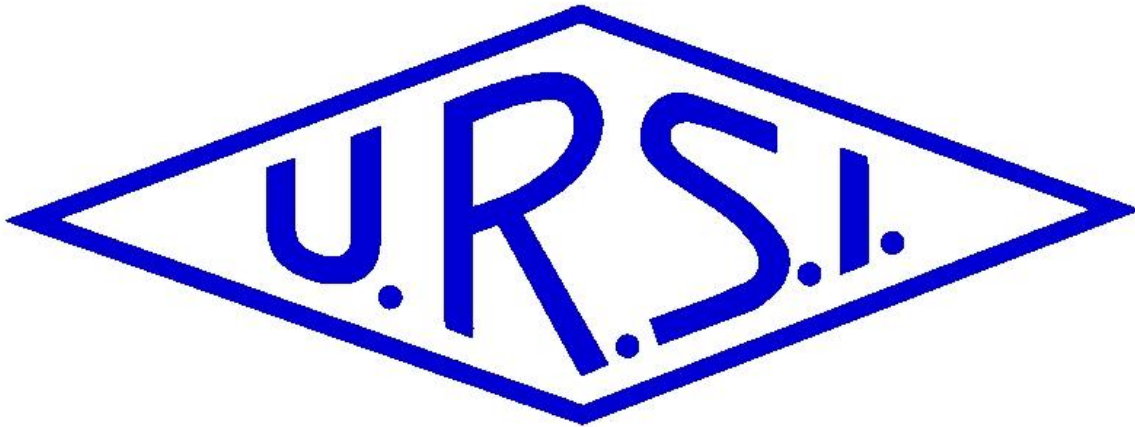


Commission Report on the triennium 2014–2017

Commission B (Fields and Waves)

prepared by Ari Sihvola (Chairperson 2014–2017)



The interest of Commission B is fields and waves, encompassing theory, analysis, computation, experiments, validation and applications. The areas of emphasis are:

- Time-domain and frequency-domain phenomena;
- Scattering and diffraction;
- General propagation including waves in specialised media;
- Guided waves;
- Antennas and radiation;
- Inverse scattering and imaging.

The Commission fosters the creation, development, and refinement of analytical, numerical, and measurement techniques to understand these phenomena. It encourages innovation and seeks to apply interdisciplinary concepts and methods.

In the Board meeting of the International Union of Radio Science (URSI) during the General Assembly 2014 in Beijing, the URSI Board approved the election of Ari Sihvola as Chair, Kazuya Kobayashi as the Vice-Chair, and Lianlin Li as the Early Career Representative of Commission B for the period 2014–2017.

The officers for 2014–2017 are as follows

Chair

Professor Ari Sihvola
Aalto University School of Electrical Engineering
Department of Electronics and Nanoengineering
Box 15500, FIN-00076 AALTO, Finland
E-mail: ari.sihvola@aalto.fi

Vice Chair

Professor Kazuya Kobayashi
Department of Electrical, Electronic, and Communication Engineering
Chuo University
1-13-27 Kasuga, Bunkyo-ku
Tokyo 112-8551, Japan
Email: kazuya@tamacc.chuo-u.ac.jp

Early Career Representative

Professor Lianlin Li
School of Electronics Engineering and Computer Science
Science Building #2, Room 2843
Peking University
Beijing, 100871, China
E-mail: lianlin.li@pku.edu.cn

Past Chair

Professor Giuliano Manara
Dipartimento di Ingegneria dell'Informazione
Università di Pisa
Via G. Caruso, 16
56122 Pisa, Italy
E-mail: g.manara@iet.unipi.it

The global network of Commission B consists of two formal bodies. Firstly, each member country of URSI has appointed an Official Member representing the activities of Commission B in that country. The Chairs of the Commission and the Central URSI communicate with this group of experts concerning the forthcoming activities.

In addition to the Official Members, Commission B is also supported by the Technical Advisory Board (B-TAB). At present, the constitution of B-TAB is the following:

- Matteo Albani Italy
- Makoto Ando Japan

- George Eleftheriades USA
- Nader Engheta USA
- Susan Hagness USA
- Levent Gürel Turkey
- Ehud Heyman Israel
- David Jackson USA
- Jiro Hirokawa Japan
- Ludger Klinkenbusch Germany
- Kazuya Kobayashi Japan
- Gerhard Kristensson Sweden
- Lianlin Li China
- Giuliano Manara Italy
- Juan Mosig Switzerland
- Paolo Nepa Italy
- Sembiam Rengarajan USA
- Magdalena Salazar Palma Spain
- Tapan Sarkar USA
- Lot Shafai Canada
- Ari Sihvola Finland
- Paul D. Smith Australia
- Donglin Su China
- Anton Tjihuis The Netherlands
- John Volakis USA
- Amir Zaghloul USA
- Don Wilton USA
- Richard Ziolkowski USA

The web site of Commission B is www.ursi.org/commission.php?id=B

Commission B was active in the organization of several scientific meetings during the triennium.

AT-RASC 2015 (Gran Canaria)

The new flagship meeting of URSI—the Atlantic Radio Science Meeting—was arranged for the first time in May 2015. In addition to several sessions built on contributed submissions to the meeting, Commission B also convened several special sessions

- Novel mathematical methods in electromagnetics
- Electromagnetic inverse scattering
- Advances in super-resolution electromagnetic imaging
- Photonic and microwave metamaterials
- Computational techniques and EM field simulators

The general lectures presented at AT-RASC were also closely connected with the domain of Commission B. In particular, the first General Lecture celebrated the sesquicentennial of Maxwell Equations: Dr. Arthur D. Yaghjian gave the talk entitled “What did Maxwell do and how did he do it: An overview of Maxwell’s Treatise”.

Furthermore, the 2015 URSI Commission B School for Young Scientists was arranged on Sunday, May 17. This time the topic was “Integral equations, fast algorithms, and parallelization strategies for the solution of extremely large problems in computational electromagnetics” with Professor Levent Gurel as instructor.

EMTS 2016 (Espoo, Finland)

The tradition of Electromagnetic Theory Symposia (EMTS) is impressive. It spans a history of over 60 years. The first gathering was in Toronto, Canada, in 1953. The year 2016 marked the twenty-second time the conference was held, this time in Espoo, Finland. EMTS2016 took place in the campus of Aalto University on 15-18 August 2016.

During the four days of the conference, a full output in electromagnetics of radio science was offered. The program of EMTS2016 consisted of 49 technical sessions, two poster sessions, and four plenary talks. The technical content of the meeting concentrated on fundamental and theoretical aspects of electromagnetics both from analytical and computational point of view. Examples of approaches were scattering and diffraction, high-frequency and beam methods, transformation optics, and boundary problems involving random media. However, also several application areas were covered, like on-body antennas and metamaterials.



The logo of EMTS2016 consists of equipotential contours of electrically charged monopole constellations.

The 261 submitted papers to the conference were evaluated by the review board which consisted of 60 experts in electromagnetics. In average, a single submission received 2.3 reviews. The final program included 247 presentations. And, of course, EMTS2016 was a perfect platform for scientific interactions after the presentations and during coffee breaks.

The amount of no-shows was pleasingly low, there were only four accepted contributions that were not presented on-site. It was also encouraging that many of our Turkish

colleagues were able to participate despite the tense political situation of their country in Summer 2016. Altogether 228 participants and 21 accompanying persons attended the EMTS2016 conference. They came from 30 different countries. All contributions that were presented in EMTS2016 are now published in IEEE Xplore.



Interactions during
coffee breaks of
EMTS2016 in Espoo.
Photo: Viktor Asadchy.

In addition to the contributed presentations, each day of the conference included a one-hour plenary talk. The talks covered the scope of commission B from theory through computations to engineering physics (video recordings of three of the plenary talks are available on the conference website <http://www.emts2016.org/>):

- Professor Friedrich W. Hehl (Universität zu Köln, Germany): Generally Covariant Maxwell Theory for Media with a Local Response: Progress since 2000
- Professor Mats Gustafsson (Lund University, Sweden): Stored Energy and Antenna Current Optimization
- Professor Mário G. Silveirinha (University of Lisbon, Instituto Superior Técnico, Portugal): Topological Photonics in a Continuum
- Professor Jin-Fa Lee (Ohio State University, USA): Computational Electromagnetics – Past, Present, and The Future

In the best of URSI traditions, a strong emphasis was put on young scientists. 20 Young Scientist Awardees (YSA) were selected from 43 applicants. These YSAs were given free registration to the conference, free accommodation, and banquet ticket. One of the poster sessions of EMTS was dedicated to these young scientists, who, in addition to their talk in one of the oral sessions, also gave a poster presentation.

Based on the submitted summaries and poster presentations, the Young Scientist Program Committee of EMTS2016, chaired by Kazuya Kobayashi, awarded three YS best paper prizes. These were given to Simon B. Adrian (Technical University of Munich, Germany, and Télécom Bretagne, France; 1000€), Marko Mikkonen (Aalto University, Finland; 750€), and Alberto Favaro (Imperial College, UK; 500€). Honorary mentions were conferred to Dimitry Valovik (Penza State University, Russia) and Xiaoyan Xiong (The University of Hong Kong).

Commission B also continued the tradition of Young Scientist Schools. On Sunday 14 August before the main conference, the 2016 URSI Commission B School for Young Scientists took place in the Finnish Nature Centre Haltia in the Nuuksio National Park. The topic of this short course was *Electromagnetic Fields and Waves: Mathematical Models and Numerical Methods*. The course instructor was Professor Yury Shestopalov assisted by Dr. Eugen Smolkin, both from University of Gävle (Sweden). 31 participants attended the school.

Expanded contributions of selected presentations in the conference will be published in the *Special Issue of the 2016 URSI International Symposium on Electromagnetic Theory* in the journal *Radio Science*. In addition, also *Radio Science Bulletin* honors the prize-winning young scientists who have been invited to write a follow-up article of their research in a forthcoming issue.

A more complete report on the EMTS2016 conference has appeared in the *Radio Science Bulletin* (No. 359, December 2016, pp.76-77), from where this text is also taken.

AP-RASC 2016 (Seoul, Korea)

Commission B took part in the organization of 2016 URSI Asia-Pacific Radio Science conference (AP-RASC'16) with the Commission B vice chairperson Professor Kazuya Kobayashi serving as the General Co-Chair of the conference. The days in August 2016 were busy times for Commission B because the AP-RASC conference took place on 21–25 August, the week after the EMTS 2016 conference.

AP-RASC'16 covered the topics of all ten URSI commissions, and in total 698 contributions were scheduled into the 107 oral and one poster sessions. Of the submitted manuscripts, 22% were from Commission B. The keynote lecture of Commission B was delivered by Professor Lotfollah Shafai of the University of Manitoba, Canada, and the title of his talk was “Challenges of antennas miniaturization and performance enhancement”.

The following Special Sessions were arranged under Commission B:

- Electrically Large Antennas
- Reconfigurable Antennas and Miniaturized Antennas
- Groundwave Propagation Modeling, Simulation and Measurement
- Metamaterials & Frequency Selective Surfaces
- Electromagnetic Field
- Wireless Power
- Computational Technique and EM
- Negative Group Delay (NGD) Devices and Applications
- Computational Techniques and EM Field Simulators
- Novel Mathematical Methods in
- Advances in Super- and High- Resolution Electromagnetic Imaging
- Multiscale Multiphysics Techniques and Applications

In addition, the joint session “RFID Antennas, Technologies, and Applications” along with Commission C was organized.

URSI-GASS 2017 (Montréal, Canada)

For the General Assembly and Scientific Symposium of our Union in August 2017, Commission B is organizing a very solid and attractive scientific programme. In addition to a tutorial lecture (“Metasurfaces: synthesis for perfect refraction and reflection of waves into arbitrary directions”) by Professor Sergei Tretyakov (Aalto University, Finland), oral and poster sessions are dedicated to the following topics:

- Electromagnetic Theory
- Solutions to Canonical Problems
- Metasurface Engineering
- Multiphysics and Multiscale Problems
- Advanced Algorithms in Computational Electromagnetics
- Integral Equation, Hybrid, and Fast Methods
- Inverse Scattering and Imaging
- Computational Electromagnetics
- Advanced Antenna Concepts
- Novel Mathematical Methods in Electromagnetics
- Recent Advances in Metamaterials
- Scattering and Diffraction
- Small Antennas from Nano to Macro Scales
- Advances in Antennas for RFID
- High-resolution Electromagnetic Sensing and Imaging

Furthermore, a memorial session will be organized honouring the life and work of Professor Staffan Ström who passed away in 2016.

EMTS 2019 (San Diego, USA)

Concerning the triennium 2017–2020, the proposal by the USNC of URSI to hold the 2019 EMT Symposium in San Diego, California was accepted in the Business meeting in GASS 2014. Professor Sembiam Rengarajan will chair the organizing committee of EMTS2019, and the preparations for the conference are already on the way. The incoming chair of Commission B, Professor Kazuya Kobayashi, will take the lead in the planning of the technical programme of EMTS 2019.

Early Career Activities

Commission B has put much efforts and financial resources on young scientists, making it possible for them to participate in the commission activities and conferences. For example, the Young Scientist Program in the EMTS 2016 meeting (free registration and

accommodation for 20 young scientists, free school event and banquet, best paper awards) had a price tag of 17620€. We used 5000€ of the Commission B funds to partially cover the expenses, the rest being taken from the registration fees of the regular participants.

The tradition of Young Scientist Schools has been continued during the triennium, as school events were organized in URSI-GASS 2014, AT-RASC 2015, and EMTS 2016.

Our ECR, Lianlin Li, has been actively participating in the steering activities of the Commission. Furthermore, he has been convening sessions on inverse scattering and imaging in all our conferences during the triennium.

Election of new officers for 2017–2020

In the Montréal URSI-GASS in August 2017, the new Vice Chair for Commission B will be elected as the present Vice Chair, Professor Kazuya Kobayashi will take the position of Chair, and Ari Sihvola will step back to serve as Past Chair. The final vote and election takes place in the business meetings of URSI-GASS. Official members for Commission B of all URSI Member committees in different countries can vote.

There are four candidates running for the position of Vice Chair of Commission B:

- Francesco P. Andriulli
- Debatosh Guha
- Paul D. Smith
- John L. Volakis

Furthermore, another Early Career Representative will be elected in Montréal. The present ECR (Professor Lianlin Li) will continue to serve three more years, and a second ECR will be elected for six years (2017–2023). There are two candidates standing for the ECR election in 2017:

- Andrea Michel
- Dimitrios Tzarouchis

Associate Editor service for *Radio Science Bulletin*

Both the Vice Chair Kazuya Kobayashi and the Early Career Representative Lianlin Li have served as Associate Editors for *Radio Science Bulletin*. They were editing several articles during the three years. A report on the EMTS 2016 conference appeared in the December 2016 issue of RSB. It is also worth noting the forthcoming “Special Issue of the Best Papers from the EMTS 2016 Young Scientist Award” in RSB.

Also a Special Issue of the 2016 URSI International Symposium on Electromagnetic Theory in the journal *Radio Science* will be edited by the Chair and Vice Chair of Commission B.

Working group activities

Commission B did not participate in any working groups.

Use of Commission funds

The funding given to Commission B from the Central URSI has been used to two purposes: participation of the Chair, Vice Chair, and ERC to the URSI Flagship meetings. The other part of the expenses was 5000€ which was used to cover the Young Scientist Program expenses in the EMTS 2016 conference. Commission B did not provide any financial support to other conferences but several meetings were given technical support by the commission.

Meetings supported by Commission B

In addition to the “own” meetings and conferences, Commission B gave technical support to 17 international conferences during 2014–2017:

| | | |
|-----------------------|---|---|
| Riva des Garda, Italy | IWMbD2016 | Second International Workshop on Metamaterials by Design — Theory, Methods and Applications to Communications and Sensing |
| Sangli, India | SCOSTEP/ISWI | SCOSTEP/ISWI International School on Space Science |
| Okinawa, Japan | ISAP 2016 | 2016 International Symposium on Antennas and Propagation |
| Chania, Greece | Metamaterials 2016 | 10th International Congress on Advanced Electromagnetic Materials in Microwaves and Optics |
| Cairns, Australia | ICEAA 2016 | Eighteenth edition of the International Conference on Electromagnetics in Advanced Applications |
| Lviv, Ukraine | MMET 2016 | 16th International Conference on Mathematical Methods in Electromagnetic Theory |
| Paris, France | Workshop on Frequencies and Radio Sciences 2016 | Workshop on Frequencies and Radio Sciences 2016 |
| Espoo, Finland | MicroRad 2016 | 14th Specialist Meeting on Microwave Radiometry and Remote Sensing of the Environment |
| Davos, Switzerland | EuCAP 2016 | European Conference on Antennas and Propagation 2016 |
| New Delhi, India | URSI-RCRS 2015 | 2nd URSI Regional Conference on Radio Science |
| Mauritius | IEEE Radio 2015 | IEEE Radio and Antenna Days of the Indian Ocean 2015 |
| Oxford, U.K. | Metamaterials 2015 | The Ninth International Congress on Advanced Electromagnetic Materials in Microwaves and Optics |

| | | |
|-----------------------------|---|---|
| Tokyo, Japan | URSI-JRSM 2015 | 2015 URSI-Japan Radio Science Meeting |
| Izmir, Turkey | CEM'15 | Computational Electromagnetics International Workshop |
| Hooghly, West Bengal, India | International Conference on Foundations and Frontiers of Computer, Electrical Engineering | International Conference on Foundations and Frontiers of Computer, Electrical Engineering: Commemorating 150 years of Maxwell's Equations |
| Lille, France | RADAR 2014 | International Radar Conference 2014 — "Catching the invisible" |
| Copenhagen, Denmark | Metamaterials 2014 | Eight International Congress on Advances Electromagnetic Materials in Microwaves and Optics |