INFOTEHNOLOOGIA TEADUSKOND
AUTOMAATIKAINSTITUUT
TEADUS- JA ARENDUSTEGEVUSE AASTAARUANNE 2012

1. Instituudi struktuur

Automaatikainstituut, Department of Computer Control
Instituudi direktor Boris Gordon

- Automaatjuhtimise ja süsteemianalüüsi õppetool, Chair of Automatic Control and Systems Analysis, Ennu Rüstern
- Reaalajasüsteemide õppetool, Chair of Real Time Systems, Leo Mõtus
- Siduteooria ja –disaini õppetool, Chair of Circuit Theory and Design, Vello Kukk
- Proaktiivtehnoloogiate teaduslaboratoorium, Laboratory for Proactive Technologies, Jürgo-Sören Preden

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

Automaatikainstituudi teadus- ja arendustegevus on viidud proaktiivtehnoloogiate teadus-laboratooriumi alla. Teaduslaboratoorium koondab instituudi teadureid, insenere ja doktorante, kes on seotud sihtfinantseeritava teadusteemaga, ETF grantide põhitäitjaid ja muude uurimisprojektide põhitäitjaid. Teadustööga tegelevad õppejõud teevad koostööd (nt ühised publikatsioonid) labori teadustöötajatega ning on seotud sihtfinantseeritava teadusteemaga (kuuluvad põhitäitjate nimekirja).

2.1 struktuuriüksuse koosseisu kuuluvate uurimisgruppide

2.1.1 teadustöö kirjeldus *(inglise keeles*);

• *Laboratory for Proactive Technologies*
• *Chair of Real Time Systems*

SF0140113As08 Proactivity and situation-awareness
Three simultaneously on-going and interacting threads are studied - proactive modelling, technology platforms and tools, and pilot applications and assessment methods. The emergent behaviour in proactive systems and their relationship to complex systems theory are of special interest. Research in proactive modelling focuses on models of situation-aware interactive computing, emergent behaviour in enterprises and organisations, self-learning and adaptation methods in control systems, and nano-components. Research on technology and tools covers agent-based and smart dust technologies, plus tools and methods for interface technologies for exchanging situational information. Pilot applications and study of methods for their assessment are divided into three parts - cases applying MATLAB/Simulink models, cases applying real world environment and physical devices, and preparatory work on set-up of verification studies.

GART5 Self-organizing middleware platform for ad-hoc networks in the domain of manufacturing and logistics

Development of a self-organizing middleware platform for ad-hoc networks in the domain of manufacturing and logistics.

• *Chair of Automatic Control and Systems Analysis*

ETF8738 Artificial intelligence methods based analysis and control of complex nonlinear systems

The aim of the project is to develop a control strategy combining advantages of classical analytical and different artificial intelligence based methods. The designed system should be capable of automatic control of complex multidimensional and hardly analyzable systems.

An intelligent control system should be able not only to make decisions according to a predefined algorithm or/and scenario but also to adapt to changing environment. The adaptive system has

• to be able to react to changes in its environment. It means be reactive;
• to analyze and predict the behavior of its environment. It means be proactive;
• to adjust itself and change its own behavior in response to disturbances and changes in environmental conditions.

Modern time complex intelligent control system consists of two main parts: adaptive control algorithm plus situation awareness.

There exist a number of classical control techniques the robustness and high reliability of which is proven by decades. Nevertheless, nowadays in more and more applications we need to control complex systems and processes which cannot (or it is not a trivial task) be represented by classical models. In these applications we need algorithms combining advantages of classical and artificial intelligence based methods.

During the last ten years has significantly grown the demand for automatic systems and devices in live-critical applications. This dramatically increases the requirements imposed to the quality of the control system. It means that more and more advanced control systems, precise and as simple as possible control task oriented models of very complex multidimensional and highly nonlinear systems are required.

In the framework of this project research is conducted in two directions, which are connected to each other:

1. reliable and satisfying high quality demands control algorithms for complex nonlinear multidimensional systems;
2. artificial intelligence based methods for precise recognition of environmental situation by real-time analysis of observed image, video and numerical data.

• *Chair of Circuit Theory and Design*

ETF9463 Development of competence-driven learning environment

The main goal of the project is developing appropriate models for learning process that enable efficient control of learning process and developing prototypes of knowledge structures to be used as base of learning. The work is based on learning log files collected in previous years consisting more than 200 thousand records, and from 2010/2011 when first implementation of competence-driven environment was launched. This first launch confirmed efficiency of that approach but also raised several problems that must be solved along with essential development of the environment. New model of tasks connecting them with competences will be developed. This model considers task as a multipole with nodes representing competencies and having different nature. Higher levels of competences will be developed not as tree structure but combining lower level elements in overlapping mode. It is assumed that those structures can also be built as personal ones to enable creation of personal learning paths. New generic models for analysis of answers will be developed. Scripts produced from old tasks appeared to be usable but far from perfect solutions. The scripts are extremely important components as they determine changes in learner's state (both knowledge level and forgetting parameters). As the number of tasks is huge, any economy and automation in producing of scripts is vary valuable. Development of new structures, methods, and tools must be verified in real learning processes. Therefore, remarkable part of the work is creation and testing new tasks, competencies, scripts, and control mechanisms. All main types of tasks will be implemented: theoretical, conventional labs (both home kits and fixed locations), distant and virtual labs. Developing combinations of those activities is also to be considered.

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

• *Laboratory for Proactive Technologies*

• *Chair of Real Time Systems*

SF0140113As08 Proactivity and situation-awareness

Enhanced and detailed research in aspects related to proactivity and situation awareness has led to progress in studying the characteristics and behaviour in large scale systems and system-of-systems engineering (L. Motus).

The research also continued with studies in virtual organiatsions and has lead to model of co-operation and co-ordinatied behaviour in virtual organisations that temporarily joined for common goal (T. Kangilaski). One possible application domains vere studied for crisis management and protection of critical infrastructure (J. Preden, R. Savimaa). Also models that integrate organisation's aims, measurable indicators, tasks, processes and resources were enhanced (R. Savimaa).

The research has also continued and results obtained in areas of team situation-awareness (J. Preden), competence based approach to learning (M. Jaanus), adaptive entities (T. Lints), simulation modelling (T. Tomson), several applications of artificial neural nets in relation to situation awareness (I. Astrov) and nano and quantum information technology (A. Udal).

Obtained theoretical knowledge has been applied in ARTEMIS JU , NATO RTO, EDA, CRISMA and IMECC projects and task groups.

Vadim Kimlaychuk received a PhD degree and Johannes Ehala received a MSc degree.

Senior researcher Jürgo-Sören Preden has been awarded a Fulbright Visiting Scholar grant to do research at University at Buffalo, The State University of New York in United States.

GART5 Self-organizing middleware platform for ad-hoc networks in the domain of manufacturing and logistics

Research activities under the GART5 project (within the scope of the Simple project) in the Research Laboratory for Proactive Technologies were based on results of previous years and focussed on further detailisation of main features of the proactive middleware. The details and components of middleware were described. Research focused also experiments on possible different application domains of the middleware approach.
The similar approach can help solving a number of practical data acquisition, collection and decision making isuses in different domains as a service-based data subscriber-consumer model with constraint specifications and evaluations correspond to the overall model of systems consisting of autonomous, oractive components that freely and dynamically interact with each ohter. Such components should be able to allow dynamic reconfiguration of communiction system, according to control tasks and environemntal conditions.
The same approach is strongly supported by proactive middleware paradigm. In addition, proactive middleware facilitates mediated communication where tha same communiction Principes are followed in all system components (nodes). Mediated communication enables to improve communication quality and reduce propagation of false information.

The researched possible application domans were:
- collection and exchange of sensor data related to monitoring of production line, related eqipment and products; the test systems consisted of distant monitoring systems like audiosensors and optical sensors as well as immediate monitoring sensors (velocity sensor, magnetic sensor, acceleration sensor, etc)
- a multi-agent simulation system related to situation awareness of its nodes and data exchange between the nodes
- synchronisation of systems nodes (e.g. semaphores or street lights)

That research enabled further investigation and more detailed description of proactive middleware characteristics and development suggestions, also in rlation to situation awareness.

During the project the ProLab project team also activlely participated in co-operative work with ohter project partners in face-to-face meetings and teleconferences.

• *Chair of Automatic Control and Systems Analysis*

ETF8738 Artificial intelligence methods based analysis and control of complex nonlinear systems

A novel genetic algorithm based approach for identification of the optimal neural networks based NN-ANARX and NN-SANARX structure is proposed. Accuracy of the models is studied and convergence of the identification algorithm is proofed using statistical methods. NN-ANARX model based approach has found a practical application. Automation systems used at Eesti Energia Iru Powerplant are analyzed, some problems arising in the control loop are studied and possible solutions are proposed. One part of the control process is modeled using neural networks based methods.
A novel method for approximation of fractional derivatives is proposed. Hardware realisability of fractional controllers is studied.
A flexible algorithm for optimization of fractional PID controllers and robust control of complex nonlinear systems is proposed and implemented in FOMCON software package. This method is the basis for future development of self-turning algorithms.
All the above mentioned results are published in the listed papers.

Kristina Vassiljeva and Juri Belikov received a PhD degree.

• *Chair of Circuit Theory and Design*

ETF9463 Development of competence-driven learning environment

Three-level competence structure has been developed and second layer is included into new planning strategies, allowing motivated decision making in problem selection. New types of tasks have been developed and several new design and analysis tools have been developed. A new lhomeabkit for programming of controllers has been developed. Automated processimg of task answers has been started with analysis of existing tasks and their result logs.

2.2 Uurimisgrupi kuni 5 olulisemat publikatsiooni läinud aastal.

- *Laboratory for Proactive Technologies*
- *Chair of Real Time Systems*

SF0140113As08

Lints, T. (2012). The essentials of defining adaptation. IEEE Aerospace and Electronic Systems Magazine, 27(1), 37 - 41.

Udal, A.; Kukk, V. (2012). An Engineering Approach to Time-Frequency Uncertainty Criteria. Electronics and Electrical Engineering, 117(1), 3 - 8.

Rannat, K.; Meriste, M.; Mõtus, L.; Preden, J.-S. (2012). On Dynamic Models for Wind Farms as Systems of Systems. In: Proceedings of 2012 7th International Conference on System of Systems Engineering : SoSE in Cooperative and Competitive Distributed Decision Making for Complex Dynamic systems : IEEE SoSE2012, Genoa, Italy, July 16-19, 2012. IEEE, 2012.

Astrov, I.; Pedai, A.; Gordon, B. (2012). Flight control of TUAV with coaxial rotor and ducted fan configuration by NARMA-L2 controllers for enhanced situational awareness. Proceedings of the World Academy of Science, Engineering and Technology, 66, 75 - 81.

Astrov, I.; Pikkov, M. (2012). An enhanced situational awareness of AUV's mission by multirate neural control. Proceedings of the World Academy of Science, Engineering and Technology, 69, 911 - 917.

Kimlaychuk, V. (2012). Simulations in Multi-Agent Communication System. (Doktoritöö, Tallinna Tehnikaülikool)Tallinna Tehnikaülikooli Kirjastus

GART5

Preden, J.-S.; Motus, L.; Pahtma, R.; Meriste, M. (2012). Data Exchange for Shared Situation Awareness. 2012 IEEE International Multi-Disciplinary Conference on Cognitive Methods in Situation Awareness and Decision Support (CogSIMA), . IEEE, 2012, 198 - 201.

Motus, L.; Meriste, M.; Preden, J.-S.; Pahtma, R. (2012). Self-aware Architecture to Support Partial Control of Emergent Behavior. 7th International Conference on System of Systems Engineering : SoSE in Cooperative and Competitive Distributed Decision Making for Complex Dynamic systems : IEEE SoSE2012, Genoa, Italy, July 16-19. IEEE, 2012, 422 - 427.

Riid, A.; Saadallah, N. (2012). Unsupervised learning of well drilling operations: Fuzzy rule-based approach. Proceedings: 2012 IEEE 16th International Conference on Intelligent Engineering Systems, June 13-15, 2012 Lisbon, Portugal (375 - 380).IEEE

Astapov, S.; Preden, J.-S.; Aruväli, T.; Gordon, B. (2012). Production machinery utilization monitoring based on acoustic and vibration signal analysis. In: Proceedings of the 8th International Conference od DAAAM Baltic Industrial Engineering 19-21st April 2012, Tallinn, Estonia: 8th International Conference of DAAAM Baltic Industrial Engineering, Tallinn, Estonia, 19-21 april 2012. (Toim.) Otto, T.. Tallinna Tehnikaülikooli Kirjastus, 2012, 268 - 273.

Preden, J.; Pahtma, R; Gordon, B.; Motus, L. (2012). Indoor positioning system based on COTS WSN devices. In: SET-168 Symposium on Navigation Sensors and Systems in GNSS Denied Environments: SET-168 Symposium on Navigation Sensors and Systems in GNSS Denied Environments, İzmir, Turkey, Oct 2012. North Atlantic Treaty Organization, 2012.

- *Chair of Automatic Control and Systems Analysis*

  ETF8738

  Tepljakov, Aleksei; Petlenkov, Eduard; Belikov, Juri (2012). Application of Newton's method to analog and digital realization of fractional-order controllers. International Journal of Microelectronics and Computer Science, 3(2), 45 - 52.

  Nomm, Sven; Vassiljeva, Kristina; Petlenkov, Eduard (2012). Evaluation function optimization for the Genetic Algorithm based tuning of NN-ANARX model structure. In: 2012 IEEE World Congress on Computational Intelligence, WCCI 2012: June 10-15, Brisbane, Austraalia: Piscataway, NJ: IEEE, 2012, 1682 - 1688.

  Vassiljeva, Kristina; Petlenkov, Eduard; Nomm, Sven (2012). Evolutionary design of the closed loop control on the basis of NN-ANARX model using genetic algorithm. In: Neural Information Processing : 19th International Conference, ICONIP 2012, Doha, Qatar, November 12-15, 2012, Proceedings, Part I: (Toim.) Huang, Tingwen; Zeng, Zhigang; Li, Chuandong; Leung, Chi Sing. Berlin: Springer, 2012, (Lecture Notes in Computer Science; 7663), 592 - 599.

  Vassiljeva, K.; Petlenkov, E.; Belikov, J. (2012). GA based optimization of NN-SANARX model for adaptive control of nonlinear systems. In: 2012 IEEE World Congress on Computational Intelligence, WCCI 2012: June 10-15, Brisbane, Australia: IEEE, 2012, 1674 - 1681.

  Vansovits, V., Petlenkov, E.; Vassiljeva, K.; Guljajev, A. (2012). Identication of industrial water boiler for model predictive control of district heat plant. In: BEC 2012 : 13th biennial Baltic Electronics Conference : proceedings of the 13th biennial Baltic Electronics Conference : Tallinn University of Technology, October 3-5, 2012, Tallinn, Estonia: 2012 13th Biennial Baltic Electronics Conference (BEC 2012) ,Tallinn, October 3-5 2012. [S.I.]: IEEE, 2012, 314 - 318.

- *Chair of Circuit Theory and Design*

  ETF9463

  Kukk, V.; Umbleja, K. (2012). Analysis of forgetting in a learning environment. In: BEC 2012 : 13th biennial Baltic Electronics Conference : proceedings of the 13th biennial Baltic Electronics Conference : Tallinn University of Technology, October 3-5, 2012, Tallinn, Estonia: 13th Biennal Baltic Electronics Conference (BEC 2012). IEEE, 2012, 335 - 338.

Jaanus, M.; Kukk, V.; Umbleja, K.; Gordon, B.; Pikkov, M. (2012). HomeLabKits - implementation and usage . In: BEC 2012 : 13th biennial Baltic Electronics Conference : proceedings of the 13th biennial Baltic Electronics Conference : Tallinn University of Technology, October 3-5, 2012, Tallinn, Estonia: IEEE, 2012, 331 - 334.

Jaanus, M.; Kukk, V.; Umbleja, K.; Gordon, B.; Pikkov, M. (2012). HomeLabKits - implementation and usage. BEC 2012 : 13th biennial Baltic Electronics Conference : proceedings of the 13th biennial Baltic Electronics Conference : Tallinn University of Technology, October 3-5, 2012, Tallinn, Estonia (331 - 334).IEEE

Umbleja, K.; Kukk, V.; Jaanus, M.; Udal, A.; Gordon, B. (2012). Analyzes of Competence Based Approach to Learning . In: Proc. ICEE-2012 Conference : ICEE-2012 conference organized in Turku, Finland, 31 July – 3 August 2012.. , 2012, 418 - 424.

Umbleja, K.; Kukk, V.; Jaanus, M. (2012). Processing Answers in Competence-Based Learning. Win Aung et al (Toim.). INNOVATIONS 2012: World Innovations in Engineering Educations and Research (91 - 100).INEER, USA

Udal, A.; Kukk, V. (2012). An Engineering Approach to Time-Frequency Uncertainty Criteria. Electronics and Electrical Engineering, 117(1), 3 - 8.

2.3 Loetelu struktuuriüksuse töötajate rahvusvahelistest tunnustustest.

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.

Proaktiivsus ja situatsiooniteadlikkus / *Proactivity and situation-awareness* / (SF0140113As08, 01.01.2008-31.12.2013, 142 300 eurot, teema juht: prof Leo Mõtus).

Iseorganiseeruv intelligentne vahevara platvorm tootmis- ja logistikaettevõtete jaoks /*Self-organizing middleware platform for ad-hoc networks in the domain of manufacturing and logistics*/ (ARTEMIS, projekt SIMPLE /GART5, 97 800 eurot, 01.05.2010 - 30.04.2013, vastutav täitja: prof Leo Mõtus).

Keeruliste mittelineaarsete süsteemide juhtimine ja analüüs tehisintellekti meetoditega /*Artificial intelligence methods based analysis and control of complex nonlinear systems*/ (ETF grant G8738, 6000 eurot, 01.01.11 - 31.12.13, vastutav täitja: dots Eduard Petlenkov).

Komptentsjuhtimisega õpikeskkonna arendus /*Development of competence-driven learning environment/* (ETF grant G9463, 7100 eurot, 01.01.12 - 31.12.13 , vastutav täitja: prof Vello Kukk).

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.

Teaduskorralduslik tegevus ja teadlasmobiilsus

Prof. Leo Mõtus:
Eesti Teaduste Akadeemia - peasekretär
Eesti Teaduste Akadeemia Kirjastus, Proceedings of the Estonian Academy of Sciences, Estonian Journal of Engineering - toimetaja (computer and systems science)
Eesti Teaduste Akadeemia - liige
The Institution of Engineering and Technology (IET) - liige
Kaitseministeeriumi Teadusnõukogu - aseesimees (Tallinna Tehnikaülikool, NATO RTO SCI paneeliesindaja)

Van.teadur Igor Astrov:
Institute of Electrical and Electronics Engineers, Inc. (IEEE) - vanem liige (*Senior member*)
The International Institute of Informatics and Systemics, USA (IIIS) - liige

Van.teadur Andres Udal:
Infotehnoloogia ja Telekommunikatsiooni Kutsenõukogu - liige (Eesti Kõrgkoolide, Teadus- ja Arendusasutuste Ametiliitude Ühendus UNIVERSITAS esindaja)

Prof. Ennu Rüstern:
Institute of Electrical and Electronics Engineers, Inc. (IEEE) - liige
The Institution of Engineering and Technology (IET) - liige
Eesti Infotehnoloogia ja Telekommunikatsiooni Liit - TTÜ esindaja
Tallinna Tehnikaülikooli valitsus - liige
Tallinna Tehnikaülikooli nõukogu - liige
Tallinna Tehnikaülikooli teaduskomisjon - liige
Tallinna Tehnikaülikooli akadeemiline komisjon - liige
Eesti Süsteemiinseneride Selts - liige

Dots. Boris Gordon:
European Society for Engineering Education (SEFI), Working Group on Ethics in Engineering Educations (EiEE) - liige

Dots. Eduard Petlenkov:
Info- ja kommunikatsioonitehnoloogia doktorikool – projektijuht

Prof. Vello Kukk:
Institute of Electrical and Electronics Engineers, Inc. (IEEE) - liige
IEEE Estonia Section, Education Society Chapter – Chair (esimees)

Vanemteadur Jürgo-Sören Preden sai Fulbright Visiting Scholar toetuse teadusuuringute tegemiseks Buffalo ülikoolis (State University of New York) Ameerika Ühendriikides.

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

- Haridus- ja Teadusministeerium

– sihtfinantseeritavad teemad:
T113A, Proaktiivsus ja situatsiooniteadlikkus, Mõtus Leo (2008 – 2013)

– baasfinantseerimise toetusfondist rahastatud projektid (sh TTÜ tippkeskused):
– riiklikud programmid:

- Teiste ministeeriumide poolt rahastatavad riiklikud programmid:
- Uurija-professori rahastamine:
- SA Eesti Teadusfond/Eesti Teadusagentuur

– grandid:
ETF9463, Komptentsjuhtimisega õpikeskkonna arendus, Kukk Vello (2012 – 2013)

ETF8738, Artificial intelligence methods based analysis and control of complex nonlinear systems, Petlenkov Eduard (2011 – 2013)

– ühisgrandid välisriigiga:
GART5, Iseorganiseeruv intelligentne vahevara platvorm tootmis- ja logistikaettevõtete jaoks, Mõtus Leo (2010 – 2013)

– 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:
- EL Raamprogrammi projektid:
- Välisriiklikud lepingud:

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

Udal, A.; Kukk, V. (2012). An Engineering Approach to Time-Frequency Uncertainty Criteria. Electronics and Electrical Engineering, 117(1), 3 - 8.

Lints, T. (2012). The essentials of defining adaptation. IEEE Aerospace and Electronic Systems Magazine, 27(1), 37 - 41.

1.2

Astrov, I.; Pikkov, M. (2012). An enhanced situational awareness of AUV's mission by multirate neural control. Proceedings of the World Academy of Science, Engineering and Technology, 69, 911 - 917.

Tepljakov, Aleksei; Petlenkov, Eduard; Belikov, Juri (2012). Application of Newton's method to analog and digital realization of fractional-order controllers. International Journal of Microelectronics and Computer Science, 3(2), 45 - 52.

Astrov, I.; Pedai, A.; Gordon, B. (2012). Flight control of TUAV with coaxial rotor and ducted fan configuration by NARMA-L2 controllers for enhanced situational awareness. Proceedings of the World Academy of Science, Engineering and Technology, 66, 75 - 81.

1.3

2.1

2.2

Astrov, I. (2012). Modeling and Simulation of Multirate Control Systems for Vehicles. Saarbrücken, Germany: Lambert Academic Publishing

3.1

Jaanus, M.; Kukk, V.; Umbleja, K.; Gordon, B.; Pikkov, M. (2012). HomeLabKits -implementation and usage. BEC 2012 : 13th biennial Baltic Electronics Conference : proceedings of the 13th biennial Baltic Electronics Conference : Tallinn University of Technology, October 3-5, 2012, Tallinn, Estonia (331 - 334).IEEE

Kangilaski, T. (2012). Maturity Models as Tools for or Focal Player Forming Virtual Organizations. Liu Pei (Toim.). Management, Manufacturing and Materials Engineering (829 - 832).Trans Tech Publications, Switzerland

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Astrov, I.; Gordon, B. (2012). Multirate depth control of an AUV by neural network model reference controller for enhanced situational awareness. N. Mastorakis, V. Mladenov, Z. Bojkovic (Toim.). Recent Researches in Applied Information Science (32 - 37).WSEAS

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Riid, A.; Saadallah, N. (2012). Unsupervised learning of well drilling operations: Fuzzy rule-based approach. Proceedings: 2012 IEEE 16th International Conference on Intelligent Engineering Systems, June 13-15, 2012 Lisbon, Portugal (375 - 380).IEEE

Tepljakov, Aleksei; Petlenkov, Eduard; Belikov, Juri (2012). A flexible MATLAB tool for optimal fractional-order PID controller design subject to specifications. In: Proceedings of the 31st Chinese Control Conference, July, 2012, Hefei, China: (Toim.) Li, Weiping; Zhao, Qianchuan. Hefei: IEEE, 2012, 4698 - 4703.

Astapov, S.; Riid, A. (2012). A Hierarchical Algorithm for Moving Vehicle Identification Based on Acoustic Noise Analysis. In: Proceedings of the 19th International Conference "Mixed Design of Integrated Circuits and Systems": 19th International Conference "Mixed Design of Integrated Circuits and Systems" MIXDES 2012, Warsaw, Poland, 24-26 May 2012. (Toim.) A. Napieralski. Warsaw, Poland: IEEE, 2012, 467 - 472.

Astapov, S.; Preden, J.-S.; Suurjaak, E. (2012). A Method of Real-Time Mobile Vehicle Identification by Means of Acoustic Noise Analysis Implemented on an Embedded Device. In: BEC 2012 : 13th biennial Baltic Electronics Conference : proceedings of the 13th biennial Baltic Electronics Conference : Tallinn University of Technology, October 3-5, 2012, Tallinn, Estonia: 13th Biennial Baltic Electronics Conference, Tallinn, Estonia, 3-5 October, 2012. (Toim.) Rang, T.. IEEE, 2012, 283 - 286.

Kukk, V.; Umbleja, K. (2012). Analysis of forgetting in a learning environment. In: BEC 2012 : 13th biennial Baltic Electronics Conference : proceedings of the 13th biennial Baltic Electronics Conference : Tallinn University of Technology, October 3-5, 2012, Tallinn, Estonia: 13th Biennal Baltic Electronics Conference (BEC 2012). IEEE, 2012, 335 - 338.

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Kimlaychuk, V. (2012). Authentication using shared knowledge. Learning agents. The 12th International Conference on Intelligent Autonomous Systems, 26-29 June 2012, Jeju Island, Korea. Springer, 2012, (Advances in Intelligent and Soft Computing), xx - xx. [ilmumas]

Kangilaski, T. (2012). Business Process Development for Industrial Cluster. In: Proceedings of the 9th International Conference on Informatics in Control, Automation and Robotics, ICINCO 2012: ICINCO 2012, 9th International Conference on Informatics in Control, Automation and Robotics, Rome, 28-31 July, 2012. (Toim.) J.-L. Ferrier, A. Bernard, O. Gusikhin and K. Madani. Portugal: SciTePress – Science and Technology Publications, 2012, 535 - 538.

Preden, J.-S.; Motus, L.; Pahtma, R.; Meriste, M. (2012). Data Exchange for Shared Situation Awareness. 2012 IEEE International Multi-Disciplinary Conference on Cognitive Methods in Situation Awareness and Decision Support (CogSIMA), . IEEE, 2012, 198 - 201.

Udal, A.; Reeder, R.; Ikonic, Z.; Harrison, P.; Velmre, E. (2012). Development of quantum cascade laser simulation software. In: BEC 2012 : 13th biennial Baltic Electronics Conference : proceedings of the 13th biennial Baltic Electronics Conference : Tallinn University of Technology, October 3-5, 2012, Tallinn, Estonia: IEEE, 2012, 47 - 48.

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2.9 Struktuuriüksuses kaitstud doktoriväitekirjade loetelu

Juri Belikov, automaatikainstituut
Teema: *Polynomial Methods for Nonlinear Control Systems* (Polünoommeetodid mittelineaarsetes juhtimissüsteemides)
Juhendaja: dotsent Eduard Petlenkov
Kaitses: 11.06.2012
Omistatud kraad: filosoofiadoktor (arvuti- ja süsteemitehnika)

Kristina Vassiljeva, automaatikainstituut
Teema: *Restricted Connectivity Neural Networks Based Identification for Control* (Piiratud ühenduvusega tehisnärvivõrkudel põhinev identifitseerimine juhtimiseks)
Juhendaja: prof Ennu Rüstern
Kaitses: 21.06.2012
Omistatud kraad: filosoofiadoktor (arvuti- ja süsteemitehnika)

Vadim Kimlaychuk, automaatikainstituut
Teema: *Simulations in Multi-Agent Communication System* (Simulatsioonid multiagentsüsteemis)
Juhendaja: prof Leo Mõtus
Kaitses: 15.08.2012
Omistatud kraad: filosoofiadoktor (arvuti- ja süsteemitehnika)

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

2.11 Struktuuriüksuses loodud tööstusomandi loetelu

3. Struktuuriüksuse infrastruktuuri uuendamise loetelu