: B10EMf2022

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* This is an automatic message.
* If you find this e-mail message irrelevant to you or if you have
any questions, please e-mail to the following address.

--

2022-05-03 17:44:09.189
==========
<< BioEM 2022 Secretariat >>
E-mail: secretariat@bioem2022.org
==========

From: Anders Ravnsborg Beierholm <>
Sent: 03-05-2022 10:27:57 (UTC +01)
To: 'BioEM 2022 Secretariat' <secretariat@bioem2022.org>
Subject: SV: BioEM 2022: Recording of sessions?

Dear Keisuke,

Thank you for the prompt reply. I will register for the conference soon.

Best regards,
Anders

_____

Anders Ravnsborg Beierholm
Specialist Consultant
T (dir.) +45 4454 3455
anrb@sis.dk

Danish Health Authority
Radiation Protection
T +45 72 22 74 00
sst@sst.dk

-----Oprindelig meddelelse-----
Fra: BioEM 2022 Secretariat <secretariat@bioem2022.org>
Sendt: 3. maj 2022 10:17
Til: Anders Ravnsborg Beierholm <anrb@sis.dk>
Cc: BioEM 2022 Secretariat <secretariat@bioem2022.org>
Emne: Re: BioEM 2022: Recording of sessions?

Dear Anders Ravnsborg Beierholm,

Yes, we are planning to record the sessions on Zoom and make them viewable for the conference registrants after the conference, probably till the end of July.

Best regards,

Keisuke

Keisuke Hisause (Mr.)
BioEM 2022 Secretariat
c/o Dupler Corp.
3F Sun-Arch Bldg., 3-1 Nemoto, Matsudo, Chiba 271-0077, Japan
Email: secretariat@bioem2022.org

?On 2022/05/03 16:20 "Anders Ravnsborg Beierholm" <anrb@sis.dk> wrote:

Dear BioEM Secretariat,

I am looking forward to the 2022 conference, and I appreciate the possibility to attend online.

At last year's meeting, a lot of the presentations were recorded and made available after the conference, which really enhanced the value of online participation, especially for those participating from another time zone.

Can you please inform me whether any of the BioEM 2022 sessions are planned to be recorded, so that they are also available after the conference has ended?

Many thanks in advance.

Best regards,

_____

Anders Ravnsborg Beierholm
Specialist Consultant
T (dir.) +45 4454 3455
anrb@sis.dk

Danish Health Authority
Radiation Protection
T +45 72 22 74 00
sst@sst.dk

-----Oprindelig meddelelse-----
Fra: secretariat@bioem2022.org <secretariat@bioem2022.org>
Sendt: 22. april 2022 09:46
Til: Anders Ravnsborg Beierholm <anrb@sis.dk>
Cc: secretariat@bioem2022.org
Emne: BioEM 2022: Entrance to Registration Form

==========
This is an automatic message from the BioEM 2022 Registration System.
==========

Dear Sir/Madam,

Thank you for your interest in BioEM 2022.

Please go on to the following page for the on-line registration procedure.

https://ksconference.com/bioem2022/regist/add?id=YWMzNWU4OTcyZjAzNDk3M2FiODkwMTkzMGI4MTc2ZTA=

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* This is an automatic message.
* If you find this e-mail message irrelevant to you or if you have any questions, please e-mail to the following address.

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2022-04-22 16:45:46.887

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<< BioEM 2022 Secretariat >>
E-mail: secretariat@bioem2022.org

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