

Department of Radio Science and Engineering

RAD Research and Education 2012

Jari J. Hänninen (editor)

Aalto University publication series
SCIENCE + TECHNOLOGY 17/2013

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Aalto University
School of Electrical Engineering
Department of Radio Science and Engineering

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© Jari J. Hänninen (editor)

ISBN 978-952-60-5247-2 (printed)

ISBN 978-952-60-5248-9 (pdf)

ISSN-L 1799-4896

ISSN 1799-4896 (printed)

ISSN 1799-490X (pdf)

<http://urn.fi/URN:ISBN:978-952-60-5248-9>

Unigrafia Oy
Helsinki 2013

Finland



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1. Introduction

The Department of Radio Science and Engineering (RAD) is a small but essential part of Aalto University, a new University formed in January 2010 as a merger of three universities: Helsinki University of Technology, Helsinki School of Economics, and the University of Art and Design in Helsinki. Located in Otaniemi, Espoo, the RAD department belonged in 2012 as one of the seven departments to the Aalto University School of Electrical Engineering. Until the end of 2010 the School of Electrical Engineering was known as the Faculty of Electronics, Communications and Automation within the Aalto University School of Science and Technology, which was the successor of the century-old Helsinki University of Technology (TKK). The history of TKK could be traced back to mid-19th century when it was founded as the rather modest Helsinki Technical School. The institution was granted university status in 1908 by Emperor Nicholas II who was the Grand Duke of Finland until his abdication in 1917.



The RAD Department in the Otaniemi campus of Aalto University is presently within the School of Electrical Engineering. (View away from the School building. Photo by Jari J. Hänninen.)

In this report, which describes the activities of the Department of Radio Science and Engineering, the following abbreviations occur often:

- Aalto ELEC: Aalto University School of Electrical Engineering (in Finnish: Aalto-yliopiston sähkötekniikan korkeakoulu)
- RAD: Department of Radio Science and Engineering (radiotieteen ja -tekniikan laitos)
- TKK: Helsinki University of Technology (Teknillinen korkeakoulu) (historical abbreviation)
- SMARAD: Centre of Excellence in Smart Radios and Wireless Research
- GETA: The Finnish Graduate School in Electronics, Telecommunications, and Automation
- IEEE: Institute of Electrical and Electronics Engineers
- URSI: International Union of Radio Science (in French: Union Radio-Scientifique Internationale)
- SA: Academy of Finland (in Finnish: Suomen Akatemia)
- EU: European Union (Euroopan unioni)
- ESA: European Space Agency (Euroopan avaruusjärjestö)
- VTT: VTT Technical Research Centre of Finland (Teknologian tutkimuskeskus VTT)

2. Finances

The total budget of the Department of Radio Science and Engineering was 6 592 000 € (in 2011, the corresponding figure was 6 059 000 €). From this amount, the funding through the university budget (including special funding for SMARAD) was 3 462 000 € (3 235 000 €), which is 53 % (53 %) of the total. Most of the researchers and students working in the RAD Department were paid from project funding, which amounted to 3 130 000 € (2 670 000 €), meaning 47 % (44 %) of the total expenses.

Project funding from external sources in 2012 and 2011 for research was as follows (in euros):

	2012	2011
Academy of Finland (SA)	1 324 000	1 126 000
Technology Development Center (TEKES)	750 000	555 000
EU	216 000	312 000
ESA and other international partners	174 000	153 000
Finnish industry and other domestic funding	666 000	524 000
TOTAL	3 130 000	2 670 000

3. Research Teams in the RAD Department

For administrative purposes, it is helpful to divide the research personnel in the RAD department into the following groups, even if the division is artificial in some respects. Interaction between the teams is strongly encouraged and several co-operation efforts are ongoing.

- **Millimeter Wave Techniques.** The research group is led by Prof. Antti Räisänen. There are 3 other scientists with a doctoral degree (Juha Mallat, Juha Ala-Laurinaho, and Dmitri Lioubtchenko) and 8 researchers working towards their doctoral degree.
- **Advanced Artificial Materials and Smart Structures.** This research group is led by Prof. Sergei Tretyakov. The research group includes 4 other scientists with a doctoral degree (Igor Nefedov, Constantinos Valagiannopoulos, Vladimir Podlozny, and Pekka Alitalo), and 2 researchers working towards their doctoral degree.
- **Optical Radio Materials.** The research group is led by Prof. Constantin Simovski. There are 2 researchers working towards their doctoral degree.
- **RF Applications in Mobile Communications and Non-Destructive Testing.** This research group was led by Prof. Pertti Vainikainen until June 2012 and since then by Dr. Katsuyuki Haneda. There are 5 other scientists with a doctoral degree (Clemens Icheln, Jari Holopainen, Veli-Matti Kolmonen, Valeri Mikhnev, and Tommi Laitinen) and 8 researchers working towards their doctoral degree.
- **Wave–Material Interaction.** The research group is led by Prof. Ari Sihvola. The group contains 6 other scientists with a doctoral degree (Prof. Emeritus Ismo Lindell, Constantinos Valagiannopoulos, Johanna Leppävirta, Henrik Kettunen, Jiaran Qi, and Henrik Wallén), and 2 researchers working towards their doctoral degree.
- **Computational Electromagnetics.** The group is led by Prof. Keijo Nikoskinen. The group contains 5 other scientists with a doctoral degree (Tero Uusitupa, Jari Hänninen, Pasi Ylä-Oijala, Seppo Järvenpää, and Matti Taskinen), and 3 researchers working towards their doctoral degree.
- **Space Technology.** The research group is led by Prof. Martti Hallikainen. The group contains one other scientist with a doctoral degree (Jaan Praks), and 8 researchers working towards their doctoral degree.
- **Circuit Theory, Simulation, and Modeling.** The research group is led by Prof. Martti Valtonen. There are 2 other scientists with a doctoral degree (Kimmo Silvonen and Timo Veijola) and 4 researchers working towards their doctoral degree.
- **Wireless Sensors.** The research group is led by Assistant Prof. Ville Viikari.

4. Personnel

The number of permanent, full-time employees in the Department of Radio Science and Engineering financed by the University budget was 23 on December 31, 2012. The total number of employees working in the Department of Radio Science and Engineering during the year 2012 was 126.

Adil, Muhammad Quasi, B.Sc.	Research assistant from 1.6.
Ala-Laurinaho, Juha, D.Sc. (Tech.)	Senior scientist
Albooyeh, Mohammad, M.Sc.	Doctoral student from 1.2.
Alitalo, Pekka, D.Sc. (Tech.)	Post-doctoral researcher
Ben Cheikh, Sami, M.Sc.	Doctoral student from 23.1.
Bin Abdullah Al-Hadi, Azremi, M.Sc.	Doctoral student
Costa, Luis, Lic.Sc. (Tech.)	University teacher
Dahlberg, Krista, Lic.Sc. (Tech.).	Doctoral student
Du, Zhou, M.Sc.	Doctoral student
Enqvist, Anton, B.Sc. (Tech.)	Research assistant until 30.4.
Generalov, Andrey, M.Sc.	Doctoral student
Haapiainen-Laine, Sari, B.Sc.	Project secretary
Hakkarainen, Anssi, Mr.	Research assistant from 1.6.
Hallikainen, Martti, D.Sc. (Tech.)	Professor
Haneda, Katsuyuki, D.Sc.	Post-doctoral researcher
Hemmo, Jussi	Research assistant 13.2.-12.8.
Holopainen, Jari, D.Sc. (Tech.)	University lecturer
Honkala, Mikko, Lic.Sc. (Tech.)	Doctoral student
Hänninen, Jari J., D.Sc. (Tech.)	Researcher
Icheln, Clemens, D.Sc. (Tech.)	University lecturer
Ilvonen, Janne, Lic.Sc. (Tech.)	Doctoral student
Jussila, Jaakko, B.Sc.	Research assistant
Järveläinen, Jan, M.Sc. (Tech.)	Doctoral student
Järvenpää, Seppo, Ph.D.	Senior scientist
Kahra, Eino, Mr.	Laboratory technician
Kainulainen, Juha, M.Sc. (Tech.)	Doctoral student
Karilainen, Antti, M.Sc. (Tech.)	Doctoral student until 31.3.
Karttunen, Aki, Lic.Sc. (Tech.)	Doctoral student
Kataja, Juhani, M.Sc. (Tech.)	Doctoral student
Kettunen, Henrik, D.Sc. (Tech.)	Post-doctoral researcher
Kestilä, Antti, M.Sc.	Doctoral student
Khanal, Subash, M.Sc. (Tech.)	Doctoral student
Khatun, Afroza Mst, M.Sc.	Doctoral student
Khursid, Osama, M.Sc.	Doctoral student
Kiminki, Sami, M.Sc. (Tech.)	Doctoral student
Kolmonen, Veli-Matti, D.Sc. (Tech.)	Post-doctoral researcher until 31.10.
Kyrö, Mikko, Lic.Sc. (Tech.)	Doctoral student
Laakso, Lauri, Mr.	Laboratory technician
Laitinen Tommi, D.Sc. (Tech.)	Senior scientist until 18.3.
Lan, Schengchan, D.Sc.	Post-doctoral researcher from 11.1.
Laurila, Pekka, Mr.	Research assistant 13.2.-12.3.
Lehtovuori, Anu, Lic.Sc. (Tech.)	University teacher
Leinonen, Tuomas, Mr.	Research assistant from 1.9.
Leppävirta, Johanna, M.Sc.	Post-doctoral researcher until 30.6.
von Lerber, Annakaisa, M.Sc. (Tech.)	Doctoral student
Leppinen, Hannu, Mr.	Research assistant until 31.8.
Lindberg, Stina, B.Sc. (Econ.)	HR Secretary
Lioubtchenko, Dmitri, Ph.D.	Academy research fellow
Mallat, Juha, D.Sc. (Tech.)	Senior university lecturer
Markkanen, Johannes, Lic.Sc. (Tech.)	Doctoral student
Miettinen, Pekka, M.Sc. (Tech.)	Doctoral student
Mikhnev, Valeri, Dr.	Senior scientist
Molina Hurtado, Daniel, B.Sc.	Research assistant until 31.5.

Morits, Dmitry, M.Sc.	Doctoral student
Mylläri, Tuula, Ms.	Secretary
Mäkelä, Sampo, Mr.	Research assistant from 1.6.
Neerot, Martin, B.Sc.	Research assistant from 1.11.
Nefedov, Igor, Dr.Sc.	Senior scientist
Nefedova, Irina, M.Sc.	Doctoral student
Niemi, Teemu, B.Sc.	Research assistant until 30.4.
Nieminen, Markku, M.Sc. (Tech.)	Controller
Nikoskinen, Keijo, D.Sc. (Tech.)	Professor, Deputy Dean
Näsälä, Antti, Mr.	Research assistant 15.2.-31.5.
Olkkonen, Martta-Kaisa, M.Sc. (Tech.)	Doctoral student
Palkamo, Noora, Ms.	Trainee 6.2.-31.8.
Parveg, Dristy, M.Sc.	Doctoral student until 31.8.
Petäistö, Christian, B.Sc.	Research assistant 2.5.-31.10.
Planman, Irma, Ms.	HR Secretary
Podlozny, Vladimir, Ph.D.	Project manager and senior scientist
Popovici, Delia, Ms.	Project secretary
Praks, Jaan, D.Sc. (Tech.)	University teacher
Qi, Jiaran, D.Sc. (Tech.)	Postdoctoral researcher until 31.8.
Radi, Younes, M.Sc.	Doctoral student
Rasilainen, Kimmo, B.Sc. (Tech.)	Research assistant
Razzaghi, Elias, M.Sc.	Doctoral student from 1.11.
Rimpiläinen, Tommi, M.Sc. (Tech.)	Doctoral student
Rouhe, Erkka, Mr.	Process engineer
Rummukainen, Pekka, Mr.	Laboratory technician
Räisänen, Antti, D.Sc. (Tech.)	Professor, Head of the department
Saber, Arif Mohammad, B.Sc.	Research assistant 1.2.-31.8.
Schmuckli, Lorenz, Mr.	Laboratory technician
Semkin, Vasilii, M.Sc.	Doctoral student
Seppänen, Jaakko, M.Sc. (Tech.)	Doctoral student
Sievinen, Pauli, Mr.	Research assistant until 2.9.
Sibakov, Viktor, M.Sc. (Tech.)	Laboratory manager
Sihvola, Ari, D.Sc. (Tech.)	Professor, Deputy Head of the department
Silvonen, Kimmo, D.Sc. (Tech.)	Senior lecturer
Simovski, Constantin, Dr.Sc.	Professor
Tamminen, Aleks, Lic.Sc. (Tech.)	Doctoral student
Taskinen, Matti, D.Sc. (Tech.)	Senior scientist
Tikka, Tuomas, M.Sc. (Tech.)	Doctoral student from 1.2.
Tretyakov, Sergei, D.Sc.	Professor
Uusitupa, Tero, D.Sc. (Tech.)	Post-doctoral researcher until 30.6.
Vaaja, Matti, M.Sc. (Tech.)	Doctoral student
Valagiannopoulos, Constantinos, Dr.	Post-doctoral researcher
Valkonen, Risto, M.Sc. (Tech.)	Doctoral student
Vainikainen, Pertti, D.Sc. (Tech.)	Professor until 30.6.
Wallén, Henrik, D.Sc. (Tech.)	University teacher
Valtonen, Martti, D.Sc. (Tech.)	Professor
Vehmas, Joni, M.Sc. (Tech.)	Doctoral student
Venkatasubramanian, Sathya, B.Sc.	Research assistant from 1.2.
Veijola, Timo, D.Sc. (Tech.)	Laboratory manager
Viikari, Ville, D.Sc. (Tech.)	Assistant professor from 1.10.
Virk, Usman, B.Sc.	Research assistant
Ylä-Oijala, Pasi, Ph.D.	Docent, senior scientist
Zvolenský, Tomás, M.Sc.	Doctoral student

Exchange students and trainees

Asadchy, Viktor, B.Sc.	Research assistant 1.3.-16.9.
Blomqvist, Ville, Mr.	Research assistant 1.6.-31.8.
Demirpolat, Caner, B.Sc.	Research assistant 1.-31.10.
Finnholm, Johnny, Mr.	Research assistant 1.6.-31.8.
Flood, Matthew, Mr.	IAESTE trainee 1.6.-31.8.
Haimakainen, Johannes, Mr.	Research assistant 1.6.-31.10.
Hashemi, Seyedmohammad, B.Sc.	Research assistant 1.3.-30.6.
Heino, Mikko, Mr.	Research assistant 1.6.-31.8.

Hernandez Zamora, Bruno. B.Sc.
 Islam, Md. Mazidul, B.Sc.
 Miah, Md. Suzan, B.Sc.
 Mirmoosa, Mohammad Sayad, B.Sc.
 Nordling, Kalle, Mr.
 Piironen, Kalle, Mr.
 Pusa, Jehki, Mr.
 Törmänen, Olli, Mr.

Erasmus stipendiate until 31.5.
 Research assistant 1.6.-31.8.
 Research assistant 1.6.-31.8.
 Research assistant 1.6.-31.8.
 Research assistant 21.5.-31.8.
 Research assistant 1.6.-31.8.
 Research assistant 1.6.-31.8.
 Research assistant 1.6.-31.8.

Docents and Emeritus professors

Alanen, Esko, D.Sc. (Tech.)

Electromagnetics. Affiliated with the University of Kuopio

Icheln, Clemens, D.Sc. (Tech.) (from 1.11.)
 Kettunen, Lauri, D.Sc. (Tech.)

RF and microwave engineering. RAD Dept.
 Computational electromagnetics. Professor,
 Tampere University of Technology

Lehto, Arto, D.Sc. (Tech.)
 Lindell, Ismo, D.Sc. (Tech.)
 Luukanen, Arttu, D.Sc. (Tech.) (until 31.5.)

Radio engineering
 Professor emeritus
 THz technology. Research professor, Director of
 MilliLab, VTT

Malmivuo, Jaakko, D.Sc. (Tech.)
 Oksanen, Markku, D.Sc. (Tech.)
 Pulliainen, Jouni, D.Sc. (Tech.)

Theoretical electrical engineering
 Electromagnetics. Affiliated with Pöyry Group
 Remote sensing. Professor, Finnish Meteorological
 Institute

Salonen, Erkki, D.Sc. (Tech.)
 Somervuo, Pekka, D.Sc. (Tech.)
 Sten, Johan D.Sc. (Tech.) (until 30.11.)
 Tiuri, Martti, D.Sc. (Tech.)
 Tolmunen, Timo, D.Sc. (Tech.)
 Tornikoski, Merja, D. Sc. (Tech.)

Radio engineering. Affiliated with University of Oulu
 Radio engineering. Affiliated with Nokia
 Electromagnetics. VTT
 Professor emeritus
 Radio engineering. Affiliated with Turku Polytechnic
 Radio astronomy. Director of Metsähovi Radio
 Observatory

Tuovinen, Jussi, D.Sc. (Tech.)

Radio engineering. Research Professor, Vice
 President, VTT

Valtaoja, Esko, Ph.D.
 Viikari, Ville, D.Sc. (Tech.)
 Viitanen, Ari, D.Sc. (Tech.)
 Ylä-Oijala, Pasi, Ph.D.

Radio astronomy. Professor, University of Turku
 Wireless sensors and antenna measurements. VTT
 Electromagnetics
 Computational Electromagnetics. RAD Dept.

5. International Visits and Visitors

5.1 Short Visits by Foreign Scientists

- Ph.D. Polymeris Athanasios, EPFL, Switzerland, 4 days
- Prof. Mikhail Davidovich, SGU, Russia, 11 days
- Ph.D., Prof. Fabrizio Frezza, University of Sapienza Roma, Italy, 1 week
- Ph.D. Thomas Gallacher, University of St Andrews, Great Britain, 3 days
- Prof. Leung Tsang, University of Washington, USA, 3 days
- Prof. Juan Lopez-Sanchez, Unversidad de Alicante, Spain, 3 days
- Dr. Franco Mantovani, Istituto di Radioastronomia, Bologna, Italy, 3 days
- M.Sc. Meifang Zhu, University of Lund, Sweden, 3 days
- Dr. Markus Peichl, German Aerospace Research Establishment, Germany, 3 days
- Prof. Magdalena Salazar Palma, Universidad Carlos III de Madrid, Espania, 5 days
- Dr. Tapan K. Sarkar, Syracuse University, USA, 6 days
- Prof. Richard Ziolkowski, University of Arizona, USA, 3 days

5.2 Extended Visits by Foreign Scientists

- Prof. Silvio Hrabar, University of Zagreb, Kroatia, 1 month
- Dr. Yelena Maksimovitch, Institute of Applied Physics, NAS of Belarus, 1 month
- Ph.D. Christoph Menzel, University of Jena, Germany, 1 month
- M.Sc. Junichi Naganawa, Tokyo Tech, Japan, 1 month

- Dr. Kenichi Takizawa, National Institute of Information and Communications Technology, Japan, 7 months
- Dr. Nicola Tedeschi, University Roma Sapienza, 6 months

5.3 Visits in Foreign Institutes by RAD Scientists

- D.Sc. (Tech.) Pekka Alitalo, German Aerospace Center (DLR), Cologne, Germany, 2 days
- M.Sc. (Tech.) Sami Ben Cheikh, Technical University of Tokyo, Japan, 3 weeks
- Dr. Katsuyuki Haneda, Tokyo Denki University, Japan, 2 weeks
- D.Sc. (Tech.) Jari Holopainen, Rheinisch-Westfälische Technische Hochschule, Aachen, Germany, 1 month
- Lic.Sc. (Tech) Anu Lehtovuori, Université Nice Sophia Antipolis, France, 8 days
- M.Sc. (Tech.) Annakaisa von Lerber, National Center of Atmospheric Research, CO, USA, 1 month
- M.Sc. (Tech.) Johannes Markkanen, University of Kentucky, USA, 6 months
- Prof. Antti Räisänen, Universidad Politécnica de Catalunya Barcelona, Spain, 4 days
- Prof. Antti Räisänen, Universidad Politécnica de Madrid, Spain, 5 days
- M.Sc. Vasilii Semkin, Université Nice Sophia Antipolis, France, 1 month
- Prof. Sergei Tretyakov, Friedrich-Schiller Universität Jena, Germany, 1 month
- M.Sc. (Tech) Risto Valkonen, Université Nice Sophia Antipolis, France, 2 weeks

6. Teaching

SPRING SEMESTER COURSES in 2012 (periods III and IV)

S-26.2300 Radio Frequency Measurements for 3rd year students (2 credits), J. Mallat and course assistants. Basics of radio-frequency measurements, laboratory experiments on impedance measurement, spectrum measurement, and RF device measurement.

S-26.3000 Radio Engineering, special assignment for 4th year students or postgraduate students (3–8 credits), A. Räisänen, S. Tretyakov, P. Vainikainen, J. Mallat, and staff. Individual projects in connection with radio engineering research conducted in the Department of Radio Science and Engineering.

S-26.3060 Research Seminar on Radio Science and Engineering for all students but especially for 4th year and postgraduate students (1 credit), A. Räisänen and professors of the department. Weekly seminar lectures on research projects. Several visiting lectures from other research laboratories and institutes or from industry.

S-26.3100 RF and Microwave Engineering for 4th year students (5 credits), P. Vainikainen, C. Icheln, J. Järveläinen, and V. Semkin. Microstrip and other planar transmission lines, passive and active circuits, oscillators, amplifiers, multipliers, mixers, frequency synthesis, phase locking, and integrated circuits.

S-26.3120 Radio Engineering, laboratory course for 4th year students (7 credits), C. Icheln and course assistants. Microwave measurements: theory and methods. Laboratory experiments on antenna measurements, GSM transceiver characterisation, as well as design, fabrication, and measurement of a transistor amplifier. Course starts in previous autumn.

S-26.3322 Radio Systems in Telecommunication II for 4th year students (3 credits), P. Mikkola and other adjunct teachers from industry. Technology of cellular phones.

S-26.3392 Electromagnetic Compatibility for 4th year students or postgraduate students (4 credits), S. Tretyakov, P. Vainikainen, and C. Icheln. Electromagnetic compatibility and testing.

S-26.4000 Postgraduate Course in Radio Science and Engineering (3–10 credits), annually varying topics. Spring term 2012: P. Ylä-Oijala. Computational techniques.

S-55.1100 Basics of Electrical and Electronics Engineering for 1st and 2nd year students (4 credits, not for electrical engineering students), K. Silvonen and L. Costa. Students learn the basics of electrical and electronics technology. Laboratory experiments.

S-55.1220 Circuit Analysis 2 for 1st year students (5 credits), M. Valtonen, J. Hänninen, and assistants. Analyzing the transient behavior of circuits using the Laplace transform, concepts pertaining to system functions, and the operation of transmission-line circuits in both the time and the frequency domain, also the use of the Smith chart.

S-55.3110 Network Synthesis for 3rd year students (5 credits), A. Lehtovuori and L. Costa. Realizing driving point functions and transfer functions using both passive and active circuits, concept of a transmission zero, comparison of different filter realisations.

S-55.3210 Numerical Circuit Design Methods for 4th year and postgraduate students (5 credits), J. Virtanen and P. Miettinen. Numerical methods used in circuit simulation and programming the numerical algorithms. Computer exercises.

S-92.3132 Remote Sensing (6 credits), M. Hallikainen. Active (radar, lidar) and passive (scanner, radiometer, spectrometer) remote sensing instruments and their applications. Remote sensing satellites and their orbits.

S-92.3146 Radio Astronomy (4 credits), M. Tornikoski. Fundamentals of astronomy and radio astronomy. Radio astronomy antennas, receivers, and observation methods. Radio emission from the Sun, Galactic objects, and extragalactic sources. SETI. Recent results. Radio frequency interference. Future of radio astronomy.

S-92.3192 Special Assignment in Space Technology (5 credits), M. Hallikainen and J. Praks. An assignment on the development and use of space technology and its applications. The assignment may be a theoretical and/or experimental investigation, including a final report. The assignment may also be carried out by a group of students.

S-92.3200 Student Satellite Project (3-6 credits), J. Praks. The course consists of various assignments in the ongoing student satellite project. The aim of the project is to design and build a satellite, capable working in space environment. The project needs contributions from various engineering fields, including radio engineering, communications, electronics, mechanics, software engineering etc.

S-92.Z Introduction to AVR microcontroller programming (1-2 credits). A course about basics of AVR system microcontrollers.

S-92.Z Intensive course on nanosatellites (1-2 cr), International lecture series about nanosatellites and CubeSat.

S-96.1121 Dynamic Field Theory for 2nd year students (5 credits), A. Sihvola and course assistants. Undergraduate level basic electromagnetics course required of most Aalto ELEC students, part 2.

S-96.3191 Special Project in Electromagnetics for 4th year students (3–5 credits), K. Nikoskinen and A. Sihvola. Research project on a chosen electromagnetic problem.

S-96.3180 Advanced Electromagnetic Simulations for 4th year students and postgraduate students (5 credits), C. Icheln, S. Järvenpää, M. Taskinen, and course assistants. Practical skills and knowledge of solving high frequency electromagnetic problems and designs using computer-aided software tools. (2nd half of the course, the 1st half was given in autumn 2011.)

S-96.3211 Waveguides and Resonators for 4th year students (5 credits), H. Wallén. Free and guided waves, waveguide and resonator structures.

S-96.3415 Antennas - Theory for 4th year students (5 credits), K. Nikoskinen, L. Costa, and J. Holopainen. Basic principles of electromagnetic radiation and analysis of antenna structures.

EPOP course for the first and second-year students (10 credits), M. Honkala and H. Kettunen. In spring 2012 it was possible to take the courses S-55.1220 Circuit Analysis 2 and S-96.1121 Dynamic Field Theory as a package taught using interactive teaching methods. Work-life skills were also emphasized, and the course included, e.g., laboratory measurements, simulation exercises, and projects done in small groups. Read more: A. Lehtovuori, M. Honkala, H. Kettunen, and J. Leppävirta, "Promoting active learning in electrical engineering basic studies," *International Journal of Engineering Pedagogy*, no. 3, pp. 5-12, 2013.

AUTUMN SEMESTER COURSES in 2012 (periods I and II)

S-26.2100 Foundations of Radio Engineering for 3rd year students (5 credits), A. Räisänen and J. Holopainen. Transmission lines and waveguides, basic microwave components and circuits, antennas, radio wave propagation, radio systems, applications.

S-26.2110 Fundamentals of Radio Engineering for master's program students (5 credits), A. Räisänen and J. Holopainen. Transmission lines and waveguides, basic microwave components and circuits, antennas, radio wave propagation, radio systems, applications.

S-26.2900 Elements of Electromagnetic Field Theory and Guided Waves for master programme students (8 credits), A. Sihvola, C. Valagiannopoulos, and a course assistant. Basics for electromagnetic field theory and guided waves. Maxwell's equations, material equations, boundary conditions, etc. Ohm's law, Kirchhoff's law, phasors, Poynting theorem, Smith chart, plane waves, waves in waveguide, resonators etc.

S-26.3000 Radio Engineering, special assignment for 4th year students or postgraduate students (3–8 credits), A. Räisänen, S. Tretyakov, J. Mallat, and staff. Individual projects in connection with radio engineering research conducted in the Department of Radio Science and Engineering.

S-26.3060 Research Seminar on Radio Science and Engineering for all students but especially for 4th year and postgraduate students (1 credit), A. Räisänen and professors of the department. Weekly seminar lectures on research projects. Several visiting lectures from other research laboratories and institutes or from industry.

S-26.3120 Radio Engineering, laboratory course for 4th year students (7 credits), C. Icheln and course assistants. Microwave measurements: theory and methods. Laboratory experiments on antenna measurements, GSM transceiver characterisation, as well as design, fabrication, and measurement of a transistor amplifier. Course continues into following spring semester.

S-26.3150 Antennas - Practice for 4th year or postgraduate students (5 credits), J. Holopainen, C. Icheln, and J. Järveläinen. Antenna parameters, simulation methods, antennas used in mobile and fixed systems, small antennas, antenna design and measurement exercises.

S-26.3342 Radar Engineering for 4th year students or postgraduate students (4 credits), O. Klemola. Operating principle of pulsed radar, radar equation, clutter, electronic warfare, radar applications, etc.

S-26.4000 Postgraduate Course in Radio Science and Engineering (3-8 credits), annually varying topics. Autumn term 2012: C. Simovski. Metamaterials from inside.

S-55.1100 Basics of Electrical and Electronics Engineering for the 1st and 2nd year students (4 credits, not for electrical engineering students), K. Silvonen, L. Costa, and J. Holopainen. Students learn the basics of electrical and electronics technology. Laboratory experiments.

S-55.1210 Circuit Analysis 1 for 1st year students (5 credits), M. Valtonen, A. Lehtovuori, and course assistants. Students learn to analyze the operation of alternating and direct current circuits and understand the basic concepts of circuit analysis.

S-55.3230 Circuit Simulation for 3rd year students (4–5 credits), L. Costa. Students learn the fundamental use of a circuit simulator and they understand the possibilities and limitations of the circuit simulator.

S-92.3110 Radio Science for space and environmental applications (2 credits), J. Praks. The course gives an overview on space environment, current trends in space technology, and remote sensing instruments and applications. The following application topics will be covered: environmental disaster assessment from space, climate change monitoring, interplanetary exploration, deep space missions, cosmology and radio astronomy and space research in Finland. During the course several visiting top lecturers from various space research and remote sensing institutes give general lectures about their topic.

S-92.3114 Spaceflight Instrumentation (6 credits), M. Hallikainen. Design, construction and testing of space-borne instruments and their integration in satellites. Reliability analysis. Satellite orbits and spaceflights. Examples of spaceflight instrumentation projects.

S-92.3192 Special Assignment in Space Technology (5 credits), M. Hallikainen and J. Praks. An assignment on the development and use of space technology and its applications. The assignment may be a theoretical and/or experimental investigation, including a final report. The assignment may also be carried out by a group of students.

S-92.3200 Student Satellite Project (3-6 credits), J. Praks. The course consists of various assignments in the ongoing student satellite project. The aim of the project is to design and build a satellite, capable working in space environment. The project needs contributions from various engineering fields, including radio engineering, communications, electronics, mechanics, software engineering etc.

S-92.4305 Special Problems in Space Technology (5 credits), M. Tornikoski. A varying topic of current interest on space technology. This year the students designed their own interplanetary missions.

S-96.1020 History of Electrical Engineering for undergraduate and postgraduate students (3 credits), A. Sihvola. Development of electromagnetics as a science and its applications in telecommunications and power engineering up till the first part of the 20th century.

S-96.1111 Static Field Theory for 2nd year students (5 credits), J. Hänninen and course assistants. Undergraduate level basic electromagnetics course required of most Aalto ELEC students, part 1.

S-96.2180 Electromagnetic Simulations for 3rd year students (5 credits), K. Nikoskinen, H. Wallén. Introduction to two commonly used electromagnetic field simulation software packages and to the algorithms behind the programs.

S-96.3131 Electromagnetics for 3rd year students (5 credits), J. Hänninen, H. Wallén, and J. Kataja. Solution methods for classical electromagnetic field problems.

S-96.3191 Special Project in Electromagnetics for 4th year students (3-5 credits), K. Nikoskinen and A. Sihvola. Research project on a chosen electromagnetic problem.

S-96.3320 Radiowave propagation (6 credits) for 4th year students, K. Nikoskinen, K. Haneda, and course assistants. Radiowave propagation and scattering in different kinds of environments consisting of obstacles and interfaces.

S-96.3330 Numerical methods in electromagnetics (5 credits), P. Ylä-Oijala and a course assistant. A course for 4th year and postgraduate students with a varying topic of numerical methods in electromagnetics. In autumn 2012 semester: Fundamentals of the finite element method (FEM) and the method of moments (MoM).

7. Degrees

7.1 Doctor of Science (Technology)

Guifré Molera Calvés Radio Spectroscopy and Space Science with VLBI Radio Telescopes for Solar System Research
Thesis defence: 27 April 2012
Supervisor: Prof. Martti Hallikainen
Instructor: Dr. Sergei Pogrebenko, JIVE, the Netherlands
Opponent: Dr. Franco Mantovani, Istituto di RadioAstronomia, Italy
Preliminary examiners: Dr. Kaj Wiik, Tuorla Observatory, University of Turku, Finland, and Dr. Alan R. Whitney, MIT/Haystack radio observatory, USA

Antti Karilainen Magnetic Materials and Responses in Antenna Applications
Thesis defence: 10 August 2012
Supervisor: Prof. Sergei Tretyakov
Opponent: Prof. Richard Ziolkowski, University of Arizona, USA
Preliminary examiners: Prof. Andrea Alù, University of Texas at Austin, USA, and Prof. Ferran Martin, Universitat Autònoma de Barcelona, Spain

- Jaan Praks Radar Polarimetry and Interferometry for Remote Sensing of Boreal Forest
Thesis defence: 23 November 2012
Supervisor: Prof. Martti Hallikainen
Opponent: Prof. Juan Manuel López-Sánchez
Preliminary examiners: Prof. Erkki Tomppo, Finnish Forest Research Institute, Finland, and Dr. Iain H. Woodhouse, The University of Edinburgh, UK
- Juha Lemmetyinen Microwave Radiometry of Snow Covered Terrain and Calibration of an Interferometric Radiometer
Thesis defence: 27 November 2012
Supervisor: Prof. Martti Hallikainen
Instructor: Prof. Jouni Pulliainen, Finnish Meteorological Institute, Finland
Opponent: Prof. Leung Tsang, University of Washington, USA
Preliminary examiners: Prof. Paolo Pampaloni, Consiglio Nazionale delle Ricerche, Istituto di Fisica Applicata “Nello Carrara”, Italy, and Prof. Marco Tedesco, City College of New York, USA

7.2 Licentiate of Science (Technology)

- Johannes Markkanen Integral Equation Methods for Extreme Materials and Surfaces (Integraaliyhtälömenetelmät erikoisille materiaaleille ja pinnoille)
Graduation date: 15 March 2012
Supervisor: Prof. Ari Sihvola
 Research done at Aalto University Department of Radio Science and Engineering
- Janne Ilvonen Environment Insensitive Mobile Terminal Antennas (Ympäristölle epäherkät matkaviestinantennit)
Graduation date: 28 May 2012
Supervisor: Prof. Pertti Vainikainen
 Research done at Aalto University Department of Radio Science and Engineering
- Mst Afroza Khatun Advanced Scanning Techniques for Field Synthesis and Near-field Antenna Measurements
Graduation date: 18 June 2012
Supervisor: Prof. Pertti Vainikainen
 Research done at Aalto University Department of Radio Science and Engineering

7.3 Diploma Engineer (M.Sc. (Tech.))

- Tuomas Tikka Attitude and Control System Implementation for 3-Axis Stabilized Nanosatellites (Asennonsäätöjärjestelmän toteutus 3-akselistabiloituihin nanosatelliitteihin)
Graduation date: 19 March 2012
Supervisor: Prof. Martti Hallikainen
 Research done at Aalto University Department of Radio Science and Engineering
- Teemu Niemi Polarization Transformations in Bianisotropic Arrays (Polarisaatiomuunnokset bianisotrooppisissa hiloissa)
Graduation date: 16 April 2012
Supervisor: Prof. Sergei Tretyakov
 Research done at Aalto University Department of Radio Science and Engineering

Xu Lei	Bordered Block-Diagonal Preserved Model-Order Reduction for RLC Circuits <i>Graduation date:</i> 11 June 2012 <i>Supervisor:</i> Prof. Martti Valtonen Research done at Aalto University Department of Radio Science and Engineering
Ilmari Kangas	Validation of Tissue Simulant Parameters for Compliance Standards of Body Worn Devices (Kudoksia simuloivien parametrien validisointi keholla kannettavien laitteiden altistusstandardeille) <i>Graduation date:</i> 27 August 2012 <i>Supervisor:</i> Prof. Keijo Nikoskinen Research done at Nokia Oyj
Pauli Sievinen	Retrieval of Urban Morphology by Means of Remote Sensing (Kaupunkialueen muotojen havainnointi kaukokartoitusinstrumentteja hyväksikäyttäen) <i>Graduation date:</i> 17 September 2012 <i>Supervisor:</i> Prof. Martti Hallikainen Research done at Aalto University Department of Radio Science and Engineering
Subash Khanal	Pulsed and Transient Characterization of THz Schottky Diodes <i>Graduation date:</i> 15 October 2012 <i>Supervisor:</i> Prof. Antti Räisänen Research done at Aalto University Department of Radio Science and Engineering
Song Jinsong	On Optimization and Read-out Resolution of the Zero Power Sensor <i>Graduation date:</i> 19 November 2012 <i>Supervisor:</i> Prof. Antti Räisänen Research done at VTT
Usman Virk	Characterization of Vehicle Penetration Loss at Wireless Communication Frequencies <i>Graduation date:</i> 19 November 2012 <i>Supervisor:</i> Prof. Antti Räisänen Research done at Aalto University Department of Radio Science and Engineering
Caner Demirpolat	X-Band Interferometric Radar for Mapping Temporal Variability in Forest <i>Graduation date:</i> 17 December 2012 <i>Supervisor:</i> Prof. Martti Hallikainen Research done at Aalto University Department of Radio Science and Engineering

8. Research

8.1 Framework

RAD is the home of the Centre of Excellence in Smart Radios and Wireless Research (SMARAD) and MilliLab. SMARAD has been nominated to the status of centre-of-excellence in research by the Academy of Finland for years 2002–2007 and 2008–2013. MilliLab, the Millimetre Wave Laboratory of Finland, is a joint research institute of VTT Technical Research Centre of Finland and Aalto University. It has enjoyed the status of an External Laboratory of the European Space Agency (ESA) since 1995.

RAD has very good facilities for experimental and computational research: circuit, antenna and propagation measurement capabilities from microwaves to terahertz frequencies, a research aircraft for remote sensing measurements, and access to microelectronics clean rooms (Micronova), a millimetre wave radio telescope (Metsähovi), and supercomputers (CSC).

8.2 Research activity

Information about recent research activity can be found on the Department web site at <http://radio.aalto.fi/en/>. The research topics of year 2012 are portrayed in the publications below.



A "space truck" containing a space exhibition toured Finland in October 2012. A special feature of the exhibition was Aalto University's mobile laboratory allowing visitors to contribute to the design of Aalto-1 nanosatellite. Photo courtesy of Avaruusrekka.

9. Publications

9.1 Books and Chapters in Books

1. M. Hulkkonen, M. Honkala, J. Virtanen, and M. Valtonen, "Initialization of HB oscillator analysis from transient data," in *Scientific Computing in Electrical Engineering SCEE 2010* (B. Michiels and J.-R. Poirier, eds.), Berlin, Springer, 2012, pp. 285-292.
2. C. Icheln, M. Martinez-Vazquez, C. Peixeiro, C. Luxey, A. Sharaiha, E. Antonino-Daviu, and R. Serrano, "Mobile communication terminals," in *Handbook on Small Antennas* (L. Jofre, M. Martinez-Vazquez, R. Serrano, and G. Roqueta, eds.), Brussels, EurAAP Technical Working Group on Compact Antennas, 2012, p. 716.
3. P. Miettinen, M. Honkala, J. Roos, and M. Valtonen, "Improving model-order reduction methods by singular exclusion," in *Scientific Computing in Electrical Engineering SCEE 2010* (B. Michiels and J.-R. Poirier, eds.), Berlin Heidelberg, Springer, 2012, pp. 387-394.
4. P. Miettinen, M. Honkala, J. Roos, and M. Valtonen, "Partitioning-based reduction of circuits with mutual inductances," in *Scientific Computing in Electrical Engineering SCEE 2010* (B. Michiels and J.-R. Poirier, eds.), Berlin, Springer, 2012, pp. 395-403.
5. C. Oestges, N. Czink, P. De Doncker, V. Degli-Esposti, K. Haneda, W. Joseph, M. Lienard, L. Liu, J. Molina-Garcia-Pardo, M. Narandzic, J. Poutanen, F. Quitin, and E. Tanghe, "Radio channel modeling for 4g networks," in *Pervasive Mobile and Ambient Wireless Communications* (R. Verdone and A. Zanella, eds.), London, Springer, 2012.
6. F. Tufvesson, K. Haneda, and V.-M. Kolmonen, "Multi-user MIMO channels," in *LTE-Advanced and Next Generation Wireless Networks: Channel Modelling and Propagation* (G. d. I. Roche, A. A. Glazunov, and B. Allen, eds.), Chichester, Wiley, 2012, pp. 187-214.
7. J. Virtanen, E. J. W. ter Maten, T. G. J. Beelen, M. Honkala, and M. Hulkkonen, "Initial conditions and robust Newton-Raphson for harmonic balance analysis of free-running oscillators," in *Progress in Industrial Mathematics at ECMI 2010* (M. Günther, A. Bartel, M. Brunk, S. Schöps, and M. E. Striebel, eds.), Berlin, Springer, 2012, pp. 29-36.

1. M. Albooyeh, D. Morits, and S. Tretyakov, "Effective electric and magnetic properties of metasurfaces in transition from crystalline to amorphous state," *Physical Review B*, vol. 85, no. 205110, 2012.
2. M. Albooyeh and C. Simovski, "Huge local field enhancement in perfect plasmonic absorbers," *Optics Express*, vol. 20, no. 20, pp. 21888-21895, 2012.
3. P. Alitalo, A. Culhaoglu, A. Osipov, S. Thurner, E. Kemptner, and S. Tretyakov, "Experimental characterization of a broadband transmission-line cloak in free space," *IEEE Transactions on Antennas and Propagation*, vol. 60, no. 10, pp. 4963-4968, 2012.
4. P. Alitalo, A. Culhaoglu, A. Osipov, S. Thurner, E. Kemptner, and S. Tretyakov, "Bistatic scattering characterization of a three-dimensional broadband cloaking structure," *Journal of Applied Physics*, vol. 111, p. 034901, 2012.
5. P. Alitalo and S. Tretyakov, "Numerical modeling and characterization of selected electromagnetic cloaking structures," *International Journal of RF and Microwave Computer-Aided Engineering*, vol. 22, no. 4, pp. 483-495, 2012.
6. P. Alitalo and C. Valagiannopoulos, "Demonstration of electromagnetic cloaking of conducting object by dielectric material cover," *Electronics Letters*, vol. 48, no. 17, pp. 1056-1057, 2012.
7. D. Baranov, A. Vinogradov, and C. Simovski, "Perfect absorption at Zenneck wave - plane wave transition," *Metamaterials*, vol. 6, no. 6, pp. 70-75, 2012.
8. D. Baranov, A. Vinogradov, K. Simovskii, I. Nefedov, and S. Tretyakov, "On the electrodynamics of an absorbing uniaxial nonpositive determined (indefinite) medium," *Journal of Experimental and Theoretical Physics*, vol. 114, no. 4, pp. 568-574, 2012.
9. A. V. Chebykin, A. A. Orlov, C. R. Simovski, Y. S. Kivshar, and P. A. Belov, "Nonlocal effective parameters of multilayered metal-dielectric metamaterials," *Physical Review B (Condensed Matter and Materials Physics)*, vol. 86, no. 10, p. 115420, 2012.
10. A. Chipouline, C. Simovski, and S. Tretyakov, "Basics of averaging of the Maxwell equations for bulk materials," *Metamaterials*, vol. 6, no. 3-4, pp. 77-120, 2012.
11. A. A. Generalov, D. V. Lioubtchenko, J. A. Mallat, V. Ovchinnikov, and A. V. Räisänen, "Mm-wave power sensor based on silicon rod waveguide," *IEEE Transactions on Terahertz Science and Technology*, vol. 2, no. 6, pp. 623-628, 2012.
12. K. Haneda, A. Richter, and A. Molisch, "Modeling the frequency dependence of ultrawideband spatio-temporal radio channels," *IEEE Transactions on Antennas and Propagation*, vol. 60, no. 6, pp. 2940-2950, 2012.
13. S. Hashemi and I. Nefedov, "Wideband perfect absorption in arrays of tilted carbon nanotubes," *Physical Review B*, vol. 86, no. 19, p. 195411, 2012.
14. J. Kainulainen, A. Colliander, J. Closa, R. Oliva, M. Martin-Neira, G. Buenadicha, P. Rubiales Alcaine, A. Hakkarainen, and M. Hallikainen, "Radiometric performance of the SMOS reference radiometers - assessment after one year of operation," *IEEE Transactions on Geoscience and Remote Sensing*, vol. 50, no. 5, pp. 1367-1383, 2012.
15. A. Karilainen and S. Tretyakov, "Circularly polarized receiving antenna incorporating two helices to achieve low backscattering," *IEEE Transactions on Antennas and Propagation*, vol. 60, no. 7, pp. 3471-3475, 2012.
16. A. Karilainen and S. Tretyakov, "Isotropic chiral objects with zero backscattering," *IEEE Transactions on Antennas and Propagation*, vol. 60, no. 9, pp. 4449-4452, 2012.
17. A. Karttunen, J. Säily, A. E. I. Lamminen, J. Ala-Laurinaho, R. Sauleau, and A. V. Räisänen, "Using optimized eccentricity rexolite lens for electrical beam steering with integrated aperture coupled patch array," *Progress in Electromagnetics Research B*, no. 44, pp. 345-365, 2012.
18. S. Khanal, T. Kiuru, J. Mallat, O. Luukkonen, and A. V. Räisänen, "Measurement of dielectric properties at 75 - 325 GHz using a vector network analyzer and full-wave simulator," *Radioengineering Journal: Special Issue on Advanced RF Measurement*, vol. 21, no. 2, pp. 551-556, 2012.
19. A. Khatun, T. Laitinen, V.-M. Kolmonen, and P. Vainikainen, "Dependence of error level on the number of probes in over-the-air multiprobe test systems," *International Journal of Antennas and Propagation*, vol. 2012, no. 624174, pp. 1-6, 2012.
20. M. Kyrö, K. Haneda, J. Simola, K.-i. Takizawa, H. Hagiwara, and P. Vainikainen, "Statistical channel models for 60 GHz radio propagation in hospital environments," *IEEE Transactions on Antennas and Propagation*, vol. 60, no. 3, pp. 1569-1577, 2012.
21. M. Kyrö, V.-M. Kolmonen, and P. Vainikainen, "Experimental propagation channel characterization of mm-wave radio links in urban scenarios," *IEEE Antennas and Wireless Propagation Letters*, vol. 11, no. 11, pp. 865-868, 2012.

22. M. Larciprete, A. Albertoni, A. Belardini, G. Leahu, R. Li Voti, F. Mura, C. Sibilina, I. Nefedov, I. Anoshkin, E. Kauppinen, and A. Nasibulin, "Infrared properties of randomly oriented silver nanowires," *Journal of Applied Physics*, vol. 112, no. 112, p. 083503, 2012.
23. I. Liberal, I. Nefedov, I. Ederra, R. Gonzalo, and S. Tretyakov, "Reconfigurable artificial surfaces based on impedance loaded wires close to a ground plane," *IEEE Transactions on Antennas and Propagation*, vol. 60, no. 4, pp. 1921-1930, 2012.
24. I. V. Lindell, L. Bergamin, and A. Favaro, "Decomposable medium condition in four-dimensional representation," *IEEE Transactions on Antennas and Propagation*, vol. 60, no. 1, pp. 367-376, 2012.
25. I. V. Lindell and A. Sihvola, "Simple skewon medium realization of DB boundary condition," *Progress in Electromagnetics Research Letters*, vol. 30, no. 30, pp. 29-39, 2012.
26. L. Liu, C. Oestges, J. Poutanen, K. Haneda, P. Vainikainen, F. Quitin, F. Tufvesson, and Doncker, "The COST2100 MIMO channel model," *IEEE Wireless Communications*, vol. 19, no. 6, pp. 92-99, 2012.
27. I. S. Maksymov, A. R. Davoyan, A. E. Miroshnichenko, C. Simovski, P. A. Belov, and Y. S. Kivshar, "Multifrequency tapered plasmonic nanoantennas," *Optics Communications*, p. 050, 2012.
28. J. Markkanen, C.-C. Lu, X. Cao, and P. Ylä-Oijala, "Analysis of volume integral equations for scattering by high-contrast penetrable objects," *IEEE Transactions on Antennas and Propagation*, vol. 60, no. 5, pp. 2367-2374, 2012.
29. J. Markkanen, P. Ylä-Oijala, and A. Sihvola, "Discretization of volume integral equation formulations for extremely anisotropic materials," *IEEE Transactions on Antennas and Propagation*, vol. 60, no. 11, pp. 5195-5202, 2012.
30. S. Maslovski and S. Tretyakov, "Perfect lensing with phase-conjugating surfaces: toward practical realization," *New Journal of Physics*, vol. 14, no. 3, p. 035007, 2012.
31. D. Morits and C. Simovski, "Isotropic negative refractive index at near infrared," *Journal of Optics A, Pure and applied Optics*, no. 14, p. 125102, 2012.
32. I. Nefedov, "Effects of electromagnetic interaction in periodic arrays of single-wall metallic carbon nanotubes," *Materials Physics and Mechanics*, vol. 13, no. 1, pp. 1-8, 2012.
33. T. Niemi, P. Alitalo, A. Karilainen, and S. Tretyakov, "Electrically small Huygens source antenna for linear polarisation," *IET Microwaves, Antennas & Propagation*, vol. 6, no. 7, pp. 735-739, 2012.
34. A. Popov, M. Shalaev, S. Myslivets, V. Slabko, and I. Nefedov, "Enhancing coherent nonlinear-optical processes in nonmagnetic backward-wave materials," *Applied Physics A*, vol. 109, no. 4, pp. 835-840, 2012.
35. J. Poutanen, F. Tufvesson, K. Haneda, V.-M. Kolmonen, and P. Vainikainen, "Multi-link MIMO channel modeling using geometry-based approach," *IEEE Transactions on Antennas and Propagation*, vol. 60, no. 2, p. 596, 2012.
36. J. Praks, O. Antropov, and M. Hallikainen, "Lidar-aided SAR interferometry studies in boreal forest: Scattering phase center and extinction coefficient at X- and L-band," *IEEE Transactions on Geoscience and Remote Sensing*, vol. 50, no. 10, pp. 3831-3843, 2012.
37. K. Rautiainen, J. Lemmetyinen, J. Pulliainen, J. Vehviläinen, M. Drusch, A. Kontu, J. Kainulainen, and J. Seppänen, "L-band radiometere observations of soil processes in Boreal and subarctic environments," *IEEE Transactions on Geoscience and Remote Sensing*, vol. 50, no. 5, pp. 1483-1497, 2012.
38. T. Rimpiläinen, H. Wallén, H. Kettunen, and A. Sihvola, "Electrical response of systropic sphere," *IEEE Transactions on Antennas and Propagation*, vol. 60, no. 11, pp. 5348-5355, 2012.
39. A. Sihvola, J. Leppävirta, and H. Kettunen, "Signs, curls, time variations: learning to appreciate Faraday's law," *Advanced Electromagnetics*, vol. 1, no. 1, pp. 1-5, 2012.
40. K. Silvonen, K. Dahlberg, and T. Kiuru, "16-term error model in reciprocal systems," *IEEE Transactions on Microwave Theory and Techniques*, vol. 60, no. 11, pp. 3551-3558, 2012.
41. C. R. Simovski, P. A. Belov, A. Atraschenko, and Y. S. Kivshar, "Wire metamaterials: Physics and applications," *Advanced Materials*, vol. 24, no. 31, pp. 4229-4248, 2012.
42. C. R. Simovski and O. Luukkonen, "Tapered plasmonic waveguides with efficient and broadband field transmission," *Optics Communications*, p. 040, 2012.
43. A. Tack, J. Koskinen, A. Hellsten, P. Sievinen, I. Esau, J. Praks, J. Kukkonen, and M. Hallikainen, "Morphological database of paris for atmospheric modeling purposes," *IEEE Journal of Selected Topics in Applied Earth Observation and Remote Sensing*, vol. 5, no. 6, pp. 1803-1810, 2012.
44. P. Vainikainen, J. Holopainen, and M. Kyrö, "Antennas for digital television receivers in mobile terminals," *Proceedings of the IEEE*, vol. 100, no. 7, pp. 2341-2348, 2012.

45. C. Valagiannopoulos and P. Alitalo, "Electromagnetic cloaking of cylindrical objects by multilayer or uniform dielectric claddings," *Physical Review B*, vol. 85, no. 115402, p. 7, 2012.
46. C. Valagiannopoulos, M. Bimpas, and N. Uzunoglu, "Implementation of the thin-wire approximation for estimating the characteristics of a metallic reinforcement bar embedded into a concrete column with circular cross section," *Microwave and Optical Technology Letters*, vol. 54, no. 3, pp. 761-767, 2012.
47. C. Valagiannopoulos and A. Sihvola, "On modeling perfectly conducting sharp corners with magnetically inert dielectrics of extreme complex permittivities," *IEEE Transactions on Antennas and Propagation*, vol. 60, no. 10, pp. 4777-4784, 2012.
48. C. Valagiannopoulos and C. Simovski, "An iterative semi-analytical technique solving the boundary value problem of transmission through an anisotropic wedge," *Radio Science*, vol. 47, no. RS6004, pp. 1-9, 2012.
49. C. Valagiannopoulos, N. Tsitsas, and G. Fikioris, "Convergence analysis and oscillations in the method of fictitious sources applied to dielectric scattering problems," *Journal of the Optical Society of America A*, vol. 29, no. 1, pp. 1-10, 2012.
50. C. Valagiannopoulos and N. Tsitsas, "Integral equation analysis of a low-profile receiving planar microstrip antenna with a cloaking superstrate," *Radio Science*, vol. 47, no. RS2022, p. 12, 2012.
51. C. Valagiannopoulos and N. Tsitsas, "Field enhancement in a grounded dielectric slab by using a single superstrate layer," *Advances in OptoElectronics*, vol. 2012, no. 439147, p. 9, 2012.
52. C. Valagiannopoulos, "On jamming unfriendly submarine communication by radiating across an island in the vicinity of the opponent's coastline," *Taylor & Francis Electromagnetics*, vol. 32, no. 7, pp. 438-449, 2012.
53. R. Valkonen, C. Icheln, and P. Vainikainen, "Power dissipation in mobile antenna tuning circuits under varying impedance conditions," *IEEE Antennas and Wireless Propagation Letters*, vol. 11, pp. 37-40, 2012.
54. J. Vehmas, P. Alitalo, and S. Tretyakov, "Experimental demonstration of antenna blockage reduction with a transmission-line cloak," *IET Microwaves, Antennas & Propagation*, vol. 6, no. 7, pp. 830-834, 2012.
55. P. Ylä-Oijala, S. P. Kiminki, K. Cools, F. Andriulli, and S. Järvenpää, "Mixed discretization schemes for electromagnetic surface integral equations," *International Journal of Numerical Modelling: Electronic Networks, Devices and Fields*, vol. 25, no. 22, pp. 525-540, 2012.
56. P. Ylä-Oijala, S. P. Kiminki, K. Cools, F. Andriulli, and S. Järvenpää, "Stable discretization of combined source integral equation for scattering by dielectric objects," *IEEE Transactions on Antennas and Propagation*, vol. 60, no. 5, pp. 2575-2578, 2012.

9.3 Published Proceedings of International Conferences

1. R. Addaci, A. Diallo, P. Le Thuc, R. Staraj, H. Katsuyuki, and P. Vainikainen, "Evaluation of diversity and MIMO performance of a new high port to port isolation dual-band system," in *IEEE Antennas and Propagation Society, AP-S International Symposium (Digest)*, 8 July 2012 - 14 July 2012, p. 6348020.
2. J. Ala-Laurinaho, D. Chicherin, Z. Du, C. Simovski, T. Zvolensky, A. V. Räisänen, M. Sterner, Z. Baghchehsaraei, U. Shah, S. Dudorov, J. Oberhammer, A. Boriskin, L. Le Coq, E. Fourn, S. Muhammad, R. Sauleau, A. Vorobyov, F. Bodereau, G. El Haj Shhade, T. Labia, P. Mallejac, J. Åberg, M. Gustafsson, and T. Schier, "TUMESA – MEMS tuneable metamaterials for smart wireless applications," in *Proceedings of the 7th European Microwave Integrated Circuits Conference*, Amsterdam, The Netherlands, EuMA, 29-30 October, 2012, pp. 95-98.
3. M. Albooyeh and C. R. Simovski, "Electromagnetic characterization of metasurfaces in presence of substrate-induced bianisotropy," in *Int. Conference Days on Diffraction 2012*, Saint Petersburg, Russia, May 28 - June 1, 2012, pp. 115-117.
4. M. Albooyeh and C. Simovski, "Huge local field enhancement in perfect plasmonic absorber," in *Metamaterials 2012, 6 International Congress on Advanced Electromagnetic Materials in Microwaves and Optics*, St. Petersburg, Russia, September 17-22, 2012, pp. 136-139.
5. M. Albooyeh, D. Morits, and S. Tretyakov, "Effective response of metasurfaces: from periodical to random structures," in *International Conference on Electromagnetics in Advanced Applications (ICEAA 2012)*, Cape Town, South Africa, 2-7 September, 2012, pp. 87-88.
6. P. Alitalo, A. Culhaoglu, A. Osipov, S. Thurner, E. Kemptner, and S. Tretyakov, "Experimental characterization of electromagnetic cloaking structures with bistatic measurements at X-band," in *6th European Conference on Antennas and Propagation (EuCAP 2012)*, Prague, Czech Republic, March 26-30, 2012.

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ISBN 978-952-60-5247-2
ISBN 978-952-60-5248-9 (pdf)
ISSN-L 1799-4896
ISSN 1799-4896
ISSN 1799-490X (pdf)

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