

TTÜ KÜBERNEETIKA INSTITUUDI TEADUS- JA ARENDUSTEGEVUSE AASTAARUANNE 2011

1. Instituudi struktuur

Instituudi direktor Andrus Salupere

- Juhtimissüsteemide osakond, Control Systems Department, Jüri Vain
- Foneetika ja kõnetehnoloogia laboratoorium, Laboratory of Phonetics and Speech Technology, Einar Meister
- Mehaanika ja rakendusmatemaatika osakond, Mechanics and Applied Mathematics Department, Jüri Engelbrecht
- Fotoelastsuse laboratoorium, Laboratory of Photoelasticity, Hillar Aben
- Lainetuse dünaamika laboratoorium, Wave Engineering Laboratory, Tarmo Soomere
- Süsteemibioloogia laboratoorium, Laboratory of Systems Biology, Marko Vendelin
- Tarkvara osakond, Software Department, Ahto Kalja
- Raamatukogu, Library, Marje Tamm

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

2.1 struktuuriüksuse koosseisu kuuluvate uurimisgruppide

2.1.1 teadustöö kirjeldus (*inglise keeles*);

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

2.2 Uurimisgrupi kuni 5 olulisemat publikatsiooni läinud aastal.

Kübernetika Instituudi teadustöö kirjeldus on esitatud sihtfinantseeritavate teemade kaupa.

MAIN LINES OF RESEARCH

SF0140077s08, Mittelineaarne dünaamika ja kompleksüsteemid

Dynamics of microstructured materials and solitons

The theory of canonical thermomechanics is formulated in terms of dual internal variables. This approach allows to derive consistently mathematical models of wave motion in microstructured solids which take into account dispersive and temperature effects. It was shown that the structure of Cosserat, micromorphic, and second gradient theories can be recovered in terms of dual internal variables in a natural way

Contact: prof J.Engelbrecht, e-mail je@ioc.ee

Selected publications

Janno, J., Engelbrecht, J. (2011). Microstructured Materials: Inverse Problems. Berlin: Springer

Berezovski, A., Engelbrecht, J., Maugin, . A. (2011). Generalized thermomechanics with dual internal variables. Archive of Applied Mechanics, 81(2), 229 - 240.

Berezovski, A., Engelbrecht, J., Maugin, G. A. (2011). Thermoelasticity with dual internal variables. Journal of Thermal Stresses, 34(5-6), 413 - 430.

Berezovski, A., Engelbrecht, J., Berezovski, M. (2011). Waves in microstructured solids: a unified viewpoint of modeling. ACTA Mechanica, 220(1-4), 349 - 363.

Waves in microstructured solids, solitons.

The emergence of soliton trains and interaction of solitons were analyzed by using a Boussinesq-type equation derived from a Mindlin-type model of microstructured solids and which describes the propagation of bi-directional waves.

The large scale analysis of dispersive and nonlinear effects has revealed mechanisms of wave profile distortions and emergence of solitary waves in microstructured solids.

Contact: prof J.Engelbrecht, e-mail je@ioc.ee

Selected publications

Engelbrecht, J., Salupere, A., Tamm, K. (2011). Waves in microstructured solids and the Boussinesq paradigm. *Wave Motion*, 48(8), 717 - 726.

Theory of short fibre reinforced materials

Different methods of describing the orientation of fibres in short fibre reinforced composite have been discussed. It has been clearly shown, that the two commonly used methods for steel fibre reinforced concrete, the orientation number and orientation profile, are insufficient.

The theory of short fibre reinforced materials is derived based on using alignment tensors and orientational parameters. The theory is applied for description of fibre reinforced concrete and composites.

Contact: Dr H.Herrmann, e-mail hh@cens.ioc.ee

Selected publications

Herrmann, H., Eik, M.(2011). Some comments on the theory of short fibre reinforced materials. *Proceedings of the Estonian Academy of Sciences*, 60(3), 179 - 183.

Acoustodiagnostics of inhomogeneous solids

The theoretical investigation of inverse problems to characterize the strongly variable properties of functionally graded materials (FGMs) on the basis of direct solutions to the problems of ultrasonic wave propagation was carried on.

The algorithms based on counterpropagating ultrasonic bursts were derived for solving the inverse problems of FGMs.

Contact: Dr A.Ravasoo, e-mail arvi@ioc.ee

Selected publications

Ravasoo, A. (2011). Counter-propagation of harmonic waves in exponentially graded materials. *Journal of Sound and Vibration*, 330(16), 3874 - 3882.

Fractality and econophysics

The stochastic triplet-map model of turbulent mixing was extended to describe the passive tracers in compressible flows and the patchiness of pollutants on the sea surface described. A Fokker-Planck equation describing the evolution of the k-spectrum of passive scalars in compressible flows has been derived analytically. This is an efficient tool for analytical studies of the statistical properties of tracer fields. The breakthrough has been achieved by making a connection between the smallest finite-time Lyapunov exponent of chaotic velocity fields, and transport along the coordinate describing logarithmic increase in tracer density gradient. A novel method of determining scaling exponents from finite-size Monte-Carlo simulation data has been tested using fractal sets like percolation clusters.

Contact: Dr J.Kalda, e-mail kalda@ioc.ee

Selected publications

Kaevand, T.; Kalda, J.; Kukk, V.; Öpik, A.; Lille, Ü. (2011). Correlation of the morphology and electrical conductivity in thin films of PEDT/PSS complex: an integrated meso-scale simulation study. *Molecular Simulation*, 37(6), 495 - 502.

Kalda, J. (2011). k-spectrum of decaying, aging and growing passive scalars in Lagrangian chaotic fluid flows. In: *ETC13 Advances in Turbulence XIII : Proceedings of the 13th European Turbulence Conference, 12-15 September 2011, University of Warsaw, Poland*: (Eds.) Bajer, K.; Kopec, J.; Kurska, M.; Kwiatkowski, K.; Podziemski, P.. Bristol: IOP Publishing, 2011, (Journal of Physics: Conference Series; 318), 052045-1 - 052045-6.

Kitt, R. (2011). Komplekssed sotsiaalsüsteemid. *Akadeemia*, 23(10 (271)), 1787 - 1800.

Optical nonlinearity and photoelasticity

An algorithm of photoelastic tomography for the determination of 3D stress fields was derived and its reliability checked in the axisymmetric case against the measurements of stresses in glass fibres and in stems of wine glasses.

It has been shown that the residual stress at the surface of tempered glass panels may vary both locally (at a distance equal to the distance between the cooling jets) and globally, i.e., stresses near the edges and corners of the panels may be considerably different from the stresses in the middle part of the panels. It was also shown that in the middle part of the panels the stresses are usually isotropic while near the edges the stresses depend on the direction.

Contact: Dr H.Aben, e-mail aben@cs.ioc.ee

Selected publications

Aben, H.; Ainola, L.; Errapart, A. (2011). Photoelastic tomography as hybrid mechanics. In: *Recent Advances in Mechanics : Selected Papers from the Symposium, Academy of Athens, Athens, Greece, 17-19 September, 2009*, Organised by the Pericles S.Theocaris Foundation in Honour of P.S.Theocaris, on the Tenth Anniversary of His Death: (Eds.) Kounadis, Anthony N.; Gdoutos, Emmanuel E.. Heidelberg: Springer, 2011, 181 - 190.

Errapart, A. (2011). Determination of all stress components of axisymmetric stress state in photoelastic tomography. In: *Advances in Experimental Mechanics VIII : Selected, peer-reviewed papers of the 8th International Conference on Advances in Experimental Mechanics: Integrating Simulation and Experimentation for Validation*, (BSSM 2011), Sept.7-9 2011, Edinburgh, Scotland: (Eds.) Burguete, R.L.; Lucas, M.; Patterson, E.A.; Quinn, S.. Durnten-Zuerich: Trans Tech Publications, 2011, (Applied Mechanics and Materials; 70), 434 - 439.

Hödemann, S., Kikas, J., Aben, H., Anton, J., Errapart, A. (2011). Effects of ray bending in scattered light photoelasticity for tempered and annealed glass plates. In: *Advances in Experimental Mechanics VIII : Selected, peer-reviewed papers of the 8th International Conference on Advances in Experimental Mechanics: Integrating Simulation and Experimentation for Validation*, (BSSM 2011), Sept.7-9 2011, Edinburgh, Scotland: (Eds.) Burguete, R. L.; Lucas, M.; Patterson, E. A.; Quinn, S. . Durnten-Zuerich: Trans Tech Publications Ltd, 2011, (Applied Mechanics and Materials; 70), 440 - 445.

Systems biology

Permeabilized rat cardiomyocyte response demonstrated intracellular origin of diffusion obstacles. By calculating the flow profile around the cell in the microscope chamber and comparing model solutions to measured data, we demonstrated that intracellular structures impose significant diffusion obstacles in rat cardiomyocytes.

Application of regularized Richardson-Lucy algorithm for deconvolution of confocal microscopy images. An open-source package for deconvolution of confocal microscopy images was developed. Stopping criteria for deconvolution of the images has been found.

Recovery of cardiac calcium release was controlled by sarcoplasmic reticulum refilling and ryanodine receptor sensitivity. The analysis of local recovery of sarcoplasmic reticulum calcium release suggested that local refilling of SR controls calcium spark amplitude recovery

Symbolic flux analysis for genome-scale metabolic networks. A symbolic Gauss-Jordan elimination routine for analyzing large metabolic networks has been developed.

Contact: Dr M.Vendelin, e-mail markov@sysbio.ioc.ee

Selected publications

Jepihhina Natalja; Beraud Nathalie; Sepp Mervi; Birkedal Rikke; Vendelin Marko 2011). Permeabilized Rat Cardiomyocyte Response Demonstrates Intracellular Origin of Diffusion Obstacles. *BIOPHYSICAL JOURNAL* Volume: 101 Issue: 9 Pages: 2112-2121 DOI: 10.1016/j.bj.2011.09.025

Laasmaa, M., Vendelin, M., Peterson, P. (2011). Application of regularized Richardson–Lucy algorithm for deconvolution of confocal microscopy images. *Journal of Microscopy*, 243(2), 124 - 140.

Schryer, D. W., Vendelin, M. Peterson, P. (2011). Symbolic flux analysis for genome-scale metabolic networks. *BMC Systems Biology*, 5, Article 81

Sepp, M., Branovets, J., Sokolova, N., Kotlyarova, S., Birkedal, R., Vendelin, M. (2011). Influence of SERCA and actomyosin ATPase on respiration kinetics in permeabilized rat cardiomyocytes. *Biophysical Journal*, 100(3, Supplement 1), 462a - 462a.

Sokolova, N., Provazza, S., Ainbinder, A., Beutner, G., Brdiczka, Di. G.; Birkedal, R., Vendelin, M., Sheu, S. S. (2011). Regulation of mitochondrial permeability transition by ADP. *Biophysical Journal*, 100(3, Supplement 1), 458a - 459a.

SF0140007s11, Lainetuse dünaamika ja rannikutehnika

Wave climate in the Baltic Sea.

An attempt was made to consolidate results from a number of recent studies into spatial patterns of variations in the Baltic Sea wave properties. We demonstrated that a large part of the mismatches between long-term changes to wave properties at selected sites can be explained by the rich spatial patterns in changes that are not resolved by the existing observation network.

A comprehensive description of spatial patterns of variations in the Baltic Sea wave properties was presented.

Contact: Prof T.Soomere, e-mail: soomere@cs.ioc.ee

Selected publications

Soomere, T., Zaitseva-Pärnaste, I., Räämet, A. (2011). Variations in wave conditions in Estonian coastal waters from 1 weekly to decadal scales. *Boreal Environment Research*, 16(Suppl A), 175 – 190

Soomere, T., Räämet, A. (2011). Spatial patterns of the wave climate in the Baltic Proper and the Gulf of Finland. *Oceanologia*, 53(1-TI), 335 – 371

Soomere, T.; Weisse, R; Behrens, A. (2011). Wave climatology in the Arkona Basin, the Baltic Sea. *Ocean Science Discussions*, 8(6), 2237 - 2270.

Preventive methods for coastal protection

A novel method was proposed for the optimisation of marine fairways, based on the quantification of various offshore areas according to the probability of pollution released in these areas to reach vulnerable regions, and it was tested for the Gulf of Finland.

Beach profiles may develop a two-section almost-equilibrium structure under joint impact of short wind waves and groups of long ship waves. The upper section of the profile is convex and follows the 4/3 power law at small depths and in the swash zone.

Contact: Prof T.Soomere, e-mail: soomere@cs.ioc.ee

Selected publications

Soomere, T., Delpeche, N., Viikmäe, B., Quak, E., Meier, M. H.E.; Döös, K. (2011). Patterns of current-induced transport in the surface layer of the Gulf of Finland. *Boreal Environment Research*, 16(Suppl A), 49 - 63.

Soomere, T., Berezovski, M., Quak, E., Viikmäe, B. (2011). Modelling environmentally friendly fairways using Lagrangian trajectories: a case study for the Gulf of Finland, the Baltic Sea. *Ocean Dynamics*, 61(10), 1669 - 1680.

Andrejev, O., Soomere, T., Sokolov, A., Myrberg, K. (2011). The role of the spatial resolution of a three-dimensional hydrodynamic model for marine transport risk assessment. *Oceanologia*, 53(1-TI), 309 - 334.

Soomere, T., Andrejev, O., Myrberg, K., Sokolov, A. (2011). The use of Lagrangian trajectories for the identification of the environmentally safe fairways. *Marine Pollution Bulletin*, 62(7), 1410 - 1420.

Soomere, T., Berezovski, M., Quak, E., Viikmäe, B. (2011). Modelling environmentally friendly fairways using Lagrangian trajectories: a case study for the Gulf of Finland, the Baltic Sea. *Ocean Dynamics*, 61(10), 1669 - 1680.

Wakes from high-speed vessels.

Beach dynamics resulting from the interplay of vessel wave wakes and background wind waves were studied experimentally using data obtained in 2008 in Tallinn Bay. The beach profile was presented schematically as a power law for the water depth h vs with the distance x from the coast and an exponent b . It was shown that wind waves of longer period are more energetic and are able to accrete the beach which generally loses sediment due to ship wakes

A new mechanism producing onshore transport of substantial amounts of water remote from the fairway through wake waves generated by high-speed vessels was described based on high-resolution water surface profiling.

Contact: Prof T.Soomere, e-mail: soomere@cs.ioc.ee

Selected publications

Soomere, T., Parnell, K. E.; Didenkulova, I. (2011). Water transport in wake waves from high-speed vessels. *Journal of Marine Systems*, 88(1), 74 - 81.

Didenkulova, I. (2011). Shapes of freak waves in the coastal zone of the Baltic Sea (Tallinn Bay). *Boreal Environment Research*, 16(Suppl A), 138 - 148.

Didenkulova, I., Pelinovsky, E., Soomere, T. (2011). Can the waves generated by fast ferries be a physical model of tsunami? *Pure and Applied Geophysics*, 168(11), 2071 - 2082.

Internal waves in a three-layer medium

The geographical and seasonal distributions of kinematic and nonlinear parameters of long internal waves obtained on a base of GDEM climatology in the Baltic Sea region were examined. The key outcome was an express estimate of the expected internal wave parameters for different regions of the Baltic Sea. The central kinematic characteristic is the near-bottom velocity in internal waves in areas where the density jump layers are located in the vicinity of the seabed. In such areas internal waves are the major driver of sediment resuspension and erosion processes and may also be responsible for destroying the laminated structure of the sedimentation regime (that frequently occurs in certain areas of the Baltic Sea). A higher-order (2+4) Korteweg-de Vries-like equation for interfacial waves was derived in a symmetric three-layer fluid.

Selected publications

Kurkina, O.E.; Kurkin, A.A.; Soomere, T.; Pelinovsky, E.N.; Rouvinskaya, E.A. (2011). Higher-order (2 + 4) Korteweg-de Vries-like equation for interfacial waves in a symmetric three-layer fluid. *Physics of Fluids*, 23(11), 116602-1 - 116602-13.

Kurkina, O.; Pelinovsky, E.; Talipova, T.; Soomere, T. (2011). Mapping the internal wave field in the Baltic Sea in the context of sediment transport in shallow water. *Journal of Coastal Research*, SI 64, vol II, 2042 - 2047.

Coastal processes

Numerically estimated wave properties and the associated closure depth along the eastern Baltic Sea coast from the Sambian Peninsula up to Pärnu Bay were compared against the existing data about accumulation and erosion.

The key outcome was an express estimate of the expected internal wave parameters for different regions of the Baltic Sea. The central kinematic characteristic was the near-bottom velocity in internal waves in areas where the density jump layers are located in the vicinity of the seabed. In such areas internal waves are the major driver of sediment resuspension and erosion processes and may also be responsible for destroying the laminated structure of the sedimentation regime (that frequently occurs in certain areas of the Baltic Sea)

Contact: Prof T.Soomere, e-mail: soomere@cs.ioc.ee

Selected publications

Soomere, T., Viška, M., Lapinskis, J., Räämet, A. (2011). Linking wave loads with the intensity of erosion along the coasts of Latvia. *Estonian Journal of Engineering*, 17(4), 359 - 374.

Kelpšaitė, L.; Dailidienė, I.; Soomere, T. (2011). Changes in wave dynamics at the south-eastern coast of the Baltic Proper during 1993-2008. *Boreal Environment Research*, 16(Suppl A), 220 - 232.

Soomere, T., Healy, T. (2011). On the dynamics of "almost equilibrium" beaches in semi-sheltered bays along the southern coast of the Gulf of Finland. Harff, Jan; Björck, Svante; Hoth, Peer (Toim.). *The Baltic Sea Basin* (255 - 279). Berlin: Springer

Rogue waves in the sea.

An amazing phenomenon is a sporadic occurrence of unexpectedly high (rogue) waves on the sea surface. The mechanisms of rogue wave formation (including deep and shallow water and coastal floodings) were reviewed. Nonlinear effects which may cause rogue waves were emphasized. The generality of the physical mechanisms suggested for the rogue wave explanation was discussed; they were valid for rogue wave phenomena in other media such as solid matters, superconductors, plasmas and nonlinear optics.

The worldwide statistics of rogue wave accidents in 2006–2010 demonstrate that the largest number of accidents occur at the coast and in the coastal zone.

It was shown that rogue wave formation within nonlinear hyperbolic systems is only possible through nonlinear wave-wave or/and wave-bottom interaction.

Contact: Dr I.Didenkulova, e-mail:ira@cs.ioc.ee

Selected publications

Slunyaev, A., Didenkulova, I., Pelinovsky, E. (2011). Rogue waters. *Contemporary Physics*, 52(6), 571 - 590.

Nikolkina, I.; Didenkulova, I. (2011). Rogue waves in 2006-2010. *Natural Hazards and Earth System Sciences*, 11(11), 2913 - 2924.

Didenkulova, I., Pelinovsky, E. (2011). Rogue waves in nonlinear hyperbolic systems (shallow-water framework). *Nonlinearity*, 24(3), R1 - R18.

Wave dynamics in the coastal zone.

The random long wave runup on a beach of constant slope was studied in the framework of the rigorous solutions of the nonlinear shallow-water equations. These solutions were used for the calculation of the statistical characteristics of the vertical displacement of the moving shoreline and its horizontal velocity. The probability characteristics of the runup heights and extreme values of the shoreline velocity coincided in the linear and nonlinear theory.

Statistical parameters of the wave inundation on a plane beach were calculated within nonlinear shallow water theory and studied experimentally.

It was shown that the probability of coastal floods grows with an increase in the nonlinearity of the incident wave field.

Contact: Dr I.Didenkulova, e-mail:ira@cs.ioc.ee

Selected publications

Denissenko, P.; Didenkulova, I.; Pelinovsky, E.; Pearson, J. (2011). Influence of the nonlinearity on statistical characteristics of long wave runup. *Nonlinear Processes in Geophysics*, 18(6), 967 - 975.

Didenkulova, I. (2011). Shapes of freak waves in the coastal zone of the Baltic Sea (Tallinn Bay). *Boreal Environment Research*, 16(Suppl A), 138 - 148.

Didenkulova, I., Pelinovsky, E., Sergeeva, A. (2011). Statistical characteristics of long waves nearshore. *Coastal Engineering*, 58(1), 94 - 102.

Didenkulova, I., Pelinovsky, E., Rodin, A. (2011). Nonlinear interaction of large-amplitude unidirectional waves in shallow water. *Estonian Journal of Engineering*, 17(4), 289 - 300.

Resonant effects.

Reflection of long sea waves from an underwater slope joint with an even bottom was studied in the framework of shallow water theory. It allowed to estimate the role of pointwise reflection from the inflection point of the bottom profile and distributed reflection from the underwater slope.

Resonant amplification of tsunami waves, induced by underwater landslides and the problems of wind set-down and set-up relaxation in inclined U-shaped bays were studied analytically within nonlinear shallow water theory.

Contact: Dr I.Didenkulova, e-mail:ira@cs.ioc.ee

Selected publications

Didenkulova, I.I.; Nikolkina, I.F.; Pelinovsky, E.N. (2011). Resonant amplification of tsunami waves generated by an underwater landslide. *Doklady Earth Sciences*, 436(1), 66 - 69.

Wave dynamics in inclined bays and channels.

The problem of long wave shoaling and runup in U-shaped bays (such as fjords) and underwater canyons was studied in the framework of 1D shallow water theory with the use of an assumption of the uniform current on the cross-section. Special attention was paid to the wave breaking criterion for waves at the coast, which appears to provide a condition of applicability for the hodograph transformation. The wave breaking condition was obtained and discussed for each of the studied problems

Contact: Dr I.Didenkulova, e-mail:ira@cs.ioc.ee

Selected publications

Didenkulova, I., Pelinovsky, E. (2011). Nonlinear wave evolution and runup in an inclined channel of a parabolic cross-section. *Physics of Fluids*, 23(8), 086602-1 - 086602-15.

Didenkulova, I., Pelinovsky, E. (2011). Runup of tsunami waves in U-shaped bays. *Pure and Applied Geophysics*, 168(6-7), 1239 - 1249.

SF0140017s08, Keerukate mittelineaarsete juhtimissüsteemide süntees

Realization of discrete-time nonlinear input-output equations: polynomial approach

The reduction and realization problems have been solved for nonlinear control systems applying the theory of non-commutative polynomials. The main advantage of polynomial approach is 'computability'; the theoretical results are complemented by explicit formulas yielding a short program code in Mathematica-based symbolic software.

Contact: Dr Ü.Kotta, e-mail: kotta@ioc.ee

Selected publications

Kotta, Ü., Tõnso, M. Relationship between two polynomial realization methods. - In: Full Papers : 18th Int. Conf. on Process Control '11 : June 14–17, 2011, Tatranská Lomnica, Slovakia / Eds. M.Fikar, M.Kvasnica. Bratislava : Slovak Univ. of Technology, 2011, 147-152.

Kähler differentials and ordinary differentials in nonlinear control theory

In the algebraic approach to nonlinear control systems two similar notions, namely Kähler differentials and the formal vector space of differential one-forms having the properties of ordinary differentials, are frequently used to study the systems. It has been proved that the formal vector space of differential one-forms is isomorphic to a quotient space (module) of Kähler differentials. These two modules coincide when they are modules over a ring of linear differential operators over the field of algebraic functions. Some remarks and examples demonstrating when the use of Kähler differentials might not be appropriate are also considered

Contact: Dr Ü.Kotta, e-mail: kotta@ioc.ee

Selected publications

Fu, G., Halás, M., Kotta, Ü., Li, Z. (2011). Some remarks on Kähler differentials and ordinary differentials in nonlinear control theory. *Systems & Control Letters*, 60(9), 699 - 703.

Control systems on regular time scales and their differential rings.

The inversive differential ring, associated with a nonlinear control system, defined on a non-homogeneous but regular time scale is constructed and equipped with three operators (delta- and nabla-derivatives and forward shift operator) whose properties are studied. The developed formalism unifies/extends those for continuous- and discrete-time systems.

Selected publications

Bartosiewicz, Z., Kotta, Ü., Pawluszewicz, E., Wyrwas, M. (2011). Control systems on regular time scales and their differential rings. *MCSS: Mathematics of Control, Signals, and Systems*, 220(3), 185-201

The relationship between single- and multi-experiment observability for discrete-time nonlinear control systems.

The connection between the concepts of the single-experiment and the multi-experiment unobservability of a nonlinear discrete-time control system is studied. The main result claims that if the system is single-experiment unobservable and the observable space is integrable, then the system is also multi-experiment unobservable. For the proof of the main result a novel mathematical technique, the so-called algebra of functions, is used.

Contact: Dr Ü.Kotta, e-mail: kotta@ioc.ee

Selected publications

Kaparin, V., Kotta, Ü., Shumsky, A. Ye.; Zhirabok, A. N. (2011). A note on the relationship between single- and multi-experiment observability for discrete-time nonlinear control systems. *Proceedings of the Estonian Academy of Sciences*, 60(3), 174 - 178.

Minimal realisation of bilinear and quadratic input-output difference equations in statespace form.

Realisability property of discrete-time bilinear and quadratic input-output (i/o) equations in the classical state-space form has been studied. Constraints on the parameters of the i/o model are suggested that lead to realizable models. Using new formulae for computing basis vectors of certain vector spaces of differential one-forms, the complete list of the third and fourth-order realizable i/o bilinear models, and a new realizable subclass of an arbitrary order is suggested. Moreover, the sufficient conditions of the second- and third-order realizable i/o quadratic models are also given. The developed theory and algorithms are illustrated by means of several examples.

Contact: Dr Ü.Kotta, e-mail: kotta@ioc.ee

Selected publications

Belikov, J.; Kotta, P.; Kotta, Ü.; Zinober, A.S.I. (2011). Minimal realisation of bilinear and quadratic input-output difference equations in state-space form. *International Journal of Control*, 84(12), 2024 - 2034.

Stable polytopes of reflection vector sets.

The convex approximation of the stability region in the polynomial coefficients space is a useful tool for many parametric robust control tasks. Much research work has been done to approximate the Schur stability domain by boxes, ellipsoids or other convex sets. The aim of the study was to find less conservative inner approximations of the stability domain by polytopes starting from different sets of reflection coefficients. First, the stability of the polytope generated by a cuboid of reflection coefficients is studied. Then the different stable polytopes of reflection vectors are investigated. At last the Schur invariant transformation is used in order to increase the volume of stable polytopes. The volumes of all these stable polytopes are calculated in order to compare the approximation quality

Contact: Dr Ü.Nurges, e-mail: nurges@ioc.ee

Selected publications

Nurges, Ü.; Avanesov, S., (2011). Four types of stable polytopes via reflection coefficients of polynomials. In: *Proceedings of the 18th IFAC World Congress : Milano, Italy, August 28 - September 2, 2011: (Toim.) Bittanti, Sergio; Cenedese, Angelo; Zampieri, Sandro. Milano: IFAC, 2011, 6646 – 6650*

Formal methods for complex robotic and embedded systems.

A distributed planning and control framework for human assistive robots has been developed and its prototype was implemented for Scrub Nurse Robot constructed (and used) by Mijawaki Laboratory in Tokyo Denki University.

Contact: Prof J.Vain, e-mail: vain@ioc.ee

Selected publications

Vain, J., Kääramees, M., Markvardt, M. (2011). Online testing of nondeterministic systems with reactive planning tester. Petre, L.; Sere, K.; Troubitsyna, E. (Eds.). *Dependability and Computer Engineering : Concepts for Software-Intensive Systems (1 - 36)*. Hershey, PA: IGI Global

Vain, J.; Kull, A., Kääramees, M., Markvardt, M., Raiend, K. (2011). Reactive testing of nondeterministic systems by test purpose directed tester. Zander, Justyna; Schieferdecker, Ira; Mosterman, Pieter J. (Eds.). *Model-Based Testing for Embedded Systems (425 - 452)*. CRC Press - Taylor & Francis Group, LLC

SF0140083s08, Mittelineaarsed, puuduliku informatsiooniga ja keeruka struktuuriga matemaatilised mudelid

Main topics of research: (i) mathematical analysis of wave propagation and inverse problems in microstructured and functionally graded solids and media with memory; (ii) numerical methods for singular integral and integro-differential equations; (iii) numerical methods for complex optimization problems, incl. ill-posed and multicriterial problems.

2D model of wave propagation in microstructured material was deduced, slaving principle applied and corresponding evolution equation obtained. Stability of inverse problems to

determine parameters of nonlinear microstructured solid by means of solitary waves was studied numerically. Inverse problem for acoustodiagnostics of properties of surface layer of functionally graded material was solved using propagation of sinus wave with 3 reflections. Estimates of superconvergence for piece-wise polynomial collocation for Fredholm integral equations were deduced, they are more exact than previously obtained estimates. Iteration methods based on two-parametric iterative regularization and the idea of Gauss-Newton method for determination of suitable weight functions in perceptrons that use sigmoid activation functions were developed. Results are obtained concerning properties of convex extension of relatively convex function. Study of description of group G_3 (that is representable as semidirect product of 2^n order cyclic group and second order cyclic group) by means of its semigroup of endomorphisms was started.

Contact: Prof J.Janno and Dr I.Kangro, e-mail: janno@ioc.ee, inga@cs.ioc.ee;

Selected publications

von Wolfersdorf, L., Janno, J. (2011). Integro-differential equations of first order with auto-convolution integral II. *Journal of Integral Equations and Applications*, 23(2), 331 - 349.

Janno, J., Engelbrecht, J. (2011). *Microstructured Materials: Inverse Problems*. Berlin: Springer

Vaarmann, O. A neural network based identification for complex non-linear systems. - In: *Proceedings of the 3rd International Conference on Applied Operational Research - ICAOR'11 : August 2011, Istanbul, Turkey / Eds. Y. Gunalay, S. Kadipasaoglu*. Vancouver : Tadbir Operational Research Group Ltd, 2011, 39-46. (Lecture Notes in Management Science ; 3).

Riismaa, T. Optimization of multi-level selection procedure and applications in optimization the structure of parallel and distributed systems. - In: *Proceedings of the 19th IASTED International Conference on Applied Simulation and Modelling [ASM 2011]: June 22 - 24, 2011, Crete, Greece / Ed. C. Angeli*. Anaheim, CA : ACTA Press, 2011, 125-130. <http://dx.doi.org/10.2316/P.2011.715-072>

Riismaa, T. Convex extension of discrete-convex functions and applications in optimization the structure of parallel and distributed processing systems. - In: *Proceedings of the 3rd International Conference on Applied Operational Research - ICAOR'11 : August 2011, Istanbul, Turkey / Eds. Y. Gunalay, S. Kadipasaoglu*. Vancouver : Tadbir Operational Research Group Ltd, 2011, 75-89. (Lecture Notes in Management Science ; 3).

SF0322709s06, Usaldusväärsed tarkvara- ja inimkeele tehnoloogiad

Speech Technology

The perception of Estonian duration-based phonological oppositions by native Estonians (L1) and non-native speakers with Russian-language background (L2) was examined. The results showed that L2 subjects were quite successful in distinguishing the Estonian short/long categories despite the non-categorical use of the duration cue in their native language. As a rule, the L2 subjects demonstrated category boundaries at longer durations, larger width of category boundaries, and lower consistency of responses compared to those of the L1 group.

The production and perception of Estonian vowel categories by L2 speakers of Estonian with Russian language background was studied. The findings support the common standpoint that L2 perception predicts the accuracy in L2 production. However, the evidence was found that despite of the correct perceptual identification of Estonian vowels, in L2 production the native vowel categorical representation outplays the newer L2 category pattern.

An innovative application of Estonian automatic speech recognition enabling web-based access to large transcribed spoken data collections has been developed. The system uses automatic or manual time-aligned transcriptions with speaker and topic segmentation information to present structured speech data more efficiently and make accessing relevant speech data quicker.

Contact: Dr. E.Meister, e-mail: einar@ioc.ee

Selected publications

Meister, Lya; Meister, Einar (2011). Perception of the short vs. long phonological category in Estonian by native and non-native listeners. *Journal of Phonetics*, 39(2), 212 – 224

Meister, Lya; Meister, Einar (2011). Production and perception of Estonian vowels by native and non-native speakers. In: Interspeech 2011 : Conference Proceedings, 27-31 August, Florence, Italy : Speech Science and Technology for Real Life: Florence, Italy: International Speech Communication Association, 2011, 1149 - 1152

Meister, Einar (2011). Human language technology developments in Estonia. In: Language, Languages and New Technologies: ICT in the Service of Languages. Contributions to the Annual Conference 2010 of EFNIL in Thessalonki: (Toim.) Stickel, Gerhard; V?radi, Tam?s. Frankfurt am Main: Peter Lang, 2011, (Duisburg Papers on Research in Language and Culture; 87), 139 – 152

Alum?e, Tanel; Kitsik, Ahti (2011). TSAB - web interface for transcribed speech collections. In: Interspeech 2011 : Conference Proceedings, 27-31 August, Florence, Italy : Speech Science and Technology for Real Life: Florence, Italy: International Speech Communication Association, 2011, 3335 - 3336

Language and automata theory

Every regular language was shown to define a unique nondeterministic automaton (called its ?atomaton), whose states are the atoms of the language, i.e., nonempty left quotients of the language and their nonempty complements. This led to a generalization of Brzozowski's double-reversal method for minimizing a deterministic finite automaton. The quantity suggested by Pomeau as an energy for Ising's spin model (a discrete system) was shown to have all the features of energy as requested by Noether's theorem, one of the most important results in classical mechanics.

Contact: Dr. H. Tamm, hellis@cs.ioc.ee

Selected publications:

J. Brzozowski, H. Tamm. Theory of ?atomata. In G. Mauri, A. Leporati, eds., Proc. of 15th Int. Conf. on Developments in Language Theory, DLT 2011 (Milano, July 2011), v. 6795 of Lect. Notes in Comput. Sci., pp. 105-116. Springer, 2011.

S. Capobianco. Generalized Besicovitch and Weyl spaces: topology, patterns, and sliding block codes. Theor. Comput. Sci., v. 412, n. 30, pp. 3822-3837, 2011.

S. Capobianco, T. Toffoli. Can anything from Noether's theorem be salvaged for discrete dynamical systems? In C. S. Calude, J. Kari, I. Petre, G. Rozenberg, eds., Proc. of 10th Int. Conf. on Unconventional Computation, UC 2011 (Turku, June 2011), v. 6714 of Lect. Notes in Comput. Sci., pp. 77-88. Springer, 2011.

Programming languages

A fine-grained analysis from the perspective of constructive mathematics was developed for the notion of finiteness, for applications to constructive programming logics (the "almost always" operator in temporal logics). A novel practical type system was devised for ML-style recursive modules that solves the double vision problem and typechecks common patterns of recursive modules including functor fixpoints. To account for datatypes where a position in a shape determines another shape (a subshape rooted by that position), the concept of directed containers was introduced and shown to characterize comonads whose underlying functor is a container. Two different sequent calculi for proof search and countermodel construction were devised for bi-intuitionistic logic: a labelled sequent calculus and a sequent calculus with analytic cuts.

Contact: Dr. T. Uustalu, tarmo@cs.ioc.ee

Selected publications:

H. Im, K. Nakata, J. Garrigue, S. Park. A syntactic type system for recursive modules. ACM SIGPLAN Notices, v. 46, n. 10, pp. 993-1012.

K. Nakata, T. Uustalu, M. Bezem. A proof pearl with the fan theorem and bar induction: walking through infinite trees with mixed induction and coinduction. In H. Yang, ed., Proc. of 9th Asian Symp. On Programming Languages and Systems, APLAS 2011 (Kenting, Dec. 2011), v. 7078 of Lect. Notes in Comput. Sci., pp. 353-368. Springer, 2011.

L. Pinto, T. Uustalu. Relating sequent calculi for bi-intuitionistic propositional logic. In S. van Bakel, S. Berardi, U. Berger, eds., Proc. of 3rd Wksh. on Classical Logic and Computation CL&C 2010 (Brno, Aug. 2010), v. 47 of Electron. Proc. in Theor. Comput. Sci., pp. 57-72. Open Publishing Assoc., 2011.

Software engineering

A novel ontology development methodology was developed for construction of light-weight domain ontologies, which brings ontology modelling closer to domain experts that are actual domain knowledge holders. The Cassandra DBMS was evaluated for applicability in cloud computing environments; extensions were suggested to the pattern language concept and the applied pattern format introduced by Alexander, Borchers and others, aiming at a generic pattern language for ubiquitous computing application design.

Contact: Dr. E. Tyugu, tyugu@cs.ioc.ee

Selected publications:

H.-M. Haav. A practical methodology for development of a network of e-government domain ontologies. In T. Skersys, R. Butleris, L. Nemuraite, R. Suomi, eds., *Building the e-World Ecosystem: Revised Selected Papers from 11th IFIP WG 6.11 Conf. on e-Business, e-Service and e-Society, I3E 2011* (Kaunas, Oct. 2011), v. 353 IFIP Advances in Information and Communication Technology of pp. 1-13. Springer, 2011.

H.-M. Haav, A. Kaljuvee, M. Luts, T. Vajakas. Ontology-driven development of personalized location-based services. In J. Barzdins, M. Kirikova, eds., *Databases and Information Systems VI*, v. 224 of *Frontiers of Artificial Intelligence and Applications*, pp. 3-18. IOS Press, 2011.

2.3 Loetelu struktuuriüksuse töötajate rahvusvahelistest tunnustustest.

Irina Didenkulova valiti Rahvusvahelise tsunami komisjoni liikmeks (Eesti esindaja)

Tarmo Soomere pälvis konsortsiumi BONUS eriauhinna uurimiprojekti „Baltic Way“ raames tehtud mereteadustes populariseerimise ja praktilise kasutamise suunas tehtud töö eest

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

Jüri Engelbrecht

ALLEA – All European Academies – president

EASAC – European Academies Science Advisory Council - liige

Euromech liige

ERAWATCH nõukoja liige

RP7 „Peoples Programme“ nõukoja liige

European Science Foundation juhtkomitee liige

ERA-NET Complexity juhtkomitee liige

Academia Europea, liige

Budapesti Tehnikaülikooli audoktor (Dr. h.c.)

Ungari Teaduste Akadeemia, auliige

Göteborgi Kuningliku Teadus- ja Kunstiühingu välisliige

Läti Teaduste Akadeemia, välisliige

Euroopa Teaduste ja Kunstide Akadeemia liige

Accademia Peloritana dei Pericolanti, välisliige

Jaan Kalda

Adisory Board of the International Physics Olympiads – liige

Einar Meister

International Speech Communication Association (ISCA), liige

Sven Nõmm

Rahvusvaheline Automaatjuhtimise Föderatsiooni (IFAC) Eesti rahvusliku komitee kontaktisik

Jaan Penjam

EL 7. Raamkava IST programmi programmkomitee Eesti delegatsiooni ekspert

ACM – Association for Computing Machinery – liige

Ewald Quak

Complexity-Net taotlusvooruu „Interdisciplinary Challenges for Complexity Science“ projektide hindaja ja Eesti Teaduste Akadeemia esindaja

EL RP7 programmi „People“ Marie Curie Industry-Academia Partnerships and Pathways (IAPP) taotlusi hindava paneeli aseesimees

Arvi Ravasoo

Euroopa Mehaanikaühingu Euromech liige

Andrus Salupere

IUTAM (International Union of Theoretical and Applied Mechanics) peassamblee liige

Eesti Rahvusvliku Mehaanika Komitee esimees

IACM – International Association for Computational Mechanics – liige

Euroopa Mehaanikaühingu Euromech liige

USACM – U.S. Association for Computational Mechanics liige

Tarmo Soomere

Euroopa Teadusfondi Merekomitee, Eesti esindaja

Journal of Marine Systems toimetuskolleegiumi liige

CBO (Läänemere okeanograafide konverentsi) juhtkomitee liige

Euroopa Geoteaduste Liidu liige

Enn Tõugu

IEEE liige

IEEE Computer Society, liige

Tarmo Uustalu

International Federation for Information Processing (IFIP), WG 2.1 „Algorithmic Languages and Calculi“ liige

Association for Computing Machinery (ACM), liige

European Association for Programming Languages and Systems (EAPLS) liige

European Association for Logic, Language and Informationn (FoLLI) liige

European Association for Computer Science Logic (EACSL) liige

European Association for Theoretical Computer Science (EATCS) liige

Interest Group in Pure and Applied Logic (IGPL) liige

Formal Methods Europe (FME) liige

Otu Vaarmann

The European Working Group *Multicriterial aid for decisions*, liige

The European Working Group *Financial modelling*, liige

Töörühma EUROPT – The Continuous Optimization (Association of European Operations Research Societies) liige

Jüri Vain

EL 6. raamprogrammi IST STREP projekt nr 045255 „Knowledge Environment for Interacting ROBOt SWARMS“ teaduskoordinaator

2.5 Aruandeaasta tähtsamad T&A finantseerimise allikad.

Küberneetika Instituudi peamisteks finantseerimise allikateks 2011. aastal olid:

Riigieelarve	1 272 097 eurot
Teadusfond	255 800 eurot
Riigi finantseeritavad fondid ja sihtasutused	331 745 eurot
Välismaised finantseerimisallikad	253 096 eurot
Ettevõtted	78 544 eurot

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.

Tarmo Soomere pälvis parima teadust ja tehnoloogiat populariseeriva teadlase (ajakirjaniku või õpetaja) tiitli merefüüsika aktuaalsete probleemide selgitamise eest populaarteaduslikes artiklites ja avalikes esinemistes.

Tarmo Soomere tunnistati TTÜ aasta teadlaseks 2011

Tarmo Soomere juhitud uurimisprojekti "BalticWay" raames tehtud tööd mereteaduste saavutuste populariseerimise ja praktilise kasutamise suunas hinnati Läänemere mereteadust finantseerivate organisatsioonide konsortsiumi BONUS eriauhinnaga.

Tanel Alumäe saavutas TTÜ 2011 a rakenduslike teadustööde konkursil teadustöö "Eestikeelse kõnetuvastuse meetodite uurimine ja arendamine" eest kolmanda koha

Silvio Capobianco artikkel „Can anything from Noether’s theorem be salvaged for discrete dynamical systems“. Lecture Notes in Computer Science, vol 6714/2011, 77–88, (kaasautor Toffoli T) pälvis juba viis päeva pärast avaldamist täispika retsensiooni Massachusettsi Tehnoloogiaülikooli mõjukas tehnoloogiaportaalis MIT Technology Review.

4.-6. veebruarini toimusid Nelijärve puhkekeskuses **19. Eesti arvutiteaduse teooriapäevad:**

27. veebruarist 4. märtsini korraldas Küberneetika Instituut Palmes **XVI Eesti Arvutiteaduse Talvekooli** (16th Estonian Winter School in Computer Science (EWSCS’11)).

Kooli neli intensiivkursust pidasid Rajeev Goré (Australian National University, Canberra, Australia; Martin Hofmann (Ludwig-Maximilians-Universität München, Germany); Bart Jacobs (Radboud Universiteit Nijmegen, The Netherlands); Dominique Unruh (University of Tartu, Estonia). Kõik lektorid on väga kõrgelt tunnustatud teadlased. Kuulajateks olid peamiselt magistrandid ja doktorandid Eestist, Lätist, Leedust, Saksamaalt, Venemaalt, Rumeeniast, Soomest. Rootsist ja Inglismaalt.

22. märtsist 1. aprillini luges **Dr. Claude Moog** (CNRS, Prantsusmaa). lühikursuse "*Feedback linearization with internal stability of mechanical underactuated systems*". IKTDK raames.

7-8. juulini korraldas Küberneetika Instituut infoturbe-alase konverentsi **10th European Conference on Information Warfare and Security ECIW-2011**.

5-7 oktoobrini korraldas Küberneetika Instituut Tallinnas konverentsi **12th Symposium on Programming Languages and Software Tools - SPLST'11**.

7.-9. oktoobrini toimusid Jõgevamaal Tõrvel **20. Eesti arvutiteaduse teooriapäevad**.

12.-13. novembrini toimus Viinistul iga-aastane **KübI sügisseminar**.

2. detsembril toimus **Eksperimentaalfoneetika töötuba**, kus Alan Wrench (Articulate Instruments Ltd., UK) tutvustas kõne artikulatsiooni uurimise meetodeid ja elektropalatograafi kasutamist.

6. detsembril toimus CENSi töötuba "**Recent Problems on Dispersive Waves**", kus esinesid ettekannetega Jüri Engelbrecht (KübI), Hui-Hui Dai (), Jiří Plešek, Radek Kolman () Arkadi Berezovski (KübI), ja Kert Tamm (KübI).

Jaan Kalda juhendatud Eesti õppurite esindajad said 42. rahvusvahelisel füüsikaolümpiaadil IPhO Bangkokis ühe kuld-, ühe hõbe- ja kolm pronksmedalit ning I Ülemaailmsel füüsikaolümpiaadil WoPhO Manokwaris (Papua, Indonesia) ühe kuldmedali (teine koht absoluutarvestuses).

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

- Haridus- ja Teadusministeerium
sihtfinantseeritavad teemad:

- SF0140077s08, Mittelineaarne dünaamika ja kompleksüsteemid, Engelbrecht Jüri

- SF0140083s08, Mittelineaarsed, puuduliku informatsiooniga ja keeruka struktuuriga matemaatilised mudelid, Kangro Inga
- SF0140017s08, Keerukate mittelineaarsete juhtimissüsteemide süntees, Kotta Ülle
- SF0322709s06, Usaldusväärsed tarkvara- ja inimkeele tehnoloogiad, Uustalu Tarmo
- SF0140007s11, Lainetuse dünaamika ja rannikutehnika, Soomere Tarmo

baasfinantseerimise toetusfondist rahastatud projektid (sh TTÜ tippkeskused):

- ÜPTK02, Mittelineaarsete protsesside analüüsi keskus CENS, Jüri Engelbrecht

riiklikud programmid:

- EKT17, Audiovisuaalse kõnesünteesi prototüüp, Meister Einar
- EKT3, Kõne- ja multimodaalsed korpused, Meister Einar
- EKT18, Kõnetuvastus, Alumäe Tanel

- Teiste ministriumide poolt rahastatavad riiklikud programmid:

- Uuriija-professori rahastamine:

- SA Eesti Teadusfond

grandid:

- ETF6922, Juhtimissüsteemid ajaskaaladel, Kotta Ülle
- ETF7520, Algebraalne automaatide teooria, Tamm Hellis
- ETF7344, Isoleeritud südamelihase raku mehaanoenergeetika, Vendelin Marko
- ETF7413, Läänemere lainetuse tingimuste ajalis-ruumiline muutlikkus muutuvates kliimatingimustes, Soomere Tarmo
- ETF7667, Mudeli-põhine plaanurite süntees mittedeterministlikele ja hajussüsteemidele, Vain Jüri
- ETF7840, Fotoelastsustomograafia kompleksed algoritmid, Aben Hillar
- ETF8041, Na⁺ /Ca²⁺ -vahetaja roll vikerforelli kardiomüotsüütide elektromehaaniline sidestus ja energeetika, Birkedal Nielsen Rikke
- ETF7728, Pöördülesanded keerukate omadustega materjalide identifitseerimisel, Janno Jaan
- ETF7909, Turbulentse segunemise roll kompleksisüsteemides toimuvate protsesside dünaamikas, Kalda Jaan
- ETF8365, Inimliigutuste tuvastamine ja modelleerimine, Nõmm Sven
- ETF8658, Solitonilised struktuurid mitteintegreeruvates süsteemides ja diskreetne spektraalanalüüs, Andrus Salupere
- ETF8870, Lained ohufaktorina Eesti rannavetes, Irina Didenkulova
- ETF8702, Multimastaapne deformatsioonilainete analüüs mikrostruktuuriga materjalides, Arkadi Berezovski
- ETF8787, Arvutialgebra meetodid juhtimissüsteemides, Maris Tõnso
- ETF8972, Reaktiivsete hapniku vormide ja kaltsiumisignaali vastastikune sõltuvus südamepuudulikkuse algstaadiumis, Hena Ramay

ühisgrandid välisriigiga:

järel doktorite grandid (SA ETF ja Mobilitas):

- MJD30, Systematic examination of arrhythmogenic calcium release in cardiac myocytes, Ramay Hena
- MJD80, The theoretical study of mitochondrial energetic metabolism, Karo Jaanus

tippeadlase grandid (Mobilitas):

- MTT63, Numerical particle tracking modeling for inhomogeneous turbulent water basins, Torsvik Tomas

- Ettevõtluse Arendamise SA

eeluuringud:

arendustoetused:

- SA Archimedesega sõlmitud lepingud

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

- AP077, Mittelineaarne dünaamika ja kompleksüsteemid, Engelbrecht Jüri
- AP709, Usaldusväärsed tarkvara- ja inimkeele tehnoloogiad, Uustalu Tarmo
- AP007, Lainetuse dünaamika ja rannikutehnika, Soomere Tarmo

Eesti tippkeskused:

- EXCS, Arvutiteaduse tippkeskus, Tarmo Uustalu
- TK124, Mittelineaarsete protsesside analüüsi keskus, Jüri Engelbrecht

riiklikud programmid:

muud T&A lepingud:

- SA Keskkonnainvesteeringute Keskusega sõlmitud lepingud:
- Siseriiklikud lepingud:
 - LN10, Tüvekontuuri servaga laudadest puitpõrandate optimeerimine, Penjam Jaan
 - LN11, Tuulikuparkide mõju analüüs seireradaritele, Vahur Kotkas
 - LN13 X-tee automatiseerimine, Pavel Grigorenko
 - LN14 JukuLab, Tanel Alumäe
- EL Raamprogrammi projektid:
 - ESTSpline, Educational, Scientific, and Technological Aspects of Splines, Quak Ewald
 - HATS, Highly Adaptive and Trustworthy Software Using Formal Models - HATS, Uustalu Tarmo
- Välisriiklikud lepingud:
 - BW, The potential of currents for environmental management of the Baltic Sea maritime industry (BalticWay), Soomere Tarmo
 - EN05, Analysis of structural and functional aspects of compartmentation of adenine nucleotides in heart muscle cells, Vendelin Marko
 - ESTwave, Educational, Scientific and Technological Aspects of Mesoscopic Continuum Physics for Waves in Complex Materials, Herrmann Heiko

2.8 Struktuuriüksuse töötajate poolt avaldatud sihtfinantseeritava teadusteema taotlemisel arvestatavad 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

Kaparin, Vadim; Kotta, Ülle; Shumsky, Alexey Ye.; Zhirabok, Alexey N. (2011). A note on the relationship between single- and multi-experiment observability for discrete-time nonlinear control systems. Proceedings of the Estonian Academy of Sciences, 60(3), 174 - 178.

Im, Hyeonseung; Nakata, Keiko; Garrigue, Jacques; Park, Sungwoo (2011). A syntactic type system for recursive modules. ACM SIGPLAN Notices, 46(10), 993 - 1012.

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Didenkulova, I.; Pelinovsky, E.; Soomere, T.; Parnell, K.E. (2011). Beach profile change caused by ship wakes and wind waves in Tallinn Bay, the Baltic Sea. *Journal of Coastal Research*, SI 64, vol I, 60 - 64.

Didenkulova, Ira; Pelinovsky, Efim; Soomere, Tarmo (2011). Can the waves generated by fast ferries be a physical model of tsunami? *Pure and Applied Geophysics*, 168(11), 2071 - 2082.

Kelpšaitė, L.; Dailidienė, I.; Soomere, T. (2011). Changes in wave dynamics at the south-eastern coast of the Baltic Proper during 1993-2008. *Boreal Environment Research*, 16(Suppl A), 220 - 232.

Ryabchuk, Daria; Kolesov, Alexander; Chubarenko, Boris; Spiridonov, Mikhail; Kurennoy, Dmitry; Soomere, Tarmo (2011). Coastal erosion processes in the eastern Gulf of Finland and their links with geological and hydrometeorological factors. *Boreal Environment Research*, 16(Suppl A), 117 - 137.

Bartosiewicz, Zbigniew; Kotta, Ülle; Pawluszewicz, Ewa; Wyrwas, Malgorzata (2011). Control systems on regular time scales and their differential rings. *MCSS: Mathematics of Control, Signals, and Systems*, 220(3), 185-201

Kaevand, T.; Kalda, J.; Kukk, V.; Öpik, A.; Lille, Ü. (2011). Correlation of the morphology and electrical conductivity in thin films of PEDT/PSS complex: an integrated meso-scale simulation study. *Molecular Simulation*, 37(6), 495 - 502.

Ravasoo, A. (2011). Counter-propagation of harmonic waves in exponentially graded materials. *Journal of Sound and Vibration*, 330(16), 3874 - 3882.

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Rousseau, Martine; Maugin, Gérard A.; Berezovski, Mihhail (2011). Elements of study on dynamic materials. *Archive of Applied Mechanics*, 81(7), 925 - 942.

Kurennoy, D.; Parnell, K.E.; Soomere, T. (2011). Fast-ferry Generated Waves in South-West Tallinn Bay. *Journal of Coastal Research*, SI 64, vol I, 165 - 169.

Didenkulova, Ira; Soomere, Tarmo (2011). Formation of two-section cross-shore profile under joint influence of random short waves and groups of long waves. *Marine Geology*, 289(1-4), 29 - 33.

Capobianco, Silvio (2011). Generalized Besicovitch and Weyl spaces: topology, patterns, and sliding block codes. *Theoretical Computer Science*, 412(30), 3822 - 3837.

Berezovski, Arkadi; Engelbrecht, Jüri; Maugin, Gérard A. (2011). Generalized thermomechanics with dual internal variables. *Archive of Applied Mechanics*, 81(2), 229 - 240.

Kurkina, O.E.; Kurkin, A.A.; Soomere, T.; Pelinovsky, E.N.; Rouvinskaya, E.A. (2011). Higher-order (2 + 4) Korteweg-de Vries-like equation for interfacial waves in a symmetric three-layer fluid. *Physics of Fluids*, 23(11), 116602-1 - 116602-13.

Kurkina, O.E.; Talipova, T.G. (2011). Huge internal waves in the vicinity of the Spitsbergen Island (Barents Sea). *Natural Hazards and Earth System Sciences*, 11(3), 981 - 986.

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- von Wolfersdorf, Lothar; Janno, Jaan (2011). Integro-differential equations of first order with auto-convolution integral II. *Journal of Integral Equations and Applications*, 23(2), 331 - 349.
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- Soomere, T.; Andrejev, O.; Sokolov, A.; Quak, E. (2011). Management of coastal pollution by means of smart placement of human activities. *Journal of Coastal Research*, SI 64, vol I, 951 - 955.
- Kurkina, O.; Pelinovsky, E.; Talipova, T.; Soomere, T. (2011). Mapping the internal wave field in the Baltic Sea in the context of sediment transport in shallow water. *Journal of Coastal Research*, SI 64, vol II, 2042 - 2047.
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2.9 Struktuuriüksuses kaitstud doktoriväitekirjade loetelu (*NB! struktuuriüksus lisab struktuuriüksuse töötaja juhendamisel mujal kaitstud doktoriväitekirjade loetelu*)

Kert Tamm, TTÜ Küberneetika Instituut

Teema: *Wave Propagation and Interaction in Mindlin–Type Microstructured Solids: Numerical Simulation* (Lainelevi ja interaktsiooni numbriline modelleerimine Mindlini tüüpi mikrostruktuursetes tahkistes)

Juhendaja: prof Andrus Salupere

Kaitses: 27.04.2011

Omistatud kraad: filosoofiadoktor (rakendusmehaanika)

Riina Maigre, TTÜ Küberneetika Instituut

Teema: *Composition of Web Services on Large Service Models* (Veebiteenuste kompositsioon suurte teenustemudelitel)

Juhendaja: juhtivteadur Enn Tõugu

Kaasjuhendaja: vanemteadur Peep Küngas

Kaitses: 22.06.2011

Omistatud kraad: filosoofiadoktor (informaatika)

Tanel Peets, TTÜ Küberneetika Instituut

Teema: *Dispersion Analysis of Wave Motion in Microstructured Solids* (Lainete dispersioon mikrostruktuuriga materjalides)

Juhendaja: prof Jüri Engelbrecht

Kaitses: 5.12.2011

Omistatud kraad: filosoofiadoktor (rakendusmehaanika)

Lya Meister, TTÜ Küberneetika Instituut

Teema: *Eesti vokaali- ja kestuskategooriad vene emakeelega keelejuhtide tajus ja häälduses. Eksperimentaalfoneetiline uurimus* (The perception and production of Estonian vowel and duration-based categories by non-native subjects with a Russian-language background. An experimental phonetic study)

Juhendajad: prof Karl Pajusalu (Tartu Ülikool) ja knd Hille Pajupuu (Eesti Keele Instituut).

Kaitses 14. 11.2011 Tartu Ülikoolis

Omistatud kraad: filosoofiadoktor (eesti keel)

Wolfgang Jeltsch TTÜ Küberneetika Instituut

Teema: "Strongly typed and efficient functional reactive programming".

Kaitses 8.12.2011 Cottbusi Tehnikaülikoolis

Omistatud kraad: PhD

Irina Nikolkina DoRa külalisdoktorant Küberneetika Instituudis

Teema: "Pikkade lainete dünaamika modelleerimine merelt lähtuvate ohtude kontekstis"

Juhendaja: prof E. Pelinovski (Nizhni Novgorod)

Kaitses: 29.04.2011 Nižni Novgorodi Riiklikus Ülikoolis

Omistatud kraad: teaduste kandidaat

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

MJD30, Systematic examination of arrhythmogenic calcium release in cardiac myocytes, Ramay Hena

MJD80, The theoretical study of mitochondrial energetic metabolism, Karo Jaanus

2.11 Struktuuriüksuses loodud tööstusomandi loetelu

2011. aastal Küberneetika Instituudis tööstusomandit ei loodud

3. Struktuuriüksuse infrastruktuuri uuendamise loetelu

1. Server-mälupank	3800	eurot
2. HP Workstation	2195	eurot
3. Veepinna asendi mõõtur	9992	euro