



IC1301 -WiPE

Wireless Power Transmission for Sustainable Electronics

Working Group 3: Novel Materials and Technologies



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Agenda

» Research Topics

- > Recent trends
- > Materials
- > Technologies

» Collaboration tools

» Past and planned activities



Research Topics: Recent trends

- » Internet of Everything (IoE) and 5G requirements
 - > low-cost
 - + for commercial reasons
 - > unobtrusive/invisible integration
 - + for aesthetic reasons
 - > reliable
 - + for security reasons
 - > autonomous
 - + for practical reasons
 - > recyclable
 - + for ecological reasons



Research Topics: Novel Materials

- » Wearable WPT systems
 - > Textile systems
- » Implantable WPT systems
 - > Biocompatible materials
- » Flexible/conformable WPT systems
 - > Plastics
- » Recyclable/green WPT systems
 - > Paper
- » Low-cost/disposable WPT systems
 - > Enhanced RFID tags



Research Topics: Novel Technologies

- » Novel WPT topologies
 - > Substrate Integrated Waveguide (SIW) technology
 - > Novel active antenna topologies
 - > Multi-antenna systems, reflectarrays
 - > Metamaterials
- » Novel CAD tools for WPT
 - > Dedicated full-wave/circuit co-design and co-optimization
 - > Dedicated fast radiative near-field and UWB modelling tools
 - > Dedicated propagation tools, integrated frameworks
 - + Body-centric environments
 - + Assessment of health effects
 - > Material characterization procedures
- » 3D printing
- » Smart leaky waveguides
- » Liquid crystals



Collaboration tools

» Short-Time Scientific Missions (STSM)

> Prime tool to initiate collaboration by exchanging ESRs

> STSMs to date

1. Caroline Loss, “Electromagnetic characterization of textile materials for wearable antennas”, University Of Beira Interior, Covilhã to Ghent University, 2014-06-02 to 2014-06-30 and 2014-10-22 to 2014-11-22 → new exchange in preparation
2. Catarina Isabel Alves Lopes, “New materials and fabrication techniques for the development of substrate integrat textile antennas”, University Of Beira Interior, Covilhã to Ghent University, 2014-10-22 to 2014-11-22
3. Ali Abu-Rghaif, “RF testbed to prove GNSS signal receive algorithms”, University of Buckingham to Ghent University, 10-11-2014 to 24-11-2014
4. Maher Jassem, “RF testbed testing for multiplexed GNSS+Bluetooth signals”, University of Buckingham to Ghent University, 10-11-2014 to 24-11-2014
5. Jan Schneider, “UWB antennas for energy harvesting” TU Kosice (SK) to TU Brno (CZ), 04-05- 2015 to 28-06-2015
6. Michal Mrnka, “LTCC based directive DRA antenna”, TU Brno (CZ) to TU Kosice (SK), 09-11-2015 to 22-11-2015



Collaboration tools

» Bilateral Erasmus+ Proposals

- > Exchange of students, e.g. Master Thesis students
- > New agreements up to date
 1. Agreement University of Beira Interior (PT) and Ghent University (BE) signed, 2014
 2. Agreement University of Perugia (IT) and Ghent University (BE) signed, 2014
- > Master Thesis student exchanges up to date
 1. Lorenzo Silvestri, “Design of reconfigurable textile Substrate Integrated Waveguides”, University of Pavia to Ghent University, Academic Year 2013-2014
 2. Enrico Massoni, “Design of reconfigurable textile Substrate Integrated Textile Antennas”, University of Pavia to Ghent University, Academic Year 2014-2015



Collaboration tools

» Synergetic research

- > Combining novel materials with novel technologies
 - + Textile/paper/plastic + SIW technology
 - Example: UGent+Univ. Pavia: textile + SIW
 - + Novel active antennas based on carbon/ferromagnetic materials
 - + Validating new CAD tools based on realistic examples

» Sharing measurement tools

- > VNAs, anechoic chambers, wireless testbeds
 - Example: Univ. Buckingham +UGent: GNSS receiver + wireless testbed

» Joint measurement campaigns

» Database of available materials and technologies



Collaborations tools

» Joint book chapters

1. S. Agneessens, S. Lemey, R. Moro, M. Bozzi and H. Rogier, “Textile substrate integrated waveguide technology for the next-generation wearable microwave systems”, in *State-of-the-art in Body-Centric Wireless Communications and Associated Applications*, Q. H. Abbasi, M. Ur Rehman, K. Qaraqe and A. Alomainy Eds., IET, Stevenage, SG1 2AY, UK, Jul. 2016.
2. C. Loss, R. Salvado, P. Pinho, R. Goncalves, H. Rogier, and S. Agneessens, “Chapter 6: Textile Materials for the Design of Wearable Antennas and Circuits”, in *Wearable Technologies and Wireless Body Sensor Networks for Healthcare*, F. José Velez and F. Derogarian Miyandoab Eds., IET, Stevenage, SG1 2AY, UK, in press 2016.

» Joint journal publications

1. R. Moro, S. Agneessens, H. Rogier, A. Dierck, and Maurizio Bozzi, “Textile Microwave Components in Substrate Integrated Waveguide Technology”, *IEEE Trans. Microwave Theory Tech.*, vol. 63, no. 2, pp. 422–432, Feb. 2015.
2. O. Caytan, S. Lemey, S. Agneessens, D. Vande Ginste, P. Demeester, C. Loss, R. Salvado, and H. Rogier, “Half-Mode Substrate-Integrated-Waveguide Cavity-Backed Slot Antenna on Cork Substrate”, *IEEE Antennas and Wireless Propagation Letters*, vol. 15, Digital Object Identifier: [10.1109/LAWP.2015.2435891](https://doi.org/10.1109/LAWP.2015.2435891), pp. 162–165, 2016.
3. J. Schneider, M. Mrnka, J. Gamec, M. Gamcova, and Z., Raida, Vivaldi antenna for RF energy harvesting, *Radioengineering*, submitted.

» Joint conference publications

1. A. Abu-Rghaif, I. Lami, M. Al-Aboodi, P. Van Torre, and H. Rogier, “Galileo Signals Acquisition Using Enhanced Subcarrier Elimination Conversion and Faster Processing”, 3rd Int. Conf. on Advances in Computing, Communication and Information Technology - CCIT 2015, Birmingham, UK, 5 pages, May 2015
2. M. Al-Aboodi, I. Lami, A. Abu-Rghaif, P. Van Torre, and H. Rogier, “A Single Acquisition Channel Receiver for GPS L1CA and L2C Signals Based on Orthogonal Signal Processing”, 28th Int. Technical Meeting of The Satellite Division of the Institute of Navigation - ION GNSS+ 2015, Tampa, USA-Tampa, 3 pages, Sept. 2015
3. C. Lopes, C. Loss, R. Salvado P. Pinho, S. Agneessens and H. Rogier, “Development of Substrate Integrated Waveguides with Textile Materials by Manual Manufacturing Techniques”, 2nd International Electronic Conference on Sensors and Applications, 6 pages, Nov. 2015.
4. S. Lemey, O. Caytan, D. Vande Ginste, P. Demeester, H. Rogier, M. Bozzi, “SIW Cavity-backed Slot (Multi-)Antenna Systems for the Next Generation IoT Applications”, 2016 IEEE Radio & Wireless Week (RWW), Austin, Texas, USA, pp. 75–77, DOI: [10.1109/WISNET.2016.7444326](https://doi.org/10.1109/WISNET.2016.7444326), Jan. 2016.
5. M. Mrnka, J. Grosinger, and Z. Raida, “Wide-band dielectric resonator antennas for RF energy harvesting”, Proceedings of 14th Conference on Microwave Techniques COMITE 2015, Pardubice: University of Pardubice, 2015, p. 40-43. ISBN: 978-1-4799-8121-2.

» Joint publications and awards

- > Ghent University and University of Pavia received Best Paper Award 1st place at the IEEE Microwave Theory and Techniques Society Topical Conference on Wireless Sensors and Sensor Networks (WiSNet)
 - + “SIW Cavity-backed Slot (Multi-)Antenna Systems for the Next Generation IoT Applications”, by S. Lemey, O. Caytan, D. Vande Ginste, P. Demeester, H. Rogier, M. Bozzi, Jan. 2016



Collaborations tools

» Training Schools

> International Spring School on Electromagnetics and emerging technologies for pervasive applications: Internet of Things, Health and Safety

+ 18th–20th April, 2016, Bologna, Italy

Organizers: Prof. Alessandra Costanzo, Prof. Diego Masotti

Collaborations tools

» Joint European Projects

> Horizon 2020

- » CTTC (ES), Ghent University (BE) and KU Leuven (BE) jointly participate in EC-H2020-ICT-2014-2: Research and Innovation Action
“Flexible and efficient hardware/software platforms for 5G network elements and devices (Flex5Gware)”, 2015-2017

» Joint European Project proposals

> Horizon 2020

1. TU Brno (CZ), TU Graz (AT), Holon Institute of Technology (IL), Univ. Aveiro (PT) jointly participate in H2020-MG-2016-2017: Research and Innovation Action
“Intelligent cover materials for airplane electronics (INCOME)”

> Czech-Israeli Cooperative Scientific Research

1. TU Brno (CZ) and Holon Institute of Technology (IL), jointly participate in
“Intelligent textile materials for home healthcare”

Past events

- » EUCAP 2014 short course, Den Haag (NL)
 - > Wearable Antenna Systems for Energy-Efficient Body-Centric Communication (lecturer H. Rogier)
 - > <http://www.eucap2014.org/short-courses/Course%20Description%20-%20Rogier.pdf>
- » NEMO 2014 conference, May 14-16, Pavia (IT)
 - > Numerical EM Modeling and Optimization
 - > <http://nemo-ieee.org/>
- » PIERS 2014 Special Session, Guangzhou (China)
 - > SC4: Novel Materials and Technologies for Microwave Components (M. Bozzi, H. Rogier)
 - > http://piers.org/piers2014Guangzhou/session.php?session_id=S051

Past events

» URSI AT-RASC 2015

- > General lecture “Energy-efficient textile antenna systems for body-centric communication and sensing”, Tuesday May 19, 2015, Lecturer: H. Rogier
- > <http://www.at-rasc.com/>

» URSI AT-RASC 2015

- > Special session S-AD “Wireless Power Transmission and Energy Harvesting (COST IC1301)”, May 2015, Organizers: P. Cruz, A. Georgiadis, H. Rogier
- > <http://www.at-rasc.com/>

Upcoming events

- » URSI Electromagnetic Theory Symposium 2016
 - > Convened session “Wearable Antennas and Body-Centric Communications”, Tuesday May 19, 2015,
Conveners: S. Agneessens, A. Kiourti, H. Rogier, J. Volakis
 - > <http://www.emts2016.org/>