1. Instituudi struktuur

Raadio- ja sidetehnika instituut, Department of Radio and Communication Engineering
Instituudi direktor Andres Taklaja (alates 01.01.2013 Toomas Ruuben)

- Mikrolainetehnika õppetool, Chair of Microwave Equipment, Andres Taklaja
- Raadiotehnika õppetool, Chair of Radio Engineering, Toomas Ruuben
- Signaalitöötluse õppetool, Chair of Signal Processing, Tõnu Trump
- Telekommunikatsiooni õppetool, Chair of Telecommunications, Eerik Lossmann
- Elektromagnetilise ühilduvuse teaduslaboratoorium, Electromagnetic Compatibility Laboratory

2. Instituudi teadus- ja arendustegevuse (edaspidi T&A) iseloomustus
(NB! punktid 2.1- 2.6 täidab struktuuriüksus)

2.1 struktuuriüksuse koosseisu kuuluvate uurimisgruppide
2.1.1 teadustöö kirjeldus *(inglise keeles)*;

There are four research groups at the Department of Radio and Communications Engineering:

Microwave Engineering Research Group (Prof. Andres Taklaja)

Objectives of the Microwave Engineering Research Group are designing, prototyping, laboratory and field testing of military radiocommunications jamming devices and Radio-Controlled Improvised Explosive Devices (RCIED) neutralizing devices.

Signal Processing Research Group (Prof. Tõnu Trump)

Research at the Signal Processing Research Group is focused on two main areas – adaptive signal processing algorithms and cognitive signal processing together with spectrum sensing.

Radio Wave Propagation Research Group (Assoc. Prof. Eerik Lossmann, Assoc. Prof. Urve Madar)

Research activities at the Group involve analysis of received signal level and background noise level measurement results for the purposes to describe statistically medium-length shortwave radio communications channels according to the Rayleigh and Rician fading channel models.

Man-Machine Relationship Research Group (Assoc. Prof. Toomas Ruuben)

Man-Machine Relationship Research Group is participating in international project CARDINAL supported by EDA (European Defence Agency). The group has been focused on two main areas of the project – intelligent perception support and decision support in military conditions.

2.1.2 aruandeaastal saadud tähtsamad teadustulemused *(inglise keeles)*.

<u>Microwave Engineering Research Group</u>

The research group continued the development of RCIED neutralizing devices and methodology for efficient detection and jamming of RCIED control signals. Novel techniques for fast detection of unknown radio signals were developed and tested. A research was initiated in the area of jamming of radiocommunications using antenna arrays. Directivity properties of various types of planar arrays (rectangular, circular etc.) were studied using modeling of the arrays in MATLAB.

<u>Signal Processing Research Group:</u>

In the area of adaptive algorithms the research continued to focus on combinations of two adaptive filters. When designing an ordinary adaptive algorithm, one faces a trade-off between the initial convergence speed and the mean-square error in steady state. In case of algorithms belonging to the Least Mean Square (LMS) family this trade-off is controlled by the step-size parameter. Large step size leads to a fast initial convergence but the algorithm also exhibits a large mean-square error in the steady state and in contrary, small step size slows down the convergence but results in a small steady state error. The combination of two adaptive filters solves this trade-off by employing two filters that adapt simultaneously on the same input signal. One of the filters has a large step size allowing fast convergence and the other one has a small step size for a small steady state error.

<u>Radio Wave Propagation Research Group</u>

A methodology is developed for SNR and BER estimation for medium-range HF communications links over Estonian mainland. Rician fading channel together with surface wave as stable component and ionospheric reflections as variable component is considered. Estimated values of K parameter are in the range from 1.3 to 9. Corresponding BER curves for communications links using 8PSK signals without and with FEC indicate insufficient reliability of HF links with relatively high level of ionospheric component (K < 5). The proposed robust technique for operating frequency selection facilitates more reliable establishment of HF data link in high latitude regions.

<u>Man-Machine Relationship Research Group:</u>

Man-Machine Relationship Research Group continued to participate in international project CARDINAL supported by EDA (European Defence Agency). The challenge in the CARDINAL project is to coordinate information flows such that military actors get the right information (no more and no less) at the right time. The project therefore aims at the design and development of an information coordination system that will provide real-time tactical support to military troops on the ground while performing their tasks in urban environments. Intelligent path planning algorithm was developed together with modelling of several path planning strategies in MATLAB environment. Due to project tasks changes, workstation GUI is also developed by TTU team. Developed path planning algorithm is integrated in to the GUI based workstation and together with the parterns from France, Nederland and Norway, we implemented many tools and algorithms for it. Most iportant of them are virtual CARDINAL world database with historical and mission timelines. Final demonstration of the project was 26.11.2012. All deiverables are sent and now the project is finished. Member states have a plan to continue with the next step in near future.

2.2 Uurimisgrupi kuni 5 olulisemat publikatsiooni läinud aastal.

1) Berdnikova, J.; Ruuben, T.; Kozevnikov, V.; Astapov, S. (2012). Acoustic Noise Pattern Detection and Identification Method in Doppler System. Electronics and Electrical Engineering, 18(8), 65 - 68.

2) Trump, T. (2012). A Robust Adaptive Sensor Array with Slepian Sequences. The Seventh IEEE Sensor Array and Multichannel Signal Processing Workshop,} Hoboken, New York, USA (SAM 2012). IEEE, 2012, 121 - 124.

3) Ruuben, T., Meister, M.-A., Lossmann, E., Berdnikova, J., Madar. U. (2012). SNR Estimation in HF Communications Channel. *In: Antennas and Propagation (EuCAP), Proceedings of the 6th European Conference on: EuCAP 2012: 6th European Conference on Antennas and Propagation, Prague, 26-30 March 2012.* IEEE, 2012.

4) Trump, T. (2012). An Adaptive Sensor Array Using an Affine Combination of Two Filters. In: Recent Researches in Communications, Signals and Information Technology: 11th WSEAS International Conference on Signal Processing, Saint-Malo, 2-4 April 2012. (Toim.) V. Niola, M. Kadoch and A. Zemliak. WSEAS, 2012, 159 - 162.

5) Trump, T. (2012). Combinations of Adaptive Filters (Plenary Lecture). 5th WSAES International Conference on Sensors and Signals (SENSIG'12). WSEAS, 2012.

2.3 Loetelu struktuuriüksuse töötajate rahvusvahelistest tunnustustustest.

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

2.5 Aruandeaasta tähtsamad T&A finantseerimise allikad.

1) Euroopa Kaitseagentuuriga (*European Defence Agency*) sõlmitud T&A leping „Inimene-seade koostöövõimekuse uuringud efektiivsemaks otsuste tegemiseks lahinguolukorras linnatingimustes" (*Capability study to investigate the essential manmachine relationship for improved decision making in urban military environment*) 2010-2012 (leping VA461).

2) LEP11051 Signaalide aeg-ruumilise töötlemise algoritmide arendus (30.06.11-30.06.12)

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.

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

- Haridus- ja Teadusministeerium
- sihtfinantseeritavad teemad:
- baasfinantseerimise toetusfondist rahastatud projektid (sh TTÜ tippkeskused):
- riiklikud programmid:

- Teiste ministeeriumide poolt rahastatavad riiklikud programmid:

- Uurija-professori rahastamine:

- SA Eesti Teadusfond/Eesti Teadusagentuur
– grandid:
– 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"):
– Eesti tippkeskused:
– riiklikud programmid:
– muud T&A lepingud:

- SA Keskkonnainvesteeringute Keskusega sõlmitud lepingud:

- Siseriiklikud lepingud:
LEP 11051   Signaalide aeg-ruumilise töötlemise algoritmide arendus, Taklaja, Andres (30.06.11-30.06.12)

- EL Raamprogrammi projektid:

- Välisriiklikud lepingud:
VA461, Inimene-seade koostöövõimekuse uuringud efektiivsemaks otsuste tegemiseks lahinguolukorras linnatingimustes, Taklaja, Andres (1.04.2010 - 30.09.2012)

2.8 Struktuuriüksuse 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).*

1.1

Berdnikova, J.; Ruuben, T.; Kozevnikov, V.; Astapov, S. (2012). Acoustic Noise Pattern Detection and Identification Method in Doppler System. Electronics and Electrical Engineering, 18(8), 65 - 68.

1.2

1.3

Ornovskis, M.; Ljahhovets, V. (2012). IPSec VPN redundancy in dual – WAN deployments using dynamic routing protocols. Молодой ученый, 1(5), 84 - 86

2.1

2.2

3.1

Trump, T. (2012). A Robust Adaptive Sensor Array with Slepian Sequences. The Seventh IEEE Sensor Array and Multichannel Signal Processing Workshop,} Hoboken, New York, USA (SAM 2012). IEEE, 2012, 121 - 124.

Ruuben, T., Meister, M.-A., Lossmann, E., Berdnikova, J., Madar. U. (2012). SNR Estimation in HF Communications Channel. *In: Antennas and Propagation (EuCAP), Proceedings of the 6th European Conference on: EuCAP 2012: 6th European Conference on Antennas and Propagation, Prague, 26-30 March 2012.* IEEE, 2012.

3.2

Trump, T. (2012). An Adaptive Sensor Array Using an Affine Combination of Two Filters. In: Recent Researches in Communications, Signals and Information Technology: 11th WSEAS International Conference on Signal Processing, Saint-Malo, 2-4 April 2012. (Toim.) V. Niola, M. Kadoch and A. Zemliak. WSEAS, 2012, 159 - 162.

Trump, T. (2012). Combinations of Adaptive Filters (Plenary Lecture). 5th WSAES International Conference on Sensors and Signals (SENSIG'12). WSEAS, 2012.

Trump, T. (2012). Combinations of Two LMS Adaptive Filters. In: Sensors, Signals, Visualization, Imaging and Simulation: 5th WSAES International Conference on Sensors and Signals (SENSIG'12), Sliema, Malta, Sept. 7-9. (Toim.) R.S. Choras and S. Oprisan. WSEAS, 2012, 53 - 58.

3.3

4.1

5.1

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

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

2.11 Struktuuriüksuses loodud tööstusomandi loetelu

US8130940B2
Echo detection
Patent välja antud: 06.03.2012
Autorid: Tõnu Trump, Andres Erisson
Omanik: Ericsson Telefon AB LM

EP2057522B1
Clock skew compensation
Patent välja antud: 27.06.2012
Autorid: Tõnu Trump, Dejan Miljkovic
Omanik: Ericsson Telefon AB LM

US8260613B2
Double talk detektor

Patent välja antud: 04.09.2012
Autor: Tõnu Trump
Omanik: Ericsson Telefon AB LM

CN101617363B
Double talk detektor
Patent välja antud: 05.09.2012
Autor: Tõnu Trump
Omanik: Ericsson Telefon AB LM

3. Struktuuriüksuse infrastruktuuri uuendamise loetelu