

TALLINNA TEHNIKAÜLIKOOL

Thomas Johann Seebecki Elektroonikainstituut

Läbi vaadanud:

Prof. Toomas Rang.
Direktor
09.01.2015

TEADUS- JA ARENDUSTEGEVUSE AASTAARUANNE

TALLINN
2014

INFOTEHNOLOOGIA TEADUSKOND
THOMAS JOHANN SEEBECKI ELEKTROONIKAINSTITUUT
TEADUS- JA ARENDUSTEGEVUSE AASTAARUANNE 2014

1. Instituudi struktuur

Thomas Johann Seebecki elektroonikainstituut;
Thomas Johann Seebeck Department of Electronics
Hea of the Department/Instituudi direktor: Prof. Toomas Rang

- Siduselektronika õppetool, Chair of Communicative Electronics, Prof. Toomas Rang
- Siduselektronika teaduslabor, Communicative Electronics Research Laboratory (Baselab SIE), Dr. Paul Annus.
- Pooljuhtelektronika teaduslabor, Semiconductor Electronics Research Laboratory (BaseLab MINAKO), Prof. Toomas Rang

2. Instituudi teadus- ja arendustegevuse (edaspidi T&A) iseloomustus

2.1. Description of the research activities:

Communicative Electronics Research Laboratory (Baselab SIE)

Investigation into spectrally sparse signals and sequences, with main emphasis on improved algorithms for synthesis and optimization continued. Possibility for optimization of the methods for synchronous real time processing of the spectrally sparse response from objects was investigated. Wide range of possible usability scenarios and application areas were under investigation, including those required for medical diagnosis; for analyzing of micro-droplets; materials and structures like smart composites; precise measurement of the properties of alloys; properties of algae; improvement of pulse oximetry with joint usage of electrical and optical impedance; investigation of the activity of neural cells (together with Chalmers Technical University in Gothenburg) and most importantly for effective differentiation between normal and cancerous tissue. New impedance measurement solutions for improvement of energy consumption estimation and energy efficiency in portable devices were targeted.

Solutions for usage in the field of medicine range for creation of an algorithm for generating vascular networks in small tissue scale for later usage during modelling of blood flow dynamics to investigation of transfer characteristics of vascular system. Work was carried out in cooperation with East Tallinn Central Hospital, North Estonian Regional Hospital, Sahlgrenska Hospitalet in Gothenburg and TAK ELIKO.

In the field of simulations an electric impedance measurement with 2 electrodes on the dynamic 3D vascular 1 layer network was investigated. The results of the simulation were impedance signals that show changing impedance signal due to pulsatile blood-flow in the small tissue patch.

Research was carried out on conversion and processing algorithms of adaptively oversampled and modulated signals with applications mainly in the impedance spectroscopy and image processing. End-applications range from determining properties of the materials and alloys to smart composites. Topics under investigation include embedded sensors, short range communication issues, signal processing and energy harvesting solutions in connection with composite materials. Solutions for precise measurement of the properties of alloys and (Euro-)coins have been developed based on the methods of the impedance spectroscopy.

Investigation of the possibilities of developing of novel solutions and algorithms for the fast and precise profiling of the roads, by using of the laser projection and smart image processing.

Most important results:

- Developing of the methods for optimal design of spectrally rich excitation signals for impedance spectroscopy. Applications yield the best results in the world at the moment. The implementation are patented (3 US patents).
- Development of methods for the monitoring of structures, materials and surfaces by the aid of novel 3D laser scanning (1 patent application), eddy current excitation and electromechanical impedance analysis (1 US patent).

Selected publications.

1. Märtens, O.; Land, R.; Gordon, R.; Min, M.; Rist, M.; Pokatilov, A. (2014). Precise eddy current measurements: Improving accuracy of determining of the electrical conductivity of metal plates. Kanoun, O. (Toim.). *Lecture Notes on Impedance Spectroscopy: Measurement, Modeling and Applications* (109 - 115). London: Taylor & Francis
2. Herranen, H.; Kuusik, A.; Saar, T.; Reidla, M.; Land, R.; Märtens, O.; Majak, J. (2014). Acceleration Data Acquisition and Processing System for Structural Health Monitoring. *In: Proceedings of the 2014 IEEE International Workshop On Metrology For Aerospace: IEEE International Workshop On Metrology For Aerospace, Benevento, Italy, May 29 - 30, 2014.*, Benevento, Italy: IEEE, 2014, 244 - 249.
3. Min, M.; Paavle, T. (2014). Broadband discrete-level excitations for improved extraction of information in bioimpedance measurements. *Physiological Measurement* (IOP, Bristol, UK), **35**(6), 2014 May 20, pp. 997 - 1010. DOI:10.1088/0967-3334/35/6/997.
4. Ojarand, J.; Min, M.; Annus, P. (2014). Crest factor optimization of the multisine waveform for bioimpedance spectroscopy. *Physiological Measurement* (IOP, Bristol, UK), **35**(6), 2014 May 20, pp. 1019 - 1033. DOI: 10.1088/0967-3334/35/6/1019.
5. Min, M.; Parve, T.; Pliquet, U.F (2014). Impedance Detection. In: Dongqing Li (ed.), *Encyclopedia of Microfluidics and Nanofluidics*. Springer, Berlin/Heidelberg, 12 Sep 2014, 28 pages. <http://www.springerreference.com/index/chapterdbid/367827>. DOI: 10.1007/SpringerReference_367827.

Semiconductor Electronics Research Laboratory (BaseLab MINAKO)

Experimental and numerical study of wide and semi-wide bandgap materials based semiconductor devices; design and fabrication of improved semiconductor components using non-traditional technologies (e.g. DWT); Specific investigations (DLTS spectroscopy, numerical experiments) of electro-physical parameters (deep levels and their influence on electrical characteristics) in semiconductor structures.

Based on the currently available simulation models the potential failure of operation of the device could occur when the body of the diode package is not sufficiently cooled, reaching operating area where failure occurs due to device physics (increase of currents, inability to withstand reverse voltage) than thermal burnout. The abnormal high temperature must last for a long time to change the device internal structure through diffusion of impurities.

The DLTS spectra obtained from the analyzed $p^+ - pin - n^+$ structures demonstrate the presence of electron- and hole-type deep levels in all investigated samples. Within each group, the configuration of the spectra is identical. This indicates that the sources of defects are stable, reproducible and

depend on the variations in technology for epitaxial growth. The width of the space charge calculated from the C - V characteristic exceeds the width of i -layer and spreads into the p and n depletion regions. The permanent change in the capacitance over all the temperature range and the very weak dependence of the capacitance on the reverse voltage indicate that the thickness of the overcompensated layer practically coincides with the thickness of the space charge, as well as indicating evidence of a homogeneous spatial distribution of defects across the width of the space charge.

Together with the Furtwangen University of Applied Sciences (Germany) the investigation of the exposure possibilities of the direct laser tool and of selection a suitable photoresist for 3D (greyscale) applications and to provide the preliminary process solution for fabricating greyscale structures in the photoresist have been done. The result of the development work has reached the proposals of most suitable photoresists and developers because of its properties like thickness and contrast, which were easily adjustable to process parameters.

The finalization of the cooperation with TI led to development of new lay-out realization for low voltage and low noise application in a single LDO. Special low noise architecture was implemented to improve noise performance. This was achieved by taking out all the main noise contributors like resistive divider with a reference amplifier into a separate group and then passing the resulting signal through a low pass filter with a very large time constant onto a voltage follower. This resulted in extremely low output noise which was verified by both simulation and measurement.

Most important results:

- The nature of the defects associated with the energy level EL_2 is generally caused by atomic permutation or to atomic vacancy complex mechanisms. We showed that important that during the LPE growth of epitaxial GaAs layers the EL_2 -level together with HL_2 -trap (B center) and HL_5 -trap (A-center) participates in the formation of i -layer. The appearance of the donor deep level EL_2 is observed at the onset crystallization temperature $T_{\text{cryst}} > 850^\circ\text{C}$, and thus the EL_2 level can act as a control engine for A- and B- centers in i -region of GaAs pin -structures.
- The applied research for photoresist development concludes that the slope structures introduced the proof that the tactile sensor is applicable for visually impaired people. The provided greyscale solution is suitability for more sophisticated structures (e.g. lenses).

Selected publications.

1. Koel, Ants; Rang, Toomas; Rang, Galina (2014). Characterization of the temperature dependent behavior of snappy phenomenon by switch-off of power GaAs diode structures. B. Sundén; C. A. Brebbia (Toim.). Heat Transfer XIII (439 - 449). Great Britain: WIT Press.
2. Kaste, Nigol; Filbert, Alexander; Mescheder, Ulrich; Rang, Toomas; Rang, Galina (2014). Process Development for 3D Laser Litography. W.P. Wilde, S.Hernandez, C. A. Brebbia (Toim.). High Performance and Optimum Design of Structures and materials (139 - 150). Inglismaa: Wessex Institute of Techonology Press.
3. Toompuu, J.; Korolkov, O.; Sleptsuk, N.; Rang, T. (2014). Investigation of Deep Level Centers in i - and n -Layers of GaAs pin -Diodes. In: *Proceedings of the 14th Biennial Baltic Electronics Conference: BEC2014 2014 14th Biennial Baltic Electronics Conference*. (Toim.) Toomas Rang, Peeter Ellervee. Tallinn: IEEE, 2014, 25 - 28.

Loetelu struktuuriüksuse töötajate rahvusvahelistest tunnustustest.

1. O. Märten, R. Land (with co-authors from ELIKO M. Rist, and from METROSERT A. Pokatilov): NI Products Best Application Contest Award of the IEEE Workshop on Metrology for Aerospace, Benevento, Italy, 2014.
2. Yar Muhammad Mughal (with co-authors Yannick Le Moullec, Paul Annus, Mart Min): Young Investigator Award (YIA) by Springer and IFMBE for the paper „Development of a Bio-Impedance Signal Simulator on the basis of the Regression-based Model of the Cardiac and Respiratory Impedance Signals“

2.3.Loetelu struktuuriüksuse töötajatest, kes on välisakadeemiate või muude oluliste T&A-ga seotud välisorganisatsioonide liikmed.

Prof. Toomas Rang:

- Journal "Electronics and Electrical Engineering" (Kaunas, Lithuania), member of the editorial board;
- Georgian Academy of Sciences, external scientific expert;
- British Engineering and Physical Sciences Research Council, external expert;
- International Program Committee of Baltic Electronics Conference BEC (Estonia), chairman;
- IEEE (USA), member;
- IEEE Education Chapter Estonia, chairman;
- Board of the Estonian Association of Engineers, member.

Prof. Mart Min:

- International Association for Bioelectromagnetism, president;
- Journal "Electronics and Electrical Engineering" (Kaunas, Lithuania), member of the editorial board;
- Journal of Electrical Bioimpedance, section editor;
- International Society of Electrical Bioimpedance, member;
- International Society of Electro-cardiology, member
- IEEE International Instrumentation and Measurement Society conferences I2MTC, member of the program committee
- "Proceedings of Riga Technical University - Electronics and Telecommunications" (Riga, Latvia), member of the editorial board
- International Committee for Promotion of Research in Bio-Impedance (ICPRBI), member

Dr. Olev Märten:

- IEEE IM/EMB/ED, Estonian section, chapter chair;

2.4. Aruandeaasta tähtsamad T&A finantseerimise allikad.

Institutsionaalne uurimisteema IUT19-11; TAR8077IE, Integreeritud elektroonikasüsteemide ja biomeditsiinitehnika tippkeskus CEBE; 2 ETF granti ja 2 lepingut välisriikidega (EL raamprogramm ja ettevõtlus), 1 Eesti riikliku programmi (materjalitehnoloogia).

2.6 Soovi korral lisada aruandeaastal saadud T&A-ga seotud tunnustusi (va punktis 2.3 toodud tunnustused), ülevaate teaduskorralduslikust tegevusest, teadlasmobiilsusest ning anda hinnang oma teadustulemustele.

Ei soovi

2.7 Instituudi teadus- ja arendustegevuse teemade ja projektide nimetused (*Eesti Teadusinfosüsteemi, edaspidi ETIS, andmetel*)

- Haridus- ja Teadusministeerium
 - Institutsionaalne uurimisteema:
IUT19-11, Impedants-spektroskoopia põhine objektide identifitseerimine ja juhtimine: signaalid, algoritmid, energiasäästlikud lahendused, Min Mart (2014 – 2019)
 - baasfinantseerimise toetusfondist rahastatud projektid (sh TTÜ tippkeskused):
 - riiklikud programmid:
 - Teiste ministeeriumide poolt rahastatavad riiklikud programmid:
AR12139, Smart composites: design and manufacturing, National R&D program „Materials technology“. RP Materjalitehnoloogia teadus- ja arendustegevuse toel (01.07.12 - 31.12.14)
Involved researchers: Olev Märtnens, Raul Land, Rauno Gordon, Mart Min, Ago Mõlder

Uuriija-professori rahastamine:

- Eesti Teadusagentuur
 - grandid:
ETF9394, Elektriliste kudede diagnostikameetodite arendamine veresoonekonna dünaamilisi mõjutusi arvestades, Gordon Rauno (2012 – 2014)
ETF8592, Laia keelutsooniga materjalidel baseeruvad integreeritud Schottky ja heterosiirded: tehnoloogiad ja modelleerimine, Rang Toomas (2011 – 2014)

Instituut osaleb kahes Eesti teekaardi projektis:

5. Eesti kiirekanal MAX-IV sünkrotronkiirguse allikale (ESS - European Spallation Source) projektis (koordinaator Prof. Toomas Rang).
8. Eesti osalus Euroopa Tuumauuringute Keskuses (CERN) projektis (koordinaator Prof. Mart Min).

ESS projekti raamides alustati 2014 *in-kind* projekti ettevalmistusi kiirendi toitemuundurite väljatöötamiseks koostöös TTU Elektrotehnika instituudi ja Lundi Ülikooliga. Tegevus jätkub aastal 2015.

Jaauaris 2015 kirjutas EV haridusminister alla Eesti liitumise European Spallation Source ERIC-uga ja Eesti on Rootsi, Taani ja Ungari järel neljas riik, kes statuudile alla kirjutas ning kuulub üle-euroopaliku initsiatiivi asutajariikide hulka.

– ühisgrandid välisriigiga:

– järeldoktorite grandid (SA ETF ja Mobilitas):

– tippteadlase grandid (Mobilitas):

- Ettevõtluse Arendamise SA

– eeluuringud:

– arendustoetused:

- SA Archimedesega sõlmitud lepingud

– infrastruktuur (nn „mini-infra“, „asutuse infra“):

IUT19-11AP14, Impedants-spektroskoopia põhine objektide identifitseerimine ja juhtimine: signaalid, algoritmid, energiasäästlikud lahendused, Min Mart (1.01.2013 - 31.12.2014)

ÜLTAP29-1, Energiasäästlikud mikro- ja nanostruktuursed sardsüsteemid ja komponendid (SARS4), Eva Keerov (1.06.2012 - 18.01.2014)

– Eesti tippkeskused:

TAR8077IE, Integreeritud elektroonikasüsteemide ja biomeditsiinitehnika tippkeskus, Mart Min (7.07.2008 - 31.08.2015)

– riiklikud programmid:

AR12118, materjalitehnoloogia, Efficient plasmonic absorbers for solar cells, Alvar Kurrel (1.07.2012 - 31.12.2014)

– muud T&A lepingud:

- SA Keskkonnainvesteeringute Keskusega sõlmitud lepingud:

- Siseriiklikud lepingud:

- Invest Science OÜ, "Terase identifitseerimine pöörisvooluga", Lep14005, periood 13.01.2014-01.04.2014, (12000eur). Vastutav täitja Olev Märten;

- Minix OÜ, "Meenemedalite automaat" Lep14009, periood 01.01.2014-31.03.2014 (4000eur). Töövõtuleping Hannes Mäehans, vastutav täitja Raul Land;

- Valge Laik OÜ, "Li-ion akudel töötav LED-lamp", Lep14012, periood 20.01.2014-23.02.2015, (5650eur). Vastutav täitja Argo Kasemaa;

- Mektory Prototron projekt „A medical-grade bioimpedance spectroscopy device”, periood 01.01.2014-30.09.2014 (35 000 EUR). Vastutav täitja Mart Min.

- EL Raamprogrammi projektid:

VFP567, FP7-SME, Innovative, Highly Efficient Road Surface Measurement and Control System, Olev Märten (01.08.12 - 31.07.14)

- Välisriiklikud lepingud:

2.8 Strukturiüksuse töötajate poolt avaldatud eelretsenseeritavad teaduspublikatsioonid (*ETIS klassifikaatori alusel 1.1, 1.2, 1.3, 2.1, 2.2, 3.1, 3.2, 3.3, 4.1 ja 5.1*).

Kategooria 1.1

1. Mölder, A.; Märten, O.; Saar, T.; Land, R. (2014). Laser Line Detection with Sub-Pixel Accuracy. *Elektronika ir Elektrotehnika*, 20(5), 132 - 135.
2. Min, M.; Paavle, T. (2014). Broadband discrete-level excitations for improved extraction of information in bioimpedance measurements. *Physiological Measurement (IOP, Bristol, UK)*, 35(6), 2014 May 20, pp. 997 - 1010. DOI:10.1088/0967-3334/35/6/997.
3. Ojarand, J.; Min, M.; Annus, P. (2014). Crest factor optimization of the multisine waveform for bioimpedance spectroscopy. *Physiological Measurement (IOP, Bristol, UK)*, 35(6), 2014 May 20, pp. 1019 - 1033. DOI: 10.1088/0967-3334/35/6/1019.
4. Min, M.; Parve, T.; Pliquett, U.F (2014). Impedance Detection. In: Dongqing Li (ed.), *Encyclopedia of Microfluidics and Nanofluidics*. Springer, Berlin/Heidelberg, 12 Sep 2014, 28 pages. <http://www.springerreference.com/index/chapterdbid/367827>. DOI: 10.1007/SpringerReference_367827.
5. Ojarand, J.; Min, M. (2014). Efficient Excitation Signals for the Fast Impedance Spectroscopy. *Elektronika ir Elektrotehnika*, 20(5), 144 - 149. Bilinskis, I.; Sudars, K.; Min, M. (2014). Method for Wideband Signal Digitizing and their Real-time Reconstruction in Enlarged Dynamic Range. *Electronics and Electrical Engineering*, 20(6), 110 - 113.
6. Bilinskis, I.; Sudars, K.; Min, M. (2014). Method for Wideband Signal Digitizing and their Real-time Reconstruction in Enlarged Dynamic Range. *Electronics and Electrical Engineering*, 20(6), 110 - 113.

Kategooria 3.1

1. Märten, O.; Land, R.; Gordon, R.; Min, M.; Rist, M.; Pokatilov, A. (2014). Precise eddy current measurements: Improving accuracy of determining of the electrical conductivity of metal plates. Kanoun, O. (Toim.). *Lecture Notes on Impedance Spectroscopy: Measurement, Modeling and Applications (109 - 115)*. London: Taylor & Francis
2. Märten, O.; Land, R.; Rist, M.; Pokatilov, A. (2014). High-accuracy Eddy Current Measurements of Metals. In: *Proceedings of the 2014 IEEE International Workshop On Metrology For Aerospace, : IEEE International Workshop On Metrology For Aerospace, Benevento, Italy, May 29 - 30, 2014.* Benevento, Italy: IEEE, 2014, 155 - 160.
3. Herranen, H.; Kuusik, A.; Saar, T.; Reidla, M.; Land, R.; Märten, O.; Majak, J. (2014). Acceleration Data Acquisition and Processing System for Structural Health Monitoring. In: *Proceedings of the 2014 IEEE International Workshop On Metrology For Aerospace: IEEE International Workshop On Metrology For Aerospace, Benevento, Italy, May 29 - 30, 2014.* Benevento, Italy: IEEE, 2014, 244 - 249.
4. Märten, O.; Pille, S.; Reidla, M. (2014). Capacitance Measurement With MSP430 Microcontrollers. In: *Proceedings: EDERC2014 : EDERC2014 (Embedded Design in Education & Research Conference), Milan (Italy), 11-12 September 2014. (Toim.) J.J.Soraghan et al.* Milan, Italy: IEEE, 2014, 260 - 263.
5. Gavrijaseva, A.; Märten, O.; Land, R.; Reidla, M. (2014). Coin Recognition Using Line Scan Camera. In: *Proceedings of the 14th Biennial Baltic Electronics Conference: 2014 14th Biennial Baltic Electronics Conference, Tallinn, 2014.* IEEE, 2014, 161 - 164.
6. Mölder, A.; Märten, O.; Saar, T.; Land, R. (2014). Extraction of the Variable Width Laser Line. In: *Proceedings of the 14th Biennial Baltic Electronics Conference: 2014*

7. Märtens, O.; Land, R.; Gordon, R.; Min, M.; Rist, M.; Pokatilov, A. (2014). Precise eddy current measurements: Improving accuracy of determining of the electrical conductivity of metal plates. Kanoun, O. (Toim.). *Lecture Notes on Impedance Spectroscopy: Measurement, Modeling and Applications* (109 - 115). London: Taylor & Francis
8. Märtens O.; Land, R.; Rist, M.; Pokatilov, A. (2014). High-accuracy Eddy Current Measurements of Metals. *In: Proceedings of the 2014 IEEE International Workshop On Metrology For Aerospace; IEEE International Workshop On Metrology For Aerospace, Benevento, Italy, May 29 - 30, 2014.*. Benevento, Italy: IEEE, 2014, 155 - 160.
9. Herranen, H.; Kuusik, A.; Saar, T.; Reidla, M.; Land, R.; Märtens, O.; Majak, J. (2014). Acceleration Data Acquisition and Processing System for Structural Health Monitoring. *In: Proceedings of the 2014 IEEE International Workshop On Metrology For Aerospace; IEEE International Workshop On Metrology For Aerospace, Benevento, Italy, May 29 - 30, 2014.*. Benevento, Italy: IEEE, 2014, 244 - 249.
10. Märtens, O.; Pille, S.; Reidla, M. (2014). Capacitance Measurement With MSP430 Microcontrollers. *In: Proceedings: EDERC2014 : EDERC2014 (Embedded Design in Education & Research Conference), Milan (Italy), 11-12 September 2014. (Toim.) J.J.Soraghan et al.* Milan, Italy: IEEE, 2014, 260 - 263.
11. Gavrijaseva, A.; Märtens, O.; Land, R.; Reidla, M. (2014). Coin Recognition Using Line Scan Camera. *In: Proceedings of the 14th Biennial Baltic Electronics Conference: 2014 14th Biennial Baltic Electronics Conference, Tallinn, 2014.* IEEE, 2014, 161 - 164.
12. Mölder, A.; Märtens, O.; Saar, T.; Land, R. (2014). Extraction of the Variable Width Laser Line. *In: Proceedings of the 14th Biennial Baltic Electronics Conference: 2014 14th Biennial Baltic Electronics Conference, Tallinn, Estonia, October 6-8, 2014.* IEEE, 2014, pp.157-160.
13. Mughal, Y. M.; Le Moullec, Y.; Annus, P.; Min, M. (2014). Development of a Bio-Impedance Signal Simulator on the basis of the Regression based Model of the Cardiac and Respiratory Impedance Signals. *In: 16th Nordic-Baltic Conference on Biomedical Engineering: 16th Nordic-Baltic Conference on Biomedical Engineering & Medical Physics and the 10th MedTech Days 2014. (Toim.) H. Mindedal, M. Persson.* Springer, 2014, (IFBME Proceedings; 48), 92 - 95.
14. Yar M. Mughal, Paul Annus, Mart Min, Rauno Gordon: An Overview of the Impedance Models of the Thorax and the Origin of the Impedance Cardiography Signal and

- Modeling of the Impedance Signals, 2014 IEEE Conference on Biomedical Engineering and Sciences (IECBES 2014), Miri, Sarawak, Malaysia, December 8-10, 2014.
15. Krivoshei, Andrei; Min, Mart; Uuetoa, Hasso; Lamp, Jürgen; Annus, Paul (2014). Electrical Bio-Impedance based non-invasive method for the central aortic blood pressure waveform estimation. *In: Proceedings of the 14th Biennial Baltic Electronics Conference: 2014 International Baltic Electronics Conference (BEC2014), Tallinn-Laulasmaa, October 6-8, 2014. (Toim.) T. Rang.* Tallinn: IEEE-Inst Electrical Electronics Engineers Inc, 2014, 181 - 184.
 16. Giannoukos, G.; Min, M. (2014). Modelling of Dynamic Electrical Bioimpedance and Measurements Safety. *In: AASRI Procedia: 2nd AASRI Conference on Computational Intelligence and Bioinformatics.* Elsevier, 2014, 12 - 18.
 17. Rist, Marek; Reidla, Marko; Land, Raul; Parve, Toomas; Märtnens, Olev; Annus, Paul; Ojarand, Jaan; Min, Mart (2014). Modular System for Spectral Analysis of Time-Variant Impedances. *In: 858 IFMBE Proceedings 45: 6th European Conference of the International Federation for Medical and Biological Engineering (MBEC 2014), Dubrovnik, 7-11 September, 2014. (Toim.) I. Lacković and D. Vasić.* Heidelberg: Springer Heidelberg, 2014, 858 - 861.
 18. Ojarand, J.; Min, M.; Annus, P.; Gorev, M.; Ellervee, P. (2014). Optimization of Multisine Excitation for a Bioimpedance Measurement Device. *In: 2014 IEEE International Instrumentation and Measurement Technology Conference Proceedings: 2014 IEEE International Instrumentation and Measurement Technology Conference (I2MTC 2014), Montevideo, Uruguay, May 12-15, 2014.* Hoboken, NJ, USA: IEE Conference Publications, 2014, 829 - 832.
 19. Krivoshei, A.; Min, M.; Lamp, J.; Annus, P. (2014). Robust Algorithm for the Augmentation Index Estimation of the CAP using Low Order Derivatives. MeMeA 2014 – IEEE International Symposium on Medical Measurements and Applications, 11-12 June 2014 at ISCTE-IUL, the Lisbon University Institute, Lisboa, Portugal. IEEE, 2014.
 20. Paavle, T.; Min, M. (2014). Time-domain manipulating of short-time chirps: Improvement energy and spectral properties. *In: Proc. of 14th Biennial Baltic Electronics Conference: 14th Biennial Baltic Electronics Conference (BEC2014), Tallinn, Estonia, Oct.6-8, 2014.* Tallinna Tehnikaülikool, 2014, 129 - 132.
 21. Koel, Ants; Rang, Toomas; Rang, Galina (2014). Characterization of the temperature dependent behavior of snappy phenomenon by switch-off of power GaAs diode structures. B. Sundén; C. A. Brebbia (Toim.). Heat Transfer XIII (439 - 449). Great Britain: WIT Press
 22. Kaste, Nigol; Filbert, Alexander; Mescheder, Ulrich; Rang, Toomas; Rang, Galina (2014). Process Development for 3D Laser Litography. W.P. Wilde, S.Hernandez, C. A. Brebbia (Toim.). High Performance and Optimum Design of Structures and materials (139 - 150). Inglismaa: Wessex Institute of Techonology Press
 23. Toompuu, J.; Korolkov, O.; Sleptsuk, N.; Rang, T. (2014). Investigation of Deep Level Centers in i- and n-Layers of GaAs pin-Diodes. *In: Proceedings of the 14th Biennial Baltic Electronics Conference: BEC2014 2014 14th Biennial Baltic Electronics Conference. (Toim.) Toomas Rang, Peeter Ellervee.* Tallinn: IEEE, 2014, 25 - 28.
 24. Mihhailov, J.; Strik, V.; Strik, S.; Rang, T. (2014). Low Noise LDO Architecture with Consideration for Low Voltage Operation. *In: Proceedings of the 14th Biennial Baltic Electronics Conference: BEC2014 2014 14th Biennial Baltic Electronics Conference. (Toim.) T. Rang, P. Ellervee.* Tallinn: IEEE, 2014, 41 - 44.

2.9 Struktuuriüksuses kaitstud doktoriväitekirjade loetelu (*NB! struktuuriüksus lisab struktuuriüksuse töötaja juhendamisel mujal kaitstud doktoriväitekirjade loetelu*)

Ants Koel, Thomas Johann Seebecki elektroonikainstituut

Teema: GaAs and SiC semiconductor materials based power structures: static and dynamic behavior analysis.

Juhendaja: Prof. Toomas Rang

Kaitstes: 30.05.2014

Omistatud kraad: filosoofiadoktor (elektroonika)

Reeno Reeder, Thomas Johann Seebecki elektroonikainstituut

Teema: Development and optimisation of modelling methods and algorithms for terahertz range radiation sources based on quantum well heterostructures

Juhendajad: emeriitprofessor Enn Velmre ja vanemteadur Andres Udal

Kaitstes: 30.05.2014

Omistatud kraad: filosoofiadoktor (elektroonika)

Jana Toompuu, Thomas Johann Seebecki elektroonikainstituut

Teema: Investigation of the specific deep levels in p-, i- and n-regions of GaAs p+-pin-n+ structures

Juhendajad: Prof. Toomas Rang ja Dr. Oleg Korolkov

Kaitstes: 12.12.2014

Omistatud kraad: filosoofiadoktor (elektroonika)

2.10 Struktuuriüksuses järel doktorina T&A-s osalenud isikute loetelu (*ETIS-e kaudu esitatud taotluste alusel*)

2.11 Struktuuriüksuses loodud tööstusomandi loetelu

1. Estonian Application:

P201400044, O.Märtens, A. Mölder, R.Land et al, (18.12.2014). Method and Device for acquiring stream of the precisely time-stamped images (Pideva täpsete aja-templitega pildivoo kujutiste hõivamise meetod ja seade).

2. USA Application

USA Patents

1.USA patent **US 8854030B2** (07.10.2014). Method and device for frequency response measurement
Inventors: Olev Märtens, Mart Min, Raul Land, Paul Annus, Tõnis Saar, Marko Reidla.

2.USA patent **US 8773151B2** (08.07.2014). Method and device for multichannel multifrequency analysis of an object. Inventors: Mart Min, Paul Annus, Antti Haapalainen, Alar Kuusik, Raul Land, Toomas Parve, Ants Ronk.

3.USA Patent **US 8674680B2** (08.03.2014). Method and device for fast measurement of frequency response with scalable short chirp signals. Inventors: Mart Min, Toivo Paavle, Raul Land, Paul Annus, Toomas Parve.

Osalemise konverentsidel.

1. Mart Min, 15-16.12.2014, Annual Conference 2014 of the University of Tartu (Institute of Molecular and Cell Biology, Estonian Genome Centre and Estonian Biocentre), Tartu. Ettekanne "Electrical bioimpedance: what it is and how to eat it?"
2. Mart Min, 7-9.11. 2014, Füüsika Sügiskool (Tartu Ülikool), Nelijärve. Ettekanne "Inimene ja impedants: rakendused meditsiinis".
3. Mart Min. 02-03.10.2014, 20 Years Anniversary Conference of Estonian Society for Biomedical Engineering and Medical Physics and the Department of Biomedical Engineering, Tallinn. Ettekanne: Electrical Impedance in biology and medicine.
4. Mart Min. 7-11.09.2014, 6th European Conference of the International Federation for Medical and Biological Engineering (MBEC 2014), Dubrovnik (Croatia). Ettekanne: Modular System for Spectral Analysis of Time-Variant Impedances.
5. Toivo Paavle. 06-08.10.2014, Baltic Electronics Conference (BEC2014) Tallinn/Laulasmaa. Ettekanne: Time-domain manipulating of short-time chirps: Improvement energy and spectral properties.
6. Andrei Krivoshei. 06-08.10.2014, Baltic Electronics Conference (BEC2014) Tallinn/Laulasmaa. Ettekanne: Electrical Bio-Impedance based non-invasive method for the central aortic blood pressure waveform estimation.
7. Yar M. Mughal. 14-16.10.2014, 16th Nordic-Baltic Conference on Biomedical Engineering & Medical Physics and the 10th MedTech Days 2014, Gothenburg, Sweden. Ettekanne: Development of a Bio-Impedance Signal Simulator on the basis of the Regression based Model of the Cardiac and Respiratory Impedance Signals.
8. Yar M. Mughal. 8-10.12.2014. IEEE Conference on Biomedical Engineering and Sciences (IECBES 2014), Miri, Sarawak, Malaysia. Ettekanne: An Overview of the Impedance Models of the Thorax and the Origin of the Impedance Cardiography Signal and Modeling of the Impedance Signals.
9. Frederick Rang. Participation at the Microsoft TechEd Europe 2014 conference, 26.-02.11.2014, Fia de Barcelona, Madrid, Spain.
10. Yannick Le Moullec, Conference "Asia Pacific Signal and Information Processing Association Annual Summit and Conference 2014 (APSIPA ASC)", organized by Asia Pacific Signal and Information Processing Association (APSIPA); 9-12 December 2014, Siem Reap, Cambodia; oral presentation of our paper "A Modular 6LoWPAN-based Wireless Sensor Body Area Network for Health-Monitoring Applications", Le Moullec, Y.; Lecat, Y.; Annus, P.; Land, R.; Kuusik, A.; Reidla, M.; Hollstein, T.; Reinsalu, U.; Tammemäe, K.; Ruberg, P.
11. Olev Märten, EDERC Texas Instrumrnts'i (TI) EUP (Euroepan University programm korraldatud, koostöös IEEE-ga) ja Eurasip'iga, 11-12. September 2014, Milano, Itaalia. Ettekanne: Martens, O.; Pille, S.; Reidla, M. (2014). Capacitance Measurement With MSP430 Microcontrollers. *In: Proceedings: EDERC2014 : EDERC2014 (Embedded Design in Education & Research Conference), Milan (Italy), 11-12 September 2014. (Toim.) J.J.Soraghan et al.* Milan, Italy: IEEE, 2014, 260 - 263.
12. Toomas Rang, Osalemise konverentsi „The 2014 International Conference on High Performance and Optimum Design of Structures and Materials“, Oostende 9-11 juuni, Belgium“ juhtkomitee koosolekul.
13. Mart Min, 23-27.09.2014, 7th International Workshop on Impedance Spectroscopy. Tutorial: Spectroscopy of time-variant impedances.

Thomas Johann Seebecki elektroonikainstituut koostöös Arvutitehnika instituudiga korraldas järjekorras juba 13. rahvusvahelise konverentsi „Baltic Electronic Conference BEC2014“. Prof. Toomas Rang programmikomitee esimees ja juhtkomitee liige ning Prof. Peeter Ellervee programmikomitee ase-esimees ja juhtkomitee liige. Konverents toimus 6-8 oktoobrini Tehnikaülikoolis (Mektory maja) ja Laulasmaa SPA Konverentsikeskuses.

Osalemine koolitustel:

1. Mart Min. Loeng-tutorial (3-es osas) „Signals in Impedance Spectroscopy “Chemnitz”i Tehnikaülikoolis Saksamaal (90 osalejat), 24.09.2014.