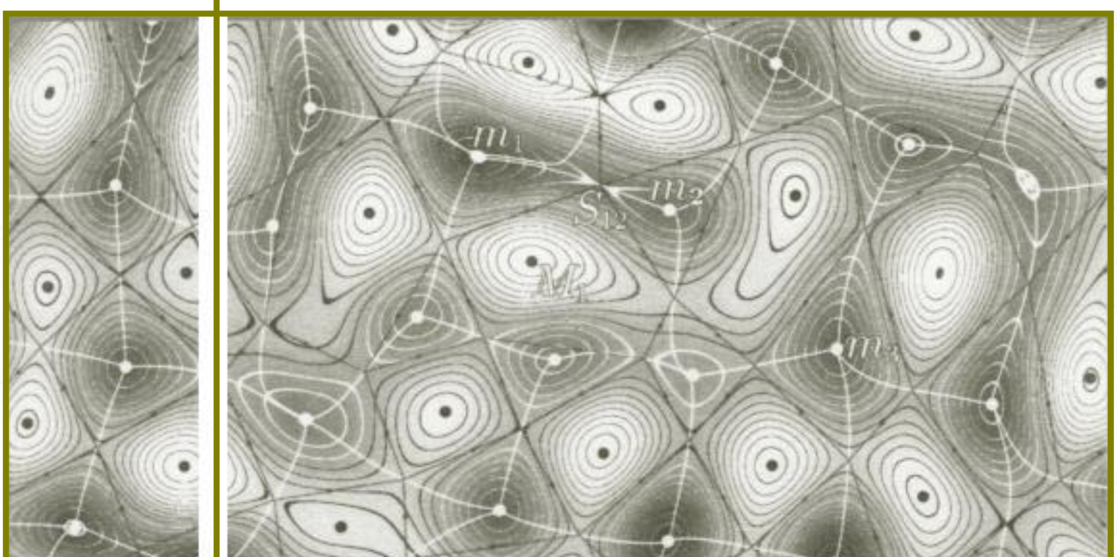
CENTRE FOR NONLINEAR STUDIES



2013 ANNUAL REPORT

Tallinn

Institute of Cybernetics at Tallinn University of Technology
Institute of Physics, University of Tartu

CENS

Centre for Nonlinear Studies

Estonian Centre of Excellence in Research

Annual Report

2013 Tallinn

Contents

Abstract

This Report gives a brief overview on activities of CENS in 2013. From August 2011, CENS is an Estonian Centre of Excellence in Research, supported by the European Regional Development Fund. Described are studies and results in: (i) dynamics of microstructured materials and solitons; (ii) general nonlinear wave theory; (iii) fractality and econophysics; (iv) nonlinear photoelasticity; (v) systems biology and cell energetics; (vi) water waves and coastal engineering; (vii) nonlinear control theory; (viii) nonlinear optics and localised waves.

The full records of papers, reports, conference talks, teaching activities, promotions, etc are all included. A separate section lists the highlights of research. The Annex includes some additional information on activities of CENS.

Keywords: nonlinear dynamics, soft matter physics, microstructured solids, solitons, acoustodiagnostics, photoelasticity, cell energetics, water waves, extreme waves, coastal engineering, differential equations, control theory, wave optics and localised waves.

The International Advisory Board

Sisukord

Lühikokkuvõte

Aruanne sisaldab ülevaadet CENSi (Mittelineaarsete Protsesside Analüüsi Keskuse) tegevusest 2013.a. Alates augustist 2011, on CENS Eesti tippkeskus, millega kaasneb toetus Euroopa Regionaalarengu Fondilt. Põhitulemused on kirjeldatud järgmiste alateemade kaupa:
(i) lainelevi mikrostruktuursetes materjalides ja solitonid; (ii) üldine mittelineaarne laineleviteooria; (iii) fraktaalsus ja ökonofüüsika; (iv) mittelineaarne fotoelastsus; (v) süsteemibioloogia ja rakuenergeetika; (vi) lained veepinnal ja rannikutehnika; (vii) mittelineaarne juhtimisteooria; (viii) mittelineaarne optika ja lokaliseeritud lained.

On esitatud publikatsioonide, konverentsiettekannete, seminaride ja õppekursuste jm. nimekirjad. Eraldi on välja toodud olulised teadustulemused. Lisas on täiendav informatsioon üksikutest tegevustest.

Võtmesõnad:
mittelineaarne dünaamika, pehmisefüüsika, mikrostruktuuriga materjalid, solitonid, akustodiagnostika, fotoelastsus, rakuenergeetika, pinnalained, hiidlained, rannikutehnika, diferentsiaalvõrrandid, juhtimisteooria, laineoptika, lokaliseeritud lained.

1. Introduction

The underlying idea for founding Centre for Nonlinear Studies (CENS) in 1999 was to bring together the scientific potential of Estonia engaged in interdisciplinary studies of complex nonlinear processes. In 2002 2007 CENS was included into the first Estonian National Programme for Centres of Excellence in Research. The results from this period are described in ”CENS Highlights, 2007” (see also Annual Reports).

In 2009 CENS was awarded with the title “Centre of Excellence in Research”of Tallinn University of Technology for years 2009–2011.

In 2011, CENS was included into the second Estonian National Programme for Centres of Excellence in Research (2011–2015).

This Report covers, like the previous ones, all the activities carried on by the staff of CENS including students. Section 2 is a short summary on the structure of CENS and on highlights in 2013. In Section 3, current research results in 2013 are briefly described. Next Sections describe funding (Section 4), publications, conferences, etc. (Section 5) and other activities of CENS (Section 6). Finally, in Section 7 conclusions are presented. Some additional materials describing the activities of CENS are given in the Annex.

2. Overview on CENS and highlights in 2013

CENS is the Estonian hub of competence, research and training in nonlinear phenomena – the intrinsic component of real world that brings in universal phenomena (solitons, coherence, chaos, hierarchies, self-emergence, etc.) which need specifc tools for their analysis and control. The research is interdisciplinary and cross-disciplinary. The present CENS from 2011 on includes the following research groups from the Institute of Cybernetics at Tallinn UT (IoC at TUT) and the University of Tartu (UT):

Nonlinear Dynamics (IoC at TUT) — Prof J.Engelbrecht;

Wave Engineering (IoC at TUT) — Prof T.Soomere;

Systems Biology (IoC at TUT) — Dr M.Vendelin;

Optics (UT) — Prof P.Saari;

Nonlinear Control Theory (IoC at TUT) — Dr Ü.Kotta.

Nonlinear Dynamics group deals with (i) nonlinear wave motion in solids; (ii) soft matter physics; (iii) photoelasticity. Attention is on hierarchical behaviour of microstructured solids under dynamical loads, including impact and corresponding inverse problems; solitons and solitary waves; turbulent mixing; processes with power laws; nonlinear photoelastic tomography.

Wave Engineering group has competence in nonlinear wave theory and modelling of fluids with the focus on applications in the marine and coastal environments. Attention is to wave excitation and propagation over the sea surface; impact of waves in coastal regions; unified framework for wave-driven phenomena, and Lagrangian transport.

Systems Biology group is focused on unravelling the intricacies behind regulation of intracellular processes in cardiac muscle cells. Efforts are mostly concentrated on studying regulatory mechanisms of metabolic processes in the heart, expanding our knowledge of cardiac energetics and contractile function, and shedding light on novel aspects of excitation-contraction coupling in rat, trout and mouse hearts. Both experimental and computational approaches are applied in investigating these topics.

Optics group has competence in physical and ultrafast optics, particularly in non-diffracting and accelerating localized waves. Both theoretical and experimental studies are carried out in these fields.

Nonlinear Control Theory group deals with dynamical control systems on time scales. Attention is focused on novel algebraic methods and symbolic software tools for solving fundamental problems for nonlinear control systems towards unification of discrete- and continuous-time control.

Synergy and added value is created in understanding universal nonlinear phenomena: mathematical models and methods of analysis; interaction of waves in a wide range of scales; solitons; solitary and localised waves; emerging features; nonlinear feedback; irreversibility; control over physical phenomena. Such studies are in the forefront of science, more specifically in studies of complex systems. There are many practical applications in materials science, environmental protection, health care, and information technology. Research is supported by several international agencies and programmes: Wellcome Trust, BONUS+, Roboswarm, Humboldt Foundation, etc.

CENS has personnel of 67, of whom 27 are PhD students (see Annex 1).

Highlights of research in 2013

Nonlinear Dynamics

- The concept of internal variables is generalized for describing the internal structure of materials as internal fields.
- The negative group velocity is proved to exist for a Mindlin-type multiscale and a felt-type materials.
- A novel wave equation for felt-type materials is proposed and analysed.
- A universal relationship between the scaling exponents has been established describing the time-fluctuations of the intersection size of two moving fractal sets.
- A novel device for optimal mixing of two compounds has been devised, which maximizes homogeneity of mixing, as described via finite-time Lyapunov exponents.
- Existence of hidden solitons is demonstrated for a hierarchical KdV system in case of three types of initial conditions, dependencies between the number of hidden solitons and material parameters as well as initial wave parameters are established.
- An orthotropic constitutive model for fibre reinforced materials based on the orientation distribution function of fibres has been proposed.

Optics

- By theoretical study and direct measurements with ultrahigh temporal and spatial resolution it was shown that a setup based on a spatial light modulator with an imprinted wrapped cubic phase shapes femtosecond pulses into curvilinearly propagating Airy pulses of type II, whereas a setup based on a custom-made refractive element with cubic phase surface profile produces type IV nondispersing Airy pulses of exceptionally high quality.

Wave Engineering

- The potential pollution released during a ship accident and further carried by currents may affect marine protected areas in the Gulf of Finland at very large distances, up to 200 km. Shifting the major fairway by a small distance in some sections may lead to a huge decrease in the amount of pollution carried to the largest marine protected area.
- Inclusion of a model component for small-scale, random spreading into the calculations of current-driven propagation of pollution substantially impacts the shape of single trajectories, the spreading rate of closely packed trajectories and the number of trajectories that eventually reach the coast. The pattern of most frequently hit coastal sections, the probability of hit to each such section and the time the pollution spends offshore are almost insensitive with respect to the absence or presence of eddy-diffusivity effects.
- Although the surface velocity field is often vorticy-dominated in the Gulf of Finland, this field contains a very small number of coherent, long-living eddies.
- Analytical theory of tsunami generation by submarine landslides (resulting in three waves) was extended to the case of narrow bays and channels of various geometries in the shallow-water framework.
- The distribution function of extreme runup characteristics can be approximated by the Rayleigh distribution in a wide range of wave amplitudes and spectra even if the incident wave field is non-Gaussian.
- We demonstrated the possibility of rogue wave formation due to the modulational instability in a basin of intermediate depth, starting from depths of about 20 m.
- Wind wave climatology in the eastern part of the Baltic Sea has been extended back to 1946 and a first approximation of a similar climatology for Lake Peipsi has been constructed.
- A novel method making use of spectrogram analysis has been applied to quantify the duration, intensity and frequency distribution of wake waves from high-speed ferries and fast conventional ships.
- The maximum wave set-up (up to 70–80 cm) forms $> 50\%$ of the all-time maximum water level and thus may serve as a substantial source of marine hazard for low-lying regions within and around the City of Tallinn.
- The qualitative patterns of wave-driven net and bulk sediment transport along the eastern Baltic Sea coast are very robust. The overall counter-clockwise transport contains two persistent reversals.

Systems Biology

- In creatine-deficient mice study we demonstrate that the healthy heart is able to preserve cardiac function at a basal level in the absence of creatine kinase-facilitated energy transfer without compromising intracellular organization and the regulation of mitochondrial energy homeostasis.
- We have shown that ADP potently restores calcium retention capacity in severely stressed mitochondria. This effect is most likely not related to a reduction in reactive oxygen species production.

Nonlinear Control Theory

- Computational aspects of realization of a set of higher-order nonlinear input/output equations in the state space form were studied. Instead of the algorithmic solutions, provided in earlier works, the explicit formulas, based on the concept of adjoint polynomials, were obtained.
- The disturbance decoupling problem by the dynamic measurement feedback for discrete-time nonlinear control systems was studied. To address the problem, the algebraic approach, called the algebra of functions, was applied, which allows the system description also depend on non-differentiable functions. A necessary and sufficient condition was given in terms of controlled and (h, f)-invariant functions. Also, algorithms were derived, which find the invariant functions and the required feedback.

3. Current results 2013

3.1 Institute of Cybernetics, Department of Mechanics and Applied Mathematics, Tallinn University of Technology

3.1.1 Dynamics of materials

Waves in microstructured solids.
The concept of internal variables is generalized for describing the internal structure of materials as internal fields. This bring thermodynamic considerations directly into modelling because the evolution of internal variables is described by satisfying entropy inequality. The model equations are of the Boussinesq type and govern wave propagation in a wide class of microstructured materials. The dispersive analysis and the numerical simulation has demonstrated many features of the wave processes. It is shown that the higher order dispersion branch is a manifestation of an internal degree of freedom. The leading dimensionless parameters are established for waves in microstructured materials. It is demonstrated how the values of parameters influence the wave propagation, the evolution and the interaction of waves under the framework of considered models. Special attention is paid to the changes of interaction trajectories of solitary waves (J.Engelbrecht, A.Berezovski, A.Salupere, K.Tamm, T.Peets).

A mathematical model describing 1D wave propagation in Mindlin-type microstructured solids with nonlinearities in the macro- and microscale is used for studying propagation of solitary waves in such media. It is demonstrated how the values of the model parameters influence the wave propagation, the evolution and the interaction of waves under the framework of considered models. For this reason the solutions of the model equations are compared under different parameter combinations against one fixed combination of material parameters which is called 'the reference case'. Interaction process is shown in Fig. 1.

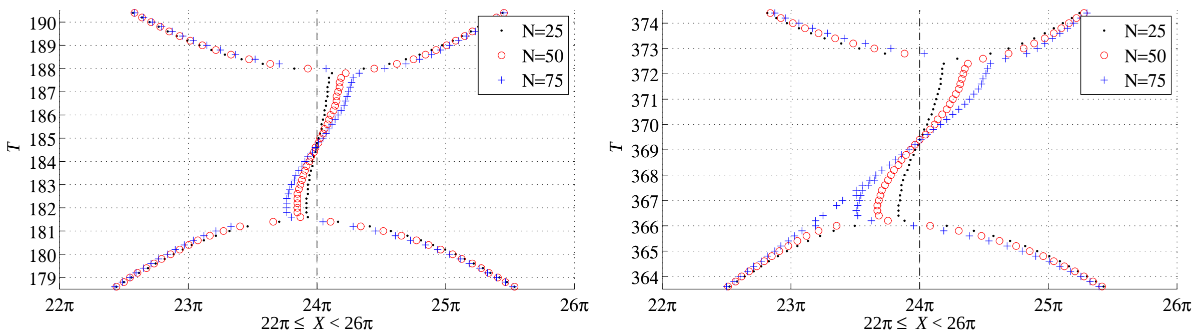


Figure 1: Trajectories of the second (left) and the fourth (right) interactions for the macroscale nonlinear parameter values of $N = 25, 50, 75$ with rest of the parameters at reference values.

On the basis of the Mindlin-type micromorphic theory for wave motion in microstructured solids the 1D governing equations and corresponding dispersion relations are derived. The leading physical dimensionless parameters are established and their importance for describing dispersion effects is discussed. The general discussion reveals the role of both geometrical and physical dimensionless parameters in mechanics of microstructured materials. The character of phase and group velocities is established – see Fig. 2.

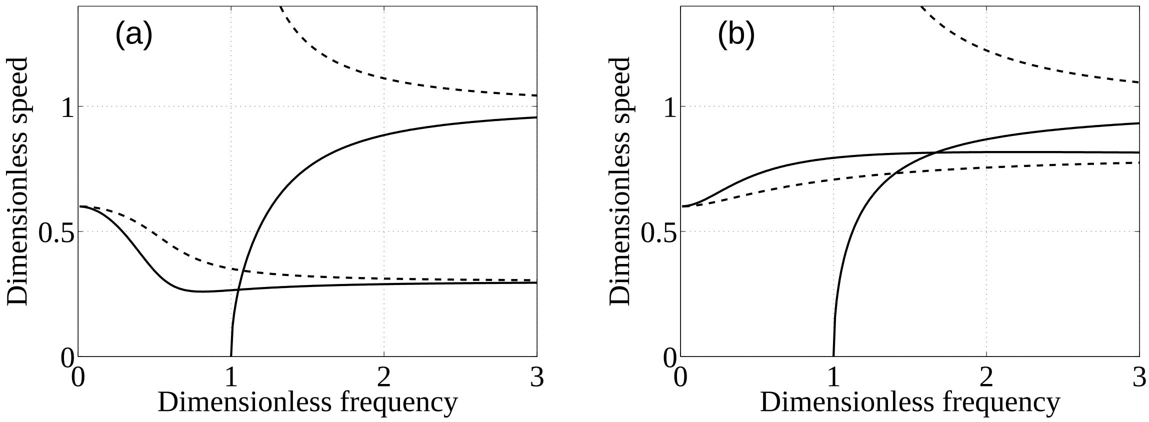


Figure 2: Group (solid line) and phase (dashed line) speed curves for (a) normal dispersion case and (b) for anomalous dispersion case.

Negative group velocity.

Waves with negative group velocity (NGV) were discovered in optics by Sommerfeld and Brillouin, and experimentally verified in many cases. For waves in solids such an effect is described mostly in layered media. It is demonstrated that in microstructured solids, the waves with NGV may also exist leading to backwards pulse propagation (see Fig. 3). The cases analysed are: a Mindlin-type hierarchically multiscale (a scale within a scale) material and a felt-type (made of fibres) material. For both cases, the dispersion analysis of one-dimensional waves shows that there exist certain ranges of physical parameters which lead to NGV. In case of a Mindlin-type multiscale materials this effect is consudered to be a result of a pre-resonant situation when to optical dispersion brances are very close to each other (T.Peets, D.Kartofelev, K.Tamm, J.Engelbrecht).

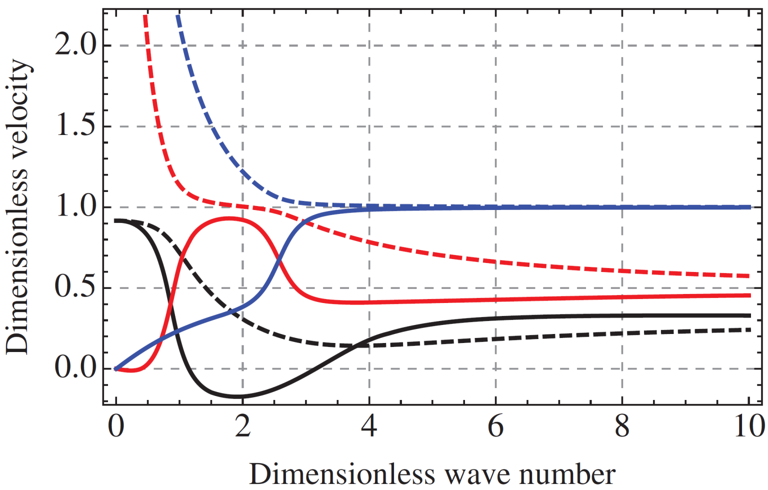


Figure 3: Blue - upper optical dispersion branch, red - lower optical dispersion branch, black - the acoustical dispersion branch. Phase (dashed lines) and group velocity (solid lines) curves against wave number for the Mindlin-type model at material parameter combination resulting in NGV

Waves in microstructured solids, general theory.

It is shown that the Green method based on postulating the potential energy function has certain advantages compared with the widely used Cauchy's method which postulates directly the stress-strain relations. Simple examples demonstrate how the Green method together with internal variables permits to determine the microstress and the interactive force between the constituents of solids. The structure of governing equations and possible physical effects captured by such modelling are described. The microstress and interactive force lead to dispersion of waves at the macrolevel (J.Engelbrecht, A.Berezovski).

Governing equations of dissipative generalized solid mechanics are derived by thermodynamic methods in the Piola-Kirchhoff framework using the Liu procedure. The isotropic small strain case is investigated in more detail. The connection to the Ginzburg-Landau type evolution, dual internal variables, and a thermodynamic generalization of the standard linear solid model of rheology is demonstrated. Specific examples are chosen to emphasize experimental confirmations and predictions beyond less general approaches (P.Ván, A.Berezovski, C.Papenfuss).

Waves in microstructured solids, numerics.
A coupled system of thermoelasticity equations including an evolution equation for an internal variable in addition to the traditional equations of motion and heat conduction is solved numerically. The internal variable is interpreted as a microtemperature or, in other words, as a temperature fluctuation due to the microstructure. The results of computation show that besides the usual diffusion of the macrotemperature in course of time, the wavetype behavior of temperature is observed because of coupling effects between microtemperature, stress, and macrotemperature. Although the observed effect of the microstructure is small, it exists in the case of realistic values of material parameters. The formulated model includes coupling parameters in addition to material properties. The ranges of these parameters are established for the prescribed materials and their influence on the wave-like temperature behavior is analyzed (A.Berezovski, J.Engelbrecht).

Stress field distortion by crack propagation in 3-point bending test.
Fracture toughness is one of the important mechanical properties of advanced ceramics for structural use, because it shows the resistance to crack propagation from a defect in ceramics. Although ceramics may have quite high strength their tendency towards uncontrolled failure is a disadvantage that limits the technical and medicinal use of the materials. There are many methods proposed for fracture toughness measurement of advanced ceramics. Among these methods, single edge precracked beam and indentation fracture methods became Japanese Industrial Standard methods at room temperature in 1990. Single edge notched beam and single edge precracked beam methods became German standard methods in 1991. The single edge V-notched beam (SEVNB) method is one of the most reliable methods for evaluating the fracture toughness of ceramics. Used with care, the SEVNB technique can therefore produce reproducible results, and as a consequence of the Versailles Project on Advanced Materials and Standards exercise many laboratories are now routinely using it. The fracture toughness determined in accordance with this test method is for the opening mode (Mode I) of loading.

The increase in toughness is believed to be associated with the strong interface connections between the reinforcement and the matrix, resulting in pull-out resistance and bridged the crack gaps leading to improved fracture toughness. It remains an open question as to what extent the traditional fibre composite models can be applied to nanocomposite systems, particularly as fibre diameters shrink to molecular length scales. It is useful, therefore, to model the crack propagation process in the pure ceramics first as a starting point for the comparison with the case of a reinforced ceramics (A.Berezovski, M.Berezovski).

Numerical simulation of the crack propagation under the 3-point bending test conditions was performed to establish the framework for the characterization of new ceramic materials. In the SEVNB method, the standard bend specimen is a single edge-notched and fatigue-cracked beam loaded in three-point bending with a support span, S, nominally equal to four times the width, W (Fig. 4).

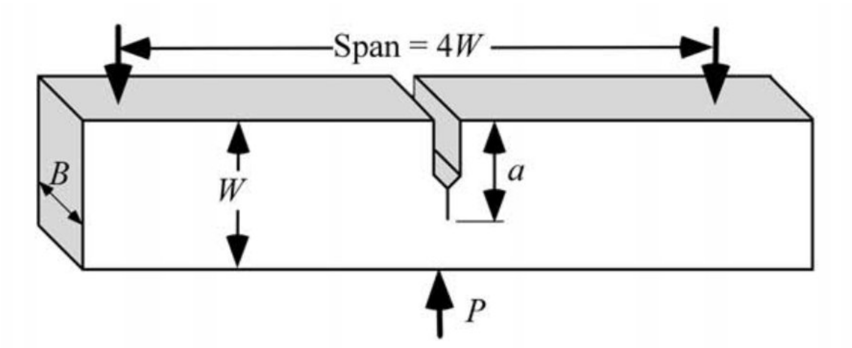


Figure 4: The general proportions of the specimen configuration.

Computed snapshots of wave field demonstrate wave propagation pictures for first 300 time steps and interaction between waves radiated by growing crack with the global wave field (Figs. 5, 6).

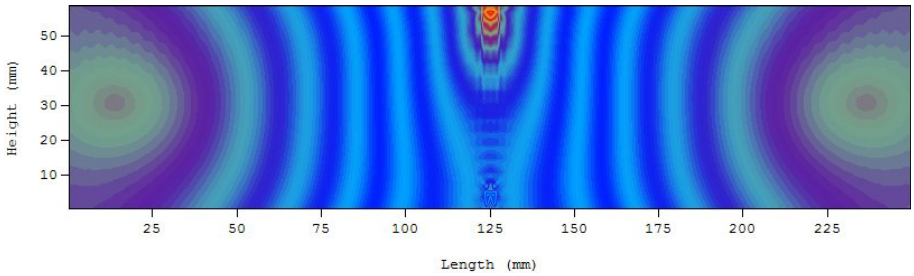


Figure 5: Snapshot of wave fields at 300 time steps.

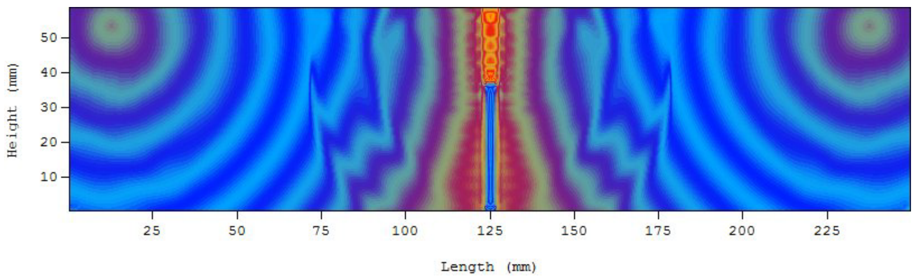


Figure 6: Snapshot of wave fields at 1040 time steps.

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 is carried on. The novelty of the research work in this year in comparison with the previous work consists in proposal to solve the problem resorting to the response of different exponentially graded materials to the dynamic excitation evoked in the material by the counter-propagation and interaction of two ultrasonic harmonic bursts. The reference case, by which the proper choice of the parameters of ultrasonic bursts leads to the effect when the oscillations evoked by counterpropagating bursts in the homogeneous material with the basic properties disappear (see Fig. 7a), is determined. Deviation of material properties from the basic ones evokes oscillations on the whole X-t plane (Fig. 7b). The phenomenon is analyzed using the phase plots and their generalizations into parametric plots composed on the basis of different profiles of boundary oscillations. Comparisons between the composed plots (Fig. 7c

and Fig. 7d for ex.) enable one to determine the character of material properties variation and to distinguish the most relevant property of the material responsible for inhomogeneity. These results may be used as the basis by elaboration of the method for qualitative nondestructive characterization of FGMs with essentially changing continuous properties (A.Ravasoo).

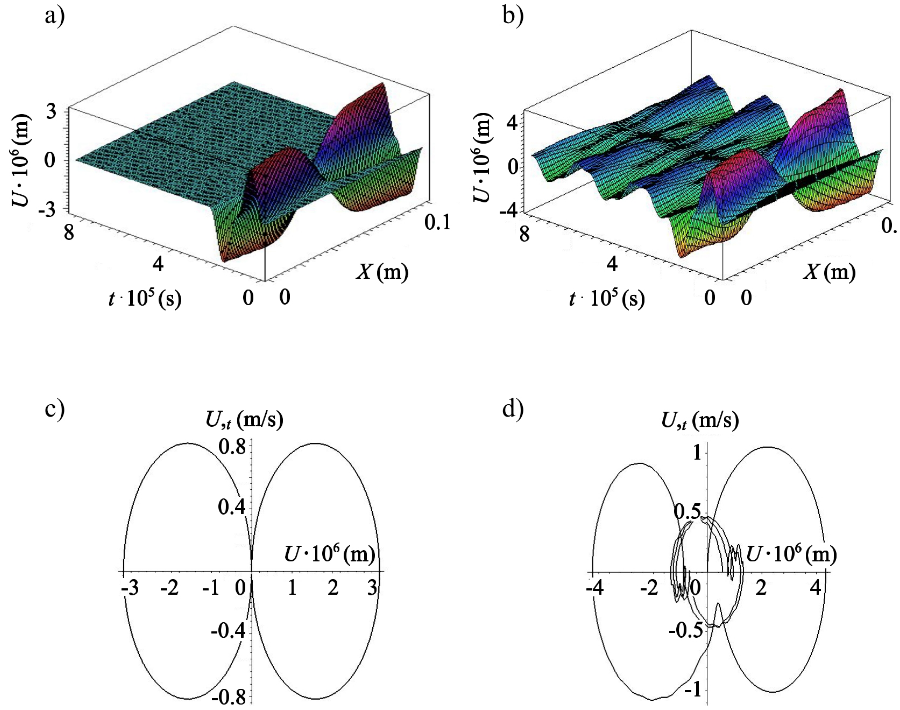


Figure 7: Interaction of tone bursts in inhomogeneous material.

The idea to consider exponentially graded properties in glass fibre reinforced composite (GFRC) means to not average the properties over the whole volume of the material, but near the surface layers to consider a functional change in the properties of the fibres or the matrix or both. The graded configuration of material properties could lessen stress concentrations for a material under loading. Based on a solution of ultrasound propagation and multiple reflections a theoretical model has been worked out to determine the material properties of exponentially graded composites, e. g. GFRC. The method allows to determine all together three parameters of inhomogeneity in the material elastic properties or the density. In addition, a sensitivity analysis of harmonic phase shifts versus the parameters of inhomogeneity has been carried out (A.Braunbrück).

Piano string vibrations. The main goal is the physics-based modeling of the piano string vibrations in case of its nonlinear amplitude limitation caused by the capo bar and the damper. The effect of a minute imperfection of the termination condition on the string vibration is investigated. It is shown that the lossless string vibrates in two distinct vibration regimes (Fig. 8).

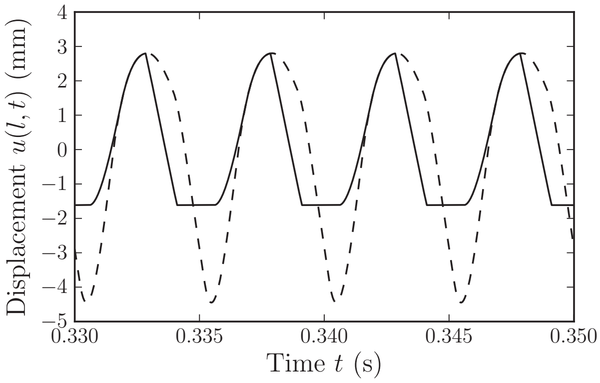


Figure 8: Four periods of the string displacement for the nonlinear bridge with a small geometric imperfection are shown by solid line. The corresponding linear case is shown by dashed line.

A constitutive equation that describes the propagation of deformation waves in the felt material is derived by using hysteretic piano hammer model. The boundary value problem is considered and the numerical solution describing the strain wave propagation is provided (Fig. 9).

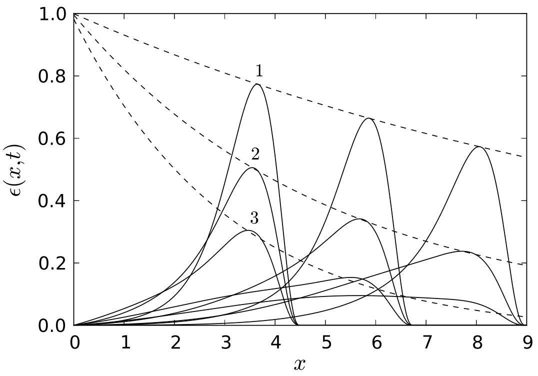


Figure 9: Snapshots of the pulse profiles shown for consecutive time moments, varying the parameter δ. The dashed lines show the amplitude decay. For pulse 1 ($\delta = 0.8$) the corresponding amplitude decay function is $e^{-0.08x}$; for pulse 2 ($\delta = 0.5$) the amplitude decay function is $e^{-0.20x}$; for pulse 3 ($\delta = 0.2$) the amplitude decay function is $e^{-0.32x}$.

An orthotropic material model for cementitious short fibre reinforced composites based on the orientation distribution of fibres.
The focus is on constitutive mappings for concrete reinforced by short steel fibres (SFRC). The material studied exhibits anisotropic properties in accordance with the orientation distribution of fibres. The constitutive relation developed is a combination of isotropic and orthotropic St. Venant-Kirchhoff material models applied to concrete matrix and to design anisotropic influence of short steel fibres respectively. The alignment tensors and orientation distribution function adopted from the mesoscopic continuum theory are utilized to identify the material symmetry and asses the contribution of fibres in the three symmetry directions calculated by using the eigenvectors of the second-order alignment tensor (Fig. 10). While assessing the orthotropic elasticity of the composite, the elastic properties of individual fibres in their local coordinates are transformed to material symmetry axes and weighted with the orientation distribution function of fibres. The advantage of the material model developed for SFRC is that it uses complete orientation information of fibres (two angles in spherical coordinates) and utilizes tensor quantities complying with the material objectivity, in contrast to common material models for cement-based short fibre reinforced composites (H.Herrmann, M.Eik together with J.Puttonen (Aalto

University)).

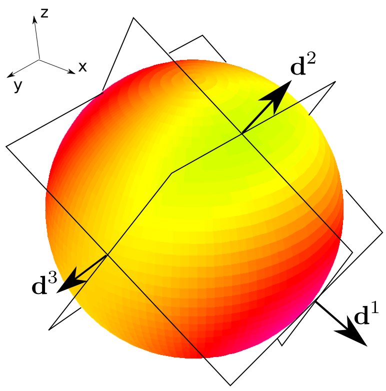


Figure 10: Orientation distribution of fibres with symmetry planes calculated from the second-order alignment tensor (eigenvectors are shown as well).

Diffusion of oriented particles in porous media.
Diffusion of particles in porous media often shows subdiffusive behavior. Here, we analyze the dynamics of particles exhibiting an orientation. The features we focus on are geometrical restrictions and the dynamical consequences of the interactions between the local surrounding structure and the particle orientation. This interaction can lead to particles getting temporarily stuck in parts of the structure. Modeling this interaction by a particular random walk dynamics on fractal structures we find that the random walk dimension is not affected while the diffusion constant shows a variety of interesting and surprising features (H.Herrmann together with R.Haber, J.Prehl, K.H.Hoffmann (TU Chemnitz)).

Software development: E.Pastorelli: VRPN server for WinTrackerIII, accepted into the main VRPN software http://www.cs.unc.edu/Research/vrpn/
E.Pastorelli (with A.Heydt (TU Berlin), H.Herrmann): porting of jReality to use VRPN tracking http://www3.math.tu-berlin.de/jreality/

3.1.2 Fractality

General aspects of fractality.
A universal relationship between the scaling exponents has been established describing the time-fluctuations of the intersection size of two moving fractal sets, such as those in Fig. A (top), where a self-affine surface intersects with a moving plane; the intersection is depicted by white contour line in the bottom part of the figure. Theoretical predictions (numbers in braces in Fig. B) are in a good agreement with the simulation data. Different curves correspond to different fractal sets This is an important finding, because there is a wide spectrum of problems which can be reduced to intersections of fractal sets; one example is the rainfall intensity as function of space and time (Fig. 11).

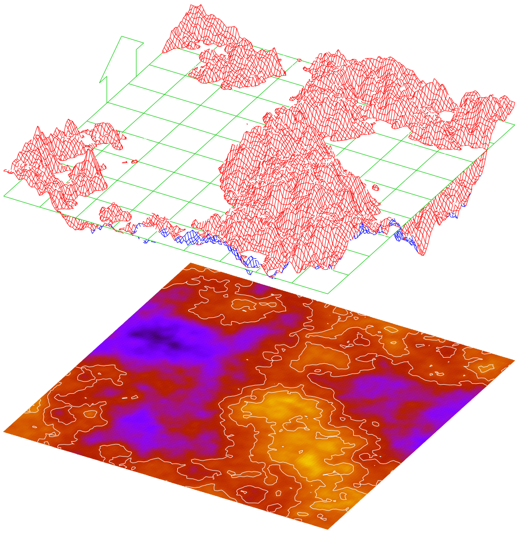


Figure 11: .

Turbulent mixing.
For technological purposes it is sometimes important to achieve as homogeneous as possible mixing, e.g. to minimize entanglement of nanofibers. In collaboration with the Department of Materials Engineering, TUT, a novel mixing device has been devised and prototyped, which maximizes homogeneity of mixing, as measured by the variance of the largest Lyapunov exponent. This is a device with rotating cylindrical walls, a cross-section of which is depicted in the figure below. Color-coding corresponds to the flow speed (Fig. 12).

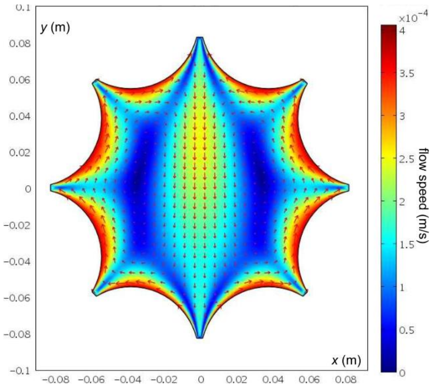


Figure 12: .

The mixing of tracers originating from two distant sources has been studied by Mihkel Kree experimentally at the IRPHE laboratory, University of Marseille. This process gives rise to patterns, where some of the patches from different sources merge, but other patches will disperse into the environment without merging, see Appendix – the cover sheet of Physics of Fluids, March 2013. The merging rate can be described via the cross-correlation coefficient as a function of time. Experimental results are in a good agreement with theory (Fig. 13).

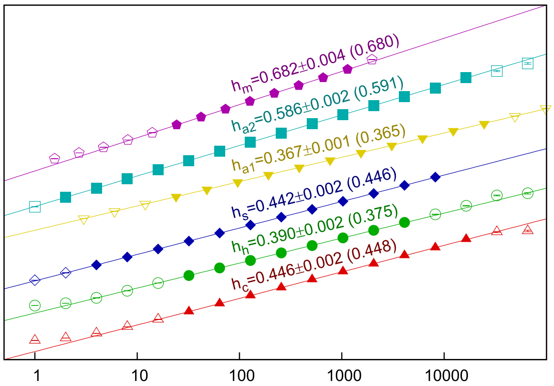


Figure 13: .

Analytical expressions have been obtained for the finite-time Lyapunov exponents and their variance for chaotic two-dimensional incompressible flows with finite correlation time. This is an important result for understanding the mismatch between the experimental results obtained for real flows, and ideal flows which are delta-correlated in time and for which a wide spectrum of theoretical results exists. Our analytical results show a clear departure from the behaviour of ideal flows (J.Kalda et al.).

3.1.3 Laboratory of Wave Engineering

Several previous attempts to mitigate *current-driven environmental risks to the nearshore* via smart use of concealed patterns of Lagrangian transport by surface currents have assumed a constant value to the entire nearshore and have often considered advection purely by numerically modelled currents. We extended these attempts towards more realistic accounting for the pollution transport to various coastal and Marine Protected Areas (MPA) and the impact of subgrid-scale turbulence on this transport. The possibility of current-driven propagation of contaminants released along a major fairway, polluting the coastal regions or Marine Protected Areas (MPA) in the Gulf of Finland, the Baltic Sea, is examined using a 3D circulation model, a Lagrangian transport model, various representations of the subgrid-scale turbulence and statistics of trajectories of single persistent pollution parcels that are passively carried by surface currents. Shifting of the existing major fairway (that passes close to one of the MPAs) by a small distance to the south leads to a huge decrease in the amount of pollution being transported to this MPA. The potential pollution released during a ship accident and further carried by currents may affect MPAs at very large distances, about 125–200 km, that is about 1/3–1/2 of the entire length of the gulf (N.Delpeche-Ellmann, T.Soomere).

The inclusion of the impact of small-scale turbulence into the model affects trajectories of pollution parcels, increases the spreading rate of initially closely packed trajectories and the number of trajectories that reach the coast. The pattern of most frequently hit coastal sections, the probability of hit to each section and the time the pollution spends offshore are, however, almost invariant with respect such an inclusion (B.Viikmäe, T.Torsvik, T.Soomere).

The above attempts assume that the water body in question hosts jet-like, coherent or semi-persistent patterns of surface currents. A hybrid method combining two approaches to detect eddies is applied to the Gulf of Finland and the Raunefjord and Vatlestraumen area south-west of Bergen, Norway. The Okubo–Weiss (OW) parameter is first used to detect the vorticity-dominated areas (where eddies usually exist). The streamline winding-angle method is used within these regions to identify single eddies. Although vorticity-dominated areas are frequent in the Gulf of Finland, the number of detected eddies is very small in this basin (Fig. 14). This feature indicates that the structure of surface flow is extremely complicated here and coherent, long-living eddies are infrequent.

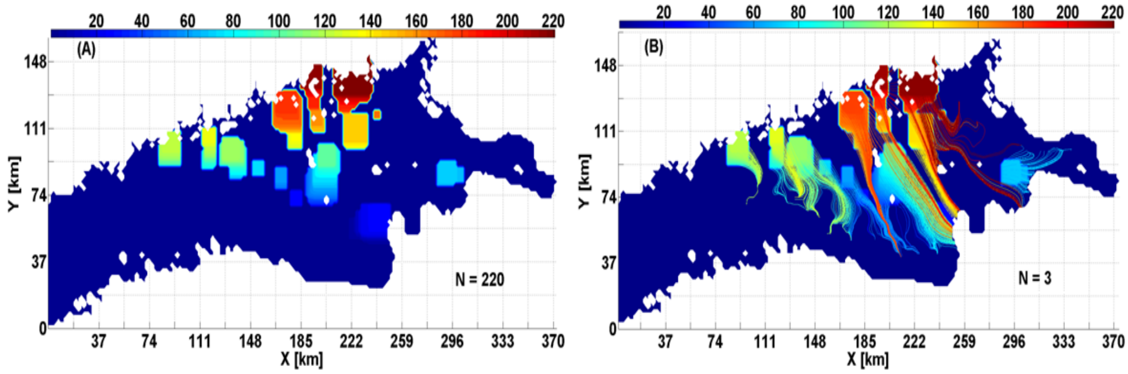


Figure 14: Fow structure in the Gulf of Finland for surface velocity data with a resolution of 1 nautical mile on 17 December 1987 at 18:00. Panels show results for (A) OW method, and (B) hybrid winding-angle method (Viikmäe and Torsvik, 2013).

The ability of the formation of patches of substances or items floating on the sea surface can be quantified using so-called flow compressibility. Large values of this quantity highlight areas with persistent flow convergence in which floating items tend to gather into patches. A modification of this measure, so called finite-time-compressibility, is used to detect areas where high convergence occurs simultaneously with the Lagrangian transport of the resulting patches. In the Gulf of Finland it is very likely that systematic development of patchiness often occurs along certain straight sections of the coastlines that usually host downwelling. Similar process may occur in two offshore locations throughout the year and near the centre of the widest part of the gulf in the windy season (A.Giudici, T.Soomere).

Analytical theory of tsunami wave generation by submarine landslides was extended to the case of narrow bays and channels of various geometries in the shallow-water framework. For a number of bottom configurations, the wave field was found explicitly in the form of the Duhamel integral. One forced wave follows the landslide and two free waves propagating in opposite directions. In a resonant case the wave amplitude is normally but depends on the particular bottom configuration. For example, the offshore-going wave is larger in the bay of rectangular cross-section, while the onshore-going wave experiences stronger amplification in a V-shaped bay.

The properties of resonant waves for the variable-volume landslide in linearly inclined bays of variable cross-sections depend on several parameters. If the volume of the landslide increases, the wave amplitude also grows but slower than in the bay of constant depth. The amplitude of the wave driven by a constant-volume landslide tends to a constant value that depends on the cross-section of the bay. If the landslide thickness decreases with a distance significantly, the amplitude of the generated wave varies non-monotonically and its maximum is also determined by the cross-section of the bay (Didenkulova and Pelinovsky, 2013).

Abnormal tsunami amplification and runup during the Samoa tsunami of 29 September 2009 in the city of Pago Pago (Tutuila, American Samoa) were estimated with respect to two different approximations of the bottom topography: a plane beach and a narrow bay, and compared with field survey data. Both formulations resulted in equally good estimates of runup (Fig. 15), having approximately the same difference with the field measurements. However, the narrow bay model presented a larger wave amplification and consequently runup, which was the main observation of the field survey (Okal et al., 2010).

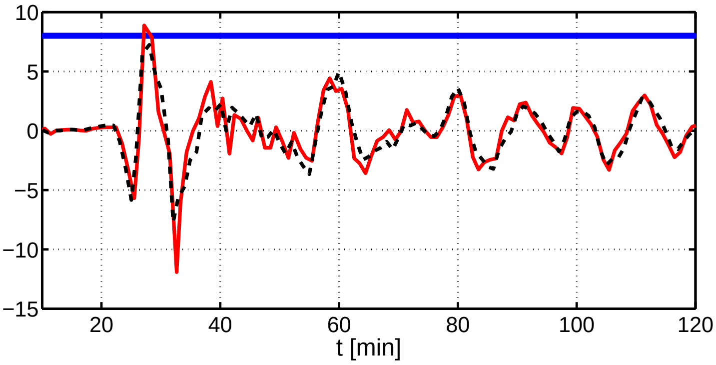


Figure 15: Runup estimates for Samoa 2009 tsunami in Pago Pago made by the assumption of the plane beach (black dotted line) and an inclined bay (red solid line); the thick solid blue line reflects 8 m level of runup measured in Pago Pago (Didenkulova, 2013).

Statistics of long wave runup on a plane beach was studied experimentally in the 300 m-long and 3.5 m-deep Large Wave Flume (Grosse Wellenkanal, GWK), Hannover, Germany, with respect to the asymmetry caused by the non-linear deformation of the approaching the coast waves and a band width of the incident wave field. Experimental results showed good agreement with theoretical predictions and confirmed the principal role of wave asymmetry on its run-up. The distribution function of extreme runup characteristics can be approximated by the Rayleigh distribution in a wide range of wave amplitudes and spectra even if an incident wave field is a non-Gaussian process (Denissenko et al., 2013; Didenkulova et al., 2013).

Wake waves from high-speed ferries and fast conventional ships pose extensive threat to safe navigation and shallow-water and coastal environment. Such vessels generate wave packets that have extremely complicated structure and involve *inter alia* trains of large, solitonic, very long and long crested waves. Their description is complicated because of their transient and highly nonlinear nature, and because of overlap of different wake components. A principally new portrayal of such wakes (Fig. 16) is obtained using a time-frequency technique (windowed Fourier transform, called spectrogram technique). The method is particularly useful for identification of low frequency signals (that may easily be masked by high frequency noise in the wave record) and components with different spectral properties but overlapping in time and/or space.

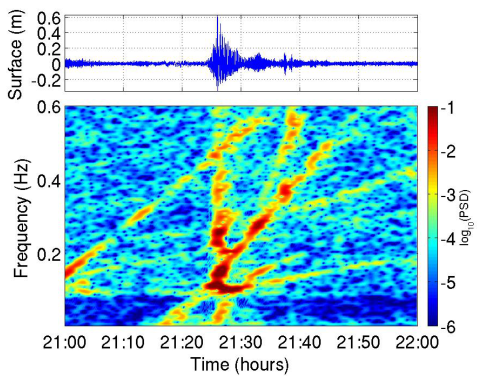


Figure 16: Spectrogram of the wake of *Tallink Star* at the island of Aegna, June 2008 (Didenkulova, Sheremet, Torsvik, Soomere 2013).

The group structure and run-up of high-speed vessel wakes was studied based on recordings near Pikakari beach, Tallinn Bay, the Baltic Sea. The most energetic vessel waves at this location (100 m from the coast at the water depth 2.7 m) had amplitudes of about 1 m, periods of 8–10 s, caused maximum run-up heights on a beach up to 1.4 m, and represented frequency modulated packets where the largest and longest waves propagated ahead of other smaller amplitude and period waves. The wave heights within a wake and the associated run-up heights were well described by the Weibull distribution, which had different parameters for wakes from different vessels (I.Didenkulova, A.Rodin).

Possibility of rogue wave formation in a basin of intermediate depth due to the modulational instability was analyzed based on the data of rogue wave catalogue in 2006-2010 (Nikolkina and Didenkulova, 2011; 2012). The modulational instability can still play a significant role in their formation for basins of 20 m and larger depth. For basins of smaller depth, the influence of modulational instability is less probable (Fig. 17). By using the rational solutions of the nonlinear Schrödinger equation (breathers), it is shown that the rogue wave packet becomes wider and contains more individual waves in intermediate rather than in deep waters (Fig. 18), which is also confirmed by observations.

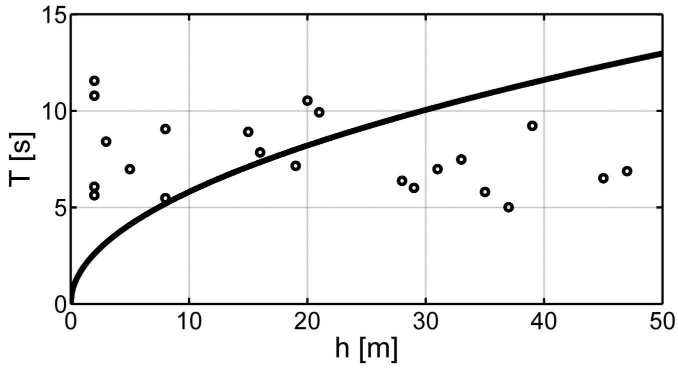


Figure 17: Rogue wave period plotted against the water depth of their occurrence; black solid line corresponds to the criterion of the modulational instability.

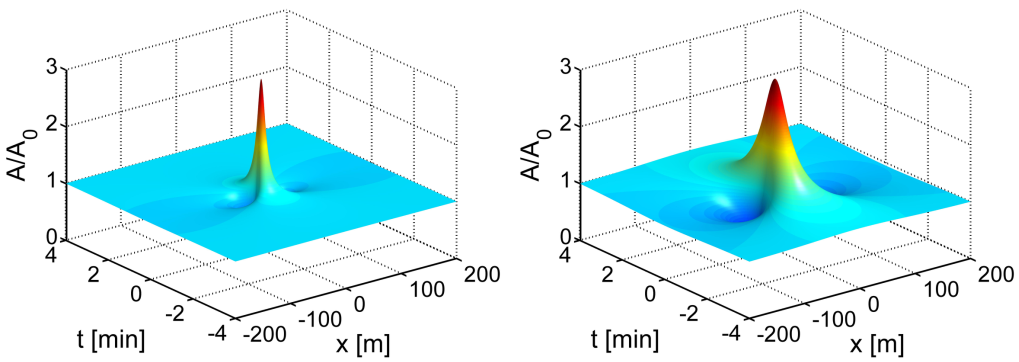


Figure 18: The Peregrine breather at the background of the carrier wave with the period 6 s and amplitude A0 = 3 m for (a) kh = ; (b) kh = 1.6 (Didenkulova, Nikolkina et al., 2013).

Wind wave climatology in the eastern part of the Baltic Sea has been extended back to 1946 using the high correlation between the metric wave height and qualitative measures of sea state, and a linear regression between these quantities at Ventspils and Liepaja (Kurzeme Peninsula, Latvia). The annual mean wave height has rapidly decreased in the entire eastern Baltic Sea from the end of 1940s until ~1970 and gradually increased since then. This course is modulated by high spatio-temporal variations in the average wave height and a strong evidence of decadal-scale changes, a part which are in counterphase for the southern and the northern Baltic Sea (Fig. 19). No secular trend in the wave intensity is evident at any observation site from the Curonian Peninsula up to the northern Baltic Proper.

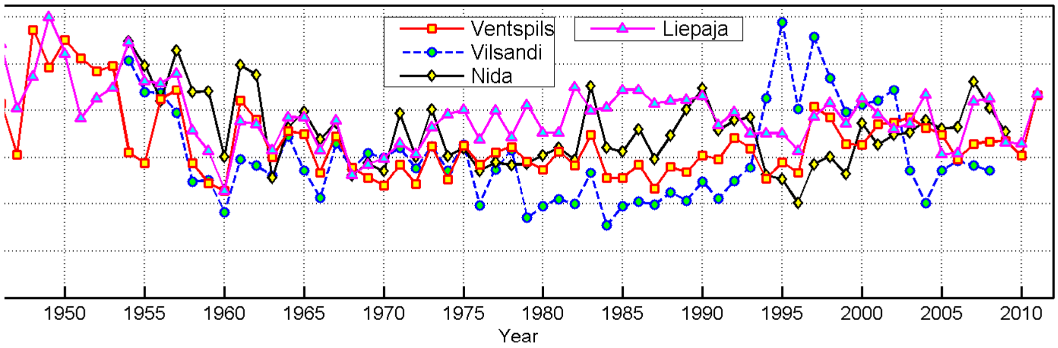


Figure 19: Annual mean wave height at four observation sites on the eastern Baltic Sea coast in 1946 – 2011 (Soomere, 2013).

The main features of wave properties in relatively large but shallow Lake Peipsi are determined based on measurements in summer and autumn 2005–2007. The wave regime is mild, with the long-term average significant wave height below 0.3 m. Wave heights are considerably lower in summer (July–August) than in autumn (October–November). Significant wave heights > 1 m covered 3% of the measurement time. The maximum recorded wave height was Hs = 1.98 m. The mean periods are mostly concentrated in a range of 1.5–2.5 s and exhibit an almost Gaussian distribution (I.Nikolkina, T.Soomere, I.Didenkulova).

One of the major outcomes of *wind wave-coast interactions* is wave-induced set-up, a process that increases water level in selected coastal regions and in this way can significantly increase the risk of flooding. It is particularly hazardous in the coastal regions with complicated geometry where the set-up only is formed if the wind direction matches the orientation of the coast. The maximum set-up heights are up to 70–80 cm in Tallinn Bay (Gulf of Finland, Baltic Sea) (Fig. 20). This is more than 50 % of the all-time maximum water level and thus may serve as a substantial source of marine hazard for low-lying regions. The analysis also reveals that wind directions during strong storms have changed in recent years.

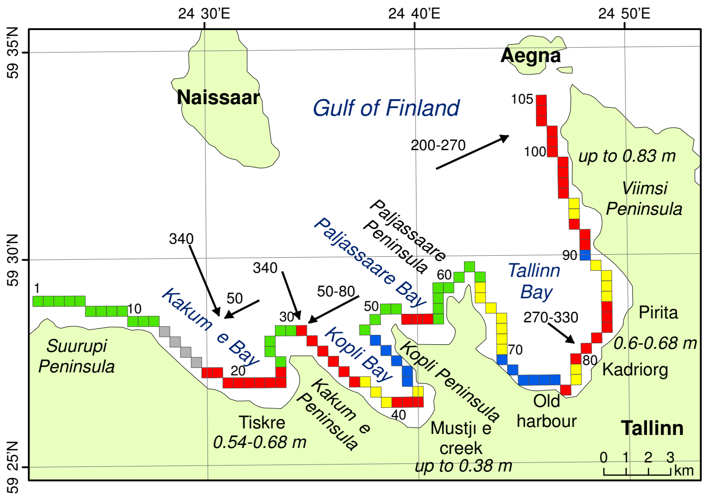


Figure 20: Areas around Tallinn potentially affected by high wave set-up (red squares) with the respective directions of wave propagation (arrows). Yellow squares: coastal stretches where the maximum wave set-up is less than 20 cm, green squares: areas where high set-up is evidently not possible because of the convex shape of the coastline, grey squares: areas naturally protected by a cliff, blue squares: various engineering structures (Soomere, Pindsoo et al., 2013).

The actual **impact of wave activity in seasonally ice-covered seas** is limited by the presence or absence of sea ice. The correlation between the wave properties calculated over the ice-free season (the mean energy, bulk wave power, and average wave height) and the duration of the ice season highly depends on the particular site at the Estonian coast. Although higher levels of the bulk wave power correspond to shorter ice seasons, statistically significant correlation of all the listed quantities and the duration of the ice season only exists at Vilsandi (a site fully open to the predominant winds). No correlation between these measures is found at the more sheltered Narva-Jõesuu site (I.Zaitseva-Pärnaste, T.Soomere).

The magnitude of **numerically simulated potential sediment transport** along the eastern Baltic Sea coast substantially depends on the details of the numerical scheme but the qualitative patterns of net and bulk sediment transport are almost insensitive with respect to the details of the wave transformation in the nearshore and with respect to the grain size. As a large part of waves approach this coastal stretch under a relatively large angle, it is necessary to calculate fully their shoaling and refraction. The counter-clockwise transport along this area contains two persistent reversals at the coast of the Baltic Proper and two frequently occurring reversals at the eastern coast of the Gulf of Riga. Single years may host completely different patterns of sediment transport. The locations of the most persistent convergence and divergence areas of the net transport match the geological composition of the seabed (M.Viška, T.Soomere).

Cross-shore beach profiles along Estonian coasts were analyzed from the viewpoint of the possibility of non-reflecting wave propagation and unexpectedly high run-up events. About a half of 194 profiles measured in 2006–2011 in 17 locations in the framework of national coastal monitoring programme could be adequately approximated using a single power function. These profiles were almost all convex with the relevant exponents around 2/3 that is characteristic to the Deans Equilibrium Profile. The underwater sections of the rest of the profiles predominantly match the Deans Equilibrium Profile. About 10% of the subaerial sections have the exponent close to 4/3 and in total about 7% of the examined profiles exhibit conditions favourable for unexpectedly high run-up (Fig. 21). The associated danger increases rapidly during high water levels.

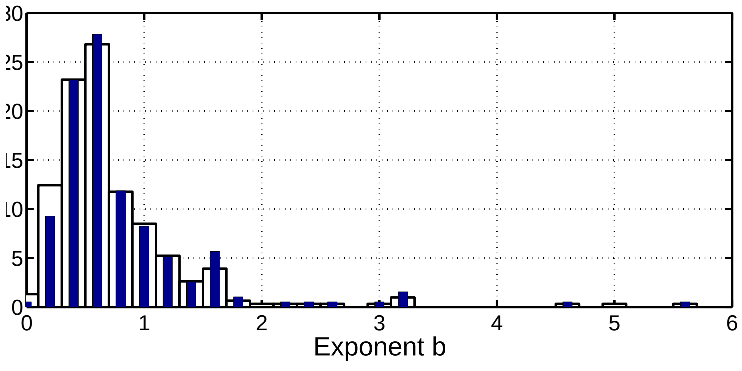


Figure 21: Distribution of the power exponent for subaerial parts of beaches (narrow blue bars) and for all sections and single-section profiles (wide white bars) (Didenkulova, Pindsoo, Soomere, Suuroja, 2013).

Other results of the Wave Engineering Laboratory team include: analysis of hazardous landslides along water basins of Nizhny Novgorod region (I.Nikolkina, I.Didenkulova with colleagues from Nizhny Novgorod), preliminary analysis of long-term variations of simulated sediment transport along the eastern Baltic Sea coast as a possible indicator of climate change (M.Viška, T.Soomere), quantification of spatial variations of wave loads and closure depth along the eastern Baltic Sea coast (T.Soomere, M.Viška, M.Eelsalu), calculations of implications of a landslide tsunami for a coastal city of Cassis, France (E.Averbukh, T.Soomere, in cooperation with colleagues from Nizhny Novgorod and Marseille), generalisation of the novel technique for protection of coasts and nearshore areas by means of preventively adjusting the location of potentially dangerous offshore activities and publication of the relevant peer-reviewed collection (T.Soomere, E.Quak, T.Torsvik in cooperation with the six other research centres involved into the BONUS BalticWay project).

3.1.4 Laboratory of Systems Biology

Unchanged mitochondrial organization and compartmentation of high-energy phosphates in creatine-deficient GAMT-/- mouse hearts.
Disruption of the creatine kinase (CK) system in hearts of CK-deficient mice leads to changes in the ultrastructure and regulation of mitochondrial respiration. We expected to see similar changes in creatine-deficient mice, which lack the enzyme guanidinoacetate methyltransferase (GAMT) to produce creatine. The aim of this study was to characterize the changes in cardiomyocyte mitochondrial organization, regulation of respiration, and intracellular compartmentation associated with GAMT deficiency. Three-dimensional mitochondrial organization was assessed by confocal microscopy. On populations of permeabilized cardiomyocytes, we recorded ADP and ATP kinetics of respiration, competition between mitochondria and pyruvate kinase for ADP produced by ATPases, ADP kinetics of endogenous pyruvate kinase, and ATP kinetics of ATPases. These data were analyzed by mathematical models to estimate intracellular compartmentation. Quantitative analysis of morphological and kinetic data as well as derived model fits showed no difference between GAMT-deficient and wild-type mice. We conclude that inactivation of the CK system by GAMT deficiency does not alter mitochondrial organization and intracellular compartmentation in relaxed cardiomyocytes. Thus, our results suggest that the healthy heart is able to preserve cardiac function at a basal level in the absence of CK-facilitated energy transfer without compromising intracellular organization and the regulation of mitochondrial energy homeostasis. This raises questions on the importance of the CK system as a spatial energy buffer in unstressed cardiomyocytes (M.Vendelin, et al.).

ADP Protects Cardiac Mitochondria under Severe Oxidative Stress.
ADP is not only a key substrate for ATP generation, but also a potent inhibitor of mitochondrial permeability transition pore (mPTP). In this study, we assessed how oxidative stress affects the potency of ADP as an mPTP inhibitor and whether its reduction of reactive oxygen species (ROS) production might be involved. We determined quantitatively the effects of ADP on mitochondrial Ca2+ retention capacity (CRC) until the induction of mPTP in normal and stressed isolated cardiac mitochondria. We used two models of chronic oxidative stress (old and diabetic mice) and two models of acute oxidative stress (ischemia reperfusion (IR) and tert-butyl hydroperoxide (t-BH)). In control mitochondria, the CRC was 344 32 nmol/mg protein. 500 mol/L ADP increased CRC to 774 65 nmol/mg protein. This effect of ADP seemed to relate to its concentration as 50 mol/L had a significantly smaller effect. Also, oligomycin, which inhibits the conversion of ADP to ATP by F0F1ATPase, significantly increased the effect of 50 mol/L ADP. Chronic oxidative stress did not affect CRC or the effect of 500 mol/L ADP. After IR or t-BH exposure, CRC was drastically reduced to 1 0.2 and 32 4 nmol/mg protein, respectively. Surprisingly, ADP increased the CRC to 447 105 and 514 103 nmol/mg protein in IR and t-BH, respectively. Thus, it increased CRC by the same amount as in control. In control mitochondria, ADP decreased both substrate and Ca2+-induced increase of ROS. However, in t-BH mitochondria the effect of ADP on ROS was relatively small. We conclude that ADP potently restores CRC capacity in severely stressed mitochondria. This effect is most likely not related to a reduction in ROS production. As the effect of ADP relates to its concentration, increased ADP as occurs in the pathophysiological situation may protect mitochondrial integrity and function (M.Vendelin, et al.).

3.1.5 Laboratory of Photoelasticity

Photoelastic technology for residual stress measurement in glass.
The aim of the investigations has been development of photoelastic measurement technology for residual stress measurement in glass articles of any shape. It has been shown that the traditional edge stress measurement permits to calculate all the stress components in tempered glass panels. A fast and simple edge stress measurement device has been developed for stress measurement in automotive glazing (Fig. 22). In cooperation with Guardian Automotive in Luxembourg and Lipik Glass in Croatia the suitability of edge stress measurement and tempering stress measurement with the scattered light method has been investigated for complete production control (Fig. 23).

Figure 22: Scattered light polariscope SCALP for stress measurement in architectural glass panels and automotive glazing.

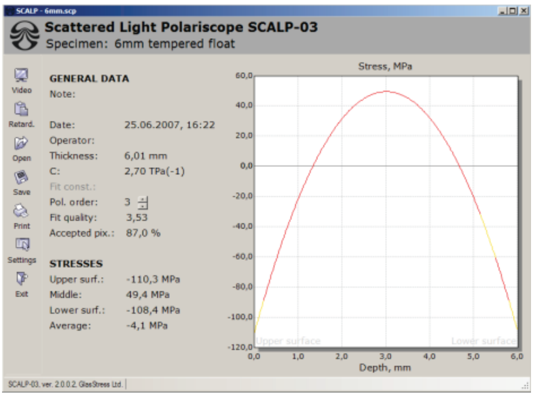


Figure 23: Stress profile through the thickness of an architectural panel.

The dependence on the tempering stress of the development of surface scratches in glass into cracks has been investigated experimentally. It has been shown that In case of the Vickers indenter the cracks are deeper and wider with higher tempering stress (H.Aben, at al.).

3.2 Institute of Cybernetics: Control Systems Department

Adjoint polynomial formulas for nonlinear state-space realization. Computational aspects of realization of a set of higher-order nonlinear input/output equations in the state space form were studied. Instead of the algorithmic solutions, provided in earlier works, the explicit formulas were obtained, which enable to compute the differentials of the state coordinates directly from the polynomial description of the nonlinear system. The solution is based on the concept of adjoint polynomials and requires a minimal amount of computations (Fig. 24). The formulas are implemented within the software package NLControl (*Mathematica* based package) and made available online via NLControl website (www.nlcontrol.ioc.ee) (J.Belikov, Ü.Kotta, M.Tõnso).

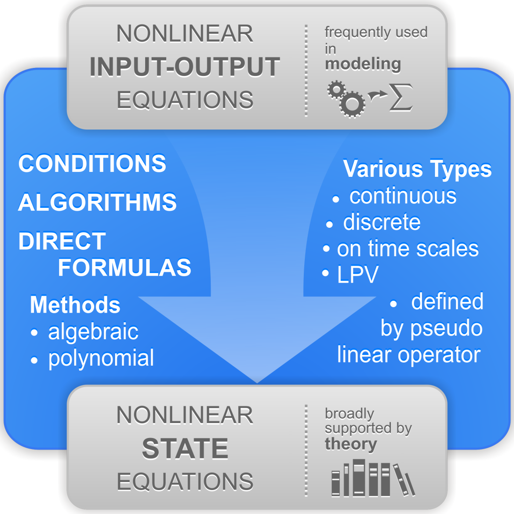


Figure 24: Realization problem.

The Minimal time-varying realization of a nonlinear time-invariant system. The state space realization is called minimal if it is (i) either accessible and observable or (ii) its state dimension is minimal. In the linear case those two definitions are equivalent, but not for nonlinear time-invariant systems. It has been shown that definitions remain equivalent in case one is searching for minimal realization in a larger class of nonlinear time-varying systems. For that purpose the nonlinear realization theory was recasted for time-varying nonlinear systems. Necessary and sufficient realizability conditions were given in terms of integrability of certain subspace (Ü.Kotta, M.Tõnso).

Polynomial accessibility condition for MIMO nonlinear control system. Computation-oriented necessary and sufficient accessibility condition for the set of nonlinear higher order input-output differential equations was found. The condition was presented in terms of the greatest common left divisor of two polynomial matrices, associated with the set of input-output equations. The condition provides a bases for finding the accessible representation of the set of input-output equations which is a suitable starting point for construction of an observable and accessible state space realization. Moreover, the condition allows to check the transfer equivalence of two nonlinear systems (Ü.Kotta, M.Tõnso).

Input-output linearization by dynamic output feedback. The problem of input-output linearization by dynamic output feedback of discrete-time multi-input multi-output nonlinear control systems was studied. The system is described by the set of higher order input-output difference equations. Necessary and sufficient solvability conditions were given together with the constructive procedure to check the conditions and compute the feedback. This linearization was used to solve the disturbance decoupling problem by measurement feedback and input-output decoupling problem by output feedback. (A.Kaldmäe, Ü.Kotta).

Measurement feedback disturbance decoupling in discrete-time nonlinear systems.
The disturbance decoupling problem by the dynamic measurement feedback for discrete-time nonlinear control systems was studied. To address the problem the algebraic approach, called the algebra of functions, was applied, which allows the system description also depend on non-differentiable functions. A necessary and sufficient condition was given in terms of controlled and (h, f)-invariant functions. Also, algorithms were derived, which find the variant unctions and the required feedback. The algorithms were implemented within the *Mathematica*-based software package NLControl and made available over the internet (A.Kaldmäe, Ü.Kotta).

On flatness of discrete-time nonlinear systems / Computation of flat outputs for nonlinear systems with *Mathematica*.
The problem of dynamic state feedback linearization of discrete-time nonlinear control systems was studied through the notion of flatness. Analogously to the continuous-time case, necessary and sufficient conditions for flatness property were obtained and showed to be equivalent to previously known results on feedback linearizability by endogenous dynamic feedback. This is done by proving the equality of certain one-forms (A.Kaldmäe, Ü.Kotta).

The first attempt to develop the *Mathematica*-based software for computing the flat outputs of the nonlinear control system was made. The implemented algorithm requires solving the systems of PDEs, brings along rapidly growing symbolic expressions and moreover, it is not finite, i.e. the number of required steps cannot be predicted. Due to complexity of the algorithm, the present implementation is able to handle only simple systems and the software development process is far from being completed (K.Halturina, M.Tõnso, Ü.Kotta).

Robust fixed order stabilizing controller design via random reflection polytopes.
A novel randomized/deterministic method to robust fixed-order controller design is proposed for discrete-time single-input, single-output plants (Fig. 25). It is based on the random generation of Schur stable polynomials using reflection coefficients and reflection polytopes of polynomials. Stable reflection segments are projected onto affine set of closed-loop characteristic polynomials and the stable polytopes in the controller parameter space are then determined. A novel approach is proposed for global and local optimization over reflection segment bunches on the basis of the weighted sum of absolute values of reflection coefficients (Ü.Nurges).

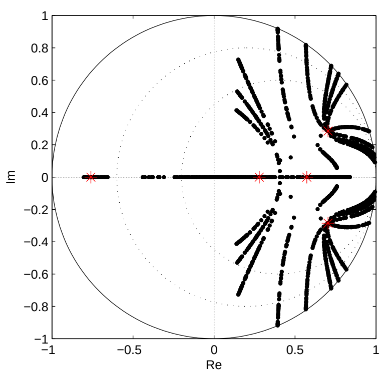


Figure 25: Root loci of the reflection segments bunch with the optimal controller.

Modeling of the human motions.
In the area of human motions analysis, novel approach to measure and model quantity and smoothness of human limb motions has been developed (see Fig. 26). Unlike many other existing techniques, proposed approach utilizes more information about the movements and as a result allows to distinguish more types of motor functions disorders. Supervision of motor functions rehabilitation was adopted to be used with Microsoft Kinect sensor. Finally Genetic algorithms based model optimization technique, developed on the previous stages of research, was applied to tune the structure NN-based human limb model (S.Nõmm).

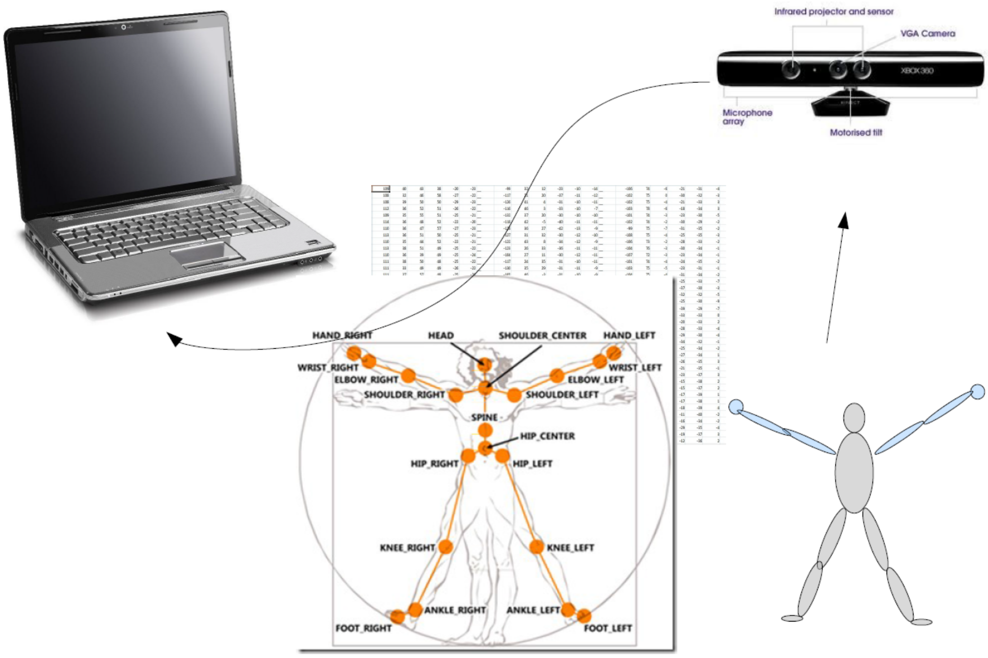


Figure 26: Modeling of human motions.

On exact feedback linearization of HVAC systems.
The possible applications of algebraic framework, based on the theory of differential one-forms, for analysis of the real-life processes were discussed. The possibilities of this approach were illustrated on two common Heating, Ventilating, and Air Conditioning (HVAC) models. Algebraic formalism provides a unified framework to handle various problems for nonlinear control systems. It is briefly explained how to check the common properties, in which engineers are usually interested in. The static and dynamic feedback linearization algorithms were discussed. Using algebraic tools it is possible to derive the appropriate change of coordinates in which the transformed system reads as a linear one (J.Belikov, Ü.Kotta, S.Srinivasan, A.Kaldmäe, K.Halturina).

***Mathematica* implementation of lattice theory for nonlinear control systems.**
Collection of *Mathematica* functions was developed, allowing to apply the techniques of algebraic lattice theory to nonlinear control problems. The software was incorporated into the package NLControl that assists the solution of various modeling, analysis and synthesis problems and using the tools of webMathematica made available for researches having no access to Mathematica. Besides the smooth systems, the developed functions are also applicable to certain subclasses of non-smooth systems depending on such phenomena as saturation, friction, hysteresis and backlash (Ü.Kotta, M.Tõnso, J.Belikov, A.Kaldmäe, V.Kaparin).

An agent-based modeling for price-responsive demand simulation.
With the ongoing deployment of smart grids, price-responsive demand is playing an increasingly

important role in the paradigm shifting of electricity markets. Taking a multi-agent system modeling approach, we have presented a conceptual platform for discovering dynamic pricing solutions that reflect the varying cost of electricity in the wholesale market as well as the level of demand participation, especially regarding household customers and small and medium sized businesses. At first, an agent-based meta-model representing various concepts, relations, and structure of agents has been constructed. Then a domain model has been instantiated based upon the meta-model. Finally, a simulation experiments have been developed for use case demonstration and model validation. The simulation is for the supplier to obtain the profit-maximizing demand curve which has such a shape that it follows the spot price curve in inverse ratio. The result suggests that this multi-agent-based construct could contribute to 1) estimating the impacts of various timevarying tariff options on peak-period energy use through simulation, before any experimental pilots can be carried out; 2) modeling the electricity retail market evolving interactions in a systematic manner; 3) inducing innovative simulation configurations. In future, the agent capacity of learning and adaptation needs to be included in the modeling framework created (J.Vain).

Exploiting aspect-orientation in model-based testing using UPPAAL timed automata.
An aspect-oriented method for model based testing using UPPAAL timed automata (UPTA) has been developed with the focus on providing a rigorous constructive approach supported by modelling and test automation tool support. Our approach provides two contributions: a) it allows for decoupling the design of different aspects of the system, then it uses a set of explicit composition patterns to weave the aspects together; b) it defines a set of coverage criteria for aspect-oriented UPTA models which allows one to generate tests for testing aspects individually or for testing the interference between aspects (see Fig. 27). In both cases, we define precise semantics for the composition and, respectively, for the test generation process (J.Vain).

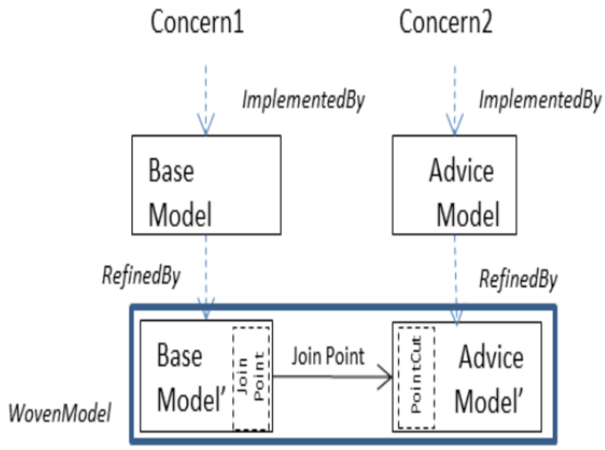


Figure 27: Generic weaving process for UPTA.

Integration of IEC 61850 and OPC UA for smart grid automation.
Smart grid (SG) is motivated to use information available in the power grid to increase the safety, reliability, and efficiency of the conventional power grid. Sophisticated control techniques using information are required for realizing SG. One major challenge is the presence of distributed heterogeneous components in SG requiring distribution of control functions. Automation intended should also support such distributed execution. One major challenge in the development of distributed control is the interoperability among devices from different manufacturers, and various conceptual entities in SG. Standardization is required for interoperability, and distributed control. IEC 61850 has emerged as the de facto standard in substation automation. On the

other hand, OPC UA is being increasingly used in industrial automation. In this investigation, we have studied the need for integration of data models following IEC 61850 and OPC UA for SG control and as enabler for new vistas like multi-agent systems, hierarchical control, and diagnosis and monitoring using suitable examples. As a result a model of control architecture has been developed (J.Vain).

3.3 University of Tartu: Optics group

The family of non-diffracting or localized waves has grown recently thanks to discovery of so-called Airy beams whose intensity maximum not only is transversely confined, but also moves along a curved trajectory during propagation in free space. Generation of ultrawideband pulsed versions of the Airy beam is a topical task in this research direction. The optics group carried out a comparative study of two optical systems for launching ultrashort Airy pulses. First, a spatial light modulator and, second, a custom refractive element with continuous surface profile were used to impose the required cubic phase on the input field. White-light spectral interferometry setup built in the previous year basing on the SEA TADPOLE technique was applied for full spatio-temporal characterization of the impulse response with ultrahigh temporal resolution approaching a single cycle of the light wave. The results (Fig. 28) show, in particular, that the custom-made refractive element allows to generate type IV Airy pulses of exceptionally high quality and resistance to dispersion. The obtained results are important for developing optical methods that make use of pulses following a curved trajectory, e.g., in high-precision micromachining and particle manipulation (P.Piksarv, A.Valdmann, H.Valtna-Lukner, P.Saari).

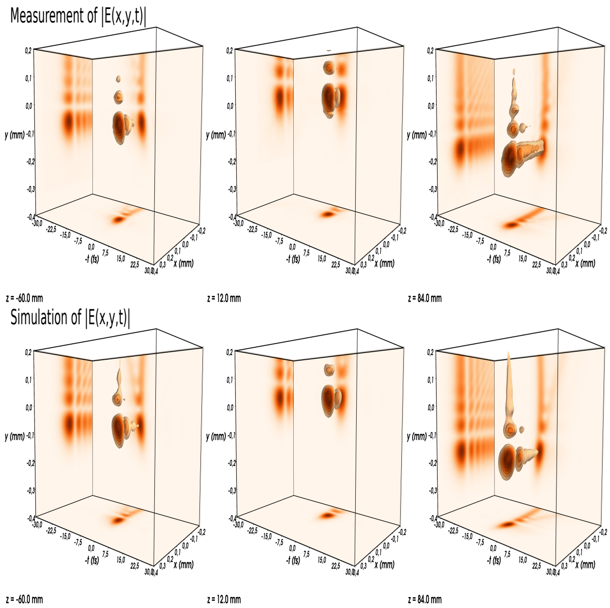


Figure 28: Measured (top) and simulated (bottom) impulse response of type IV Airy pulse generator consisting of a custom-made continuous cubic phase element and a Fourier lens f = 500mm at three propagation distances. Color represents the relative amplitude of the electric field isosurfaces. The images show projections of the pulse to the corresponding planes.

Possibilities of application of the effect of conical refraction has attracted interest in literature of the recent years. In the optics group the far-field asymptotic evolution of circularly and linearly polarized Gaussian laser beams transformed by internal conical refraction in a biaxial crystal has been studied (Fig. 29) The specific intensity and polarization patterns of far-field beams have been analyzed, and a good agreement between experimental observations and predictions of paraxial theory of conical refraction has been shown (V.Peet).

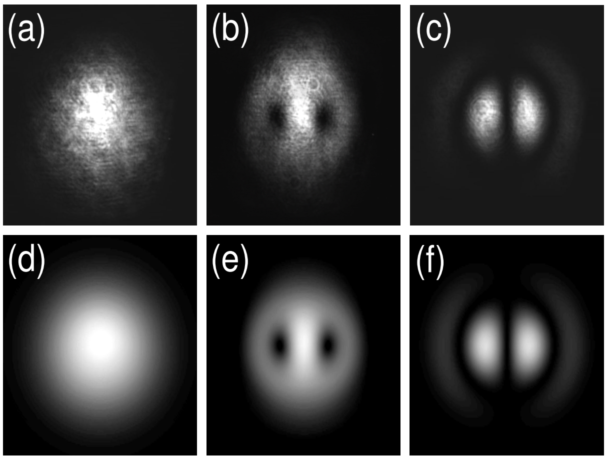


Figure 29: Experimental (top row) and theoretical (bottom row) profiles of the beams produced by conical refraction of a linearly polarized Gaussian input: without polarization selection (a, d); selected in parallel polarization (b,e); selected in orthogonal polarization (c, f). Each picture size is $16 \times 16mm^2$.

3.4 Research within international programmes

3.4.1 FP7 Marie Curie Initial Training Network (FP7-PEOPLE-1-1-ITN) Shapes, Geometry, Algebra www.saga-network.eu (01.11.2008 – 31.10.2013), led by Stiftelsen SINTEF (Norway); partners: University of Oslo (Norway); Johannes Kepler Universität Linz (Austria); Universidad de Cantabria (Spain); Vilnius University (Lithuania); National and Kapodistrian University Athens (Greece); INRIA – Institut National de Recherche en Informatique et Automatique (France); Fondazione GraphiTech (Italy); Missler Software (France); Kongsberg SIM (Norway); Participating Scientist: E.Quak.

This training network dealt with the potential of classical approaches in geometry and algebra for industrial applications of geometric modelling and computer-aided geometric design, investigated by young researchers hosted at the project partners and funded by the EC Research Executive Agency (REA). The concluding event of this network was the SAGA Final Workshop in Trento, Italy, October 9-11, where Ewald Quak gave a presentation on applying for EU research funding.

3.4.2 FP7 Marie Curie International Research Staff Exchange Scheme (PIRSES-GA-2011-295164-EUMLS) EU-Ukrainian Mathematicians for Life Sciences (EUMLS), http://www.math.uni-luebeck.de/EUMLS/ (1.4.2012 – 31.3.2016), led by Universität zu Lübeck (Germany). Participating Scientist: E.Quak.

3.4.3 Estonian-Polish joint research project "Algebraic methods in nonlinear control" 2013–2015 under the agreement on scientific cooperation between the Estonian Academy of Sciences and the Polish Academy of Sciences (Estonian project coordinator: Ü.Kotta).

3.4.4 Estonian-Bulgarian joint research project under the agreement on scientific cooperation between the Bulgarian Academy of Sciences and the Estonian Academy of Sciences Tsunamis in Inland Seas (Black and Baltic Seas) 2012 – 2014 (Estonian project coordinator: I.Didenkulova).

3.4.5 FP7 European Commission Funded Collaborative Research Project Hydralab IV, Joint Research Activities, Grant HyIV-FZK-03 ”Long wave dynamics and statistics of the shoreline motion: influence of the asymmetry and nonlinearity of incoming waves”, 2010 – 2014 (Project coordinator: I. Didenkulova).

4. Funding

4.1 Target funding through the Ministry of Education and Research

1. Block grant SF0140077s08 “Nonlinear dynamics and complex systems” (2008–2013), PI: J.Engelbrecht.
2. Block grant SF0140018s08 “Synthesis of complex nonlinear control systems” (2008–2013), PI: Ü.Kotta.
3. Block grant SF0140007s11 “Wave dynamics for coastal engineering” (2011–2016), PI: T.Soomere.
4. Wellcome Trust, until 01.02.2014 PI: M.Vendelin.

4.2 Funding through the Archimedes Foundation

1. Funding from the programme ”Estonian Centres of Excellence in Research”

4.3 Estonia Research Agency (formerly Estonian Science Foundation) grants

1. P.Saari, grant 7870, “Femtosecond optics of linear and nonlinear localized waves” (2009–2013).
2. S.Nõmm, grant 8365, “Modeling and recognition of human gestures” (2010–2013).
3. A.Salupere, grant 8658, “Solitonic structures in nonintegrable systems and discrete spectral analysis” (2011–2014).
4. A.Berezovski, grant 8702, “Multiscale simulation of high strain rate dynamics in microstructured materials”(2011–2014).
5. M.Tõnso, grant 8787, “Computer algebra methods in control” (2011–2014).
6. I.Didenkulova, grant 8870, “Wave induced hazards in Estonian coastal waters” (2011–2014).
7. T.Soomere, grant 9125, “Quantification the reaction of the eastern Baltic Sea coast to changing wave conditions” (2012–2015).

4.4 International grants

1. The project “Computer Algebra, Symbolic Computation, and Automatic Control”(CASCAC) within G.F.PARROT programme – a bilateral research and technology programme between France and Estonia (2013–2014). Estonian PI – M.Tõnso.

2. Project “Multi-Agent Systems for Smart Grid Control and Optimization”within FP7 EU – India Science programme “New INDIGO Partnership Programme”. Partners: Åbo Akademi University (Finland), Kalasalingam University (India), INSA de Rouen (The National Institute of Applied Sciences, Rouen, France), ABB India Ltd. (India), TUT (Estonia). Estonian PI –J.Vain.

3. Wellcome Trust International Senior Research Fellowship (2007–2012/2013) – M.Vendelin.

4. MOBILITAS Top Researcher Grant MTT63 “Numerical particle tracking modeling for inhomogeneous turbulent water basins” (2011–2015) – T.Torsvik.

5. MOBILITAS post-doctoral grant MJD270 “Statistics of extreme wave conditions and events for Estonian coastal waters” (2012–2014) – I.Nikolkina.

6. TEMPUS project “Strengthening Education in Space-based REMOte sensing for monitoring of ecosystems in Israel, Azerbaijan, Kazakhstan”(SESREMO, 20 partners), 543720-TEMPUS-1-2013-1-DE-TEMPUS-JPCR (2013–2016) – I.Didenkulova, T.Soomere.

4.5 Additional funding (State Programmes)

1. Smart composites-design and manufacturing (SCDM) – A.Salupere, A.Braunbrück, J.Kalda and PhD students.

2. Grant “Science-based forecast and quantification of risks to properly and timely react to hazards impacting Estonian mainland, air space, water bodies and coasts” TERIKVANT (2012–2014) from the Estonian Research Council in the framework of supporting R&D in environmental technology (SFOS 3.2.0802.11–0043) – T.Soomere.

4.6 Supportive grants (travel, etc)

1. D.Kartofelev, Archimedes Foundation DoRa T6 grant approved Dec. 2012 for working at the acoustics laboratory of Aalto University, School of Electrical Engineering, Department of Signal Processing and Acoustics. During 2013 spring semester.

2. D.Kartofelev, Archimedes Foundation DoRa T8 grant. Conference travel expenses Stockholm, Sweden for attending the SMAC Stockholm music acoustics conference 2013 / SMC Sound and music computing conference 2013, 30 July – 3 August, 2013.

3. D.Kartofelev, Bilateral exchange programmes between Estonian and Hungarian Academies of Sciences. Conference travel expenses to visit FUDoM 13 Finno-Ugric International Conference On Mechanics, 11–15 August, 2013.

4. M.Mustonen, Archimedes Foundation DoRa T8 grant approved June 2013 for working at the acoustics laboratory of Aalto University, School of Electrical Engineering, Department of Signal Processing and Acoustics, 10–16 June, 2013.

5. P.Piksarv, Kristjan Jaak scholarship for attending the 34th PIERS in Stockholm.

6. H.Lukner, DoRa doctoral studies and internationalisation programme travel grant for attending the 34th PIERS in Stockholm.

7. J.Belikov, HITSA travel grant for attending The 2013 IEEE Multi-Conference on Systems and Control (MSC 2013), Hyderabad, India, 28–30 August, 2013.

8. K.Halturina, Doctoral Studies and Internationalisation Programme DoRa grant for attending HYCON-EECI Graduate School on Control, Paris, France, 18–22 February, 2013.

9. K.Halturina, Google Women in Tech Conference and Travel Grant EMEA for attending Robotics: Science and Systems Conference and Workshops, Berlin, Germany, 24–28 June, 2013.

10. A.Kaldmäe, SA Archimedes Kristjan Jaak grant for attending HYCON-EECI Graduate School on Control, Paris, France, 18–22 February, 2013.

11. A.Kaldmäe, SA Archimedes Kristjan Jaak grant for attending the 9th IFAC Symposium on Nonlinear Control Systems (NOLCOS 2013), Toulouse, France, 4–6 September, 2013.

12. A.Kaldmäe, EIFFEL grant for studing in Ecole Centrale de Nantes, France, 14 October, 2013 – 13 July, 2014.

13. Ü.Kotta, Travel grant (travel and accommodation up to 2500 euros) for visiting Ecole Centrale de Nantes, France, 1–12 July and 14–25 October, 2013.

14. M.Tõnso, HITSA travel grant for attending the 9th IFAC Symposium on Nonlinear Control Systems (NOLCOS 2013), Toulouse, France, 04–06 September, 2013.

15. I.Didenkulova, EGU grant for attending EGU General Assembly 2013, Vienna, Austria, 7–12 April, 2013.

16. I.Didenkulova, IUGG grant for attending International Tsunami Symposium in Gocek, Turkey, 25–28, September 2013.

17. I.Didenkulova, Cambridge Philosophical Society fellowship to participate in the program "Mathematics for the Fluid Earth" at the Isaac Newton Institute for Mathematical Sciences (Cambridge, UK), 21 October – 23 November, 2013.

18. A.Rodin, DoRa 8 grant for attending International Coastal Symposium in Plymouth, UK, 8–12 April, 2013.

4.7 Total income of CENS in 2012–2013(Euros)

Source	**2011**	**2012**	**2013**
Targeted financing (TF)[1]	610660	613780	484790
ESF grants[2]	187414	132662	70976
External project funding*[3]	526698	508405	554454
EU Structural Funds[4]	29656	314000	295926
Grand total	**1354428**	**1568847**	**1406146**

Remarks:

* EU Structural Funds excluded.

1 Targeted financing is used to support evaluated R&D research topics (both basic and applied) from State budget through the Ministry of Education and Reserach.

2 ESF grants are available to individuals as well as research groups who have to undergo a research project financing competition (this programme is closing).

3 External project funding – R&D grants from and contracts with various Estonian and foreign institutions (Wellcome Trust, Humboldt Foundation, Marie Curie actions, etc).

4 EU Structural Funds for supporting R&D activities implemented through the Archimedes Foundation (Implementation Agency of Structural Support), programme for Centres of Excellence in Research.

5. Publicity of Results

5.1 Publications

5.1.1 Books, theses

1. T.Soomere, E.Quak. Preventive Methods for Coastal Protection: Towards the Use of Ocean Dynamics for Pollution Control. Cham: Springer, 2013, 442 p.

2. J.Engelbrecht (guest editor) Special issue of Wave Motion: Advanced Modelling of Wave Propagation in Solids, 2013, 50, no 7.

3. M.Sepp. Estimation of diffusion restrictions in cardiomyocytes using kinetic measurements. PhD thesis, TUT Press, Tallinn 2013.

4. P.Piksarv, Spatiotemporal characterization of diffractive and non-diffractive light pulses. PhD thesis. University of Tartu Press. Tartu 2013.

5. V.Kaparin. Transformation of Nonlinear State Equations into Observer Form. PhD thesis, TUT Press, Tallinn 2013.

6. I.Zaitseva-Pärnaste. Wave climate and its decadal changes in the Baltic Sea derived from visual observations. TUT Press,. PhD thesis, TUT Press, Tallinn 2013.

7. I.Didenkulova. Long wave dynamics in the coastal zone with application to marine induced hazards. Thesis for Doctor of Science in Physics and Mathematics degree. Speciality "Oceanography". P.P.Shirshov Institute of Oceanology, Russian Academy of Sciences, Moscow, Russia on 17 December 2013.

8. A.Rodin. Influence of wave breaking effects on long wave transformation and runup on a beach. Thesis for Candidate of Science in Physics and Mathematics degree. Speciality "Fluid Mechanics". Nizhny Novgorod State Technical University, Nizhny Novgorod, Russia on 28 June 2013.

5.1.2 Papers (refereed)

IoC Department of Mechanics and Applied Mathematics

1. J.Engelbrecht. Microstructured continua and scaling for wave motion. Atti della Accademia Peloritana dei Pericolanti (AAPP), Classe di Sci Fis Mat e Nat, 2013, 91 (S1) A8.

2. J.Engelbrecht, A.Berezovski. Internal structures and internal variables in solids. J. of Mechanics of Materials and Structures, 2012, 7, 10, 983–996 (published in 2013).

3. A.Berezovski, J.Engelbrecht, A.Salupere, K.Tamm, T.Peets, M.Berezovski. Dispersive waves in microstructured solids. Int. J. Solids Structures, 2013, 50, 1981–1990.

4. J.Engelbrecht, T.Peets, K.Tamm, A.Salupere. Deformation waves in microstructured solids and dimensionless parameters. -In: Proc. Estonian Acad. Sci, 2013,62, 109–115.

5. T.Peets, D.Kartofelev, K.Tamm, J.Engelbrecht. Waves in microstructured solids and negative group velocity. Europhys. Letters – EPL, 2013, 103, 16001 (6pp).

6. J.Engelbrecht, A.Berezovski. On modelling of wave propagation in microstructured solids. Estonian J. Engng., 2013, 19, No 3, 171–182.

7. J.Engelbrecht. Wave equations in mechanics. Estonian J. Engng., 2013, 19, 4, 273–282.

8. A.Berezovski, M.Berezovski. Influence of microstructure on thermoelastic wave propagation. Acta Mechanica, 224, 2013, 2623–2633.

9. A.Berezovski, J.Engelbrecht. Thermoelastic waves in solids with microstructure: dual internal variables approach. J. Coupled Systems and Multiscale Dynamics, 1, 2013, 112–119.

10. P.Van, A.Berezovski and C.Papenfuss. Thermodynamic approach to generalized solid mechanics. Continuum Mechanics and Thermodynamics, Online First.

11. K.Tamm, T.Peets. On the influence of internal degrees of freedom on dispersion in microstructured solids. Mech. Research Comm., 2013, 47, 106–111.

12. A.Salupere, K.Tamm. On the influence of material properties on the wave propagation in Mindlin-type microstructured solids. Wave Motion, 50(7), 1127–1139.

13. D.Kartofelev, A.Stulov, H-M.Lehtonen, V.Välimäki. Modeling a vibrating string terminated against a bridge with arbitrary geometry. -In: Proc. of SMAC 2013: 4th Stockholm Music Acoustics Conference, July 30 – August 3, 2013. Eds R.Bresin, A.Askenfelt. Stockholm: KTH Royal Institute of Technology, 2013, 626–632.

14. A.Stulov. Mathematical model of echolocation of fish-catching bats. Wave Motion, 2013, 50(3), 579–585.

15. M.Kree, J.Duplat, and E.Villermaux. The mixing of distant sources. Physics of Fluids 2013, 25, 091103.

16. I.Mandre, J.Kalda. Efficient method of finding scaling exponents from finite-size Monte-Carlo simulations. European Physical J. B, 2013, 86(2), 56-1-6.

17. I.Mandre, J.Kalda. Intersections of moving fractal sets. EPL – A Letters J. Exploring the Frontiers of Physics, 2013, 103(1), 10012-p1-p5.

18. J.Kalda, J.Kikas, M.Heidelberg, S.Ainsaar, R.Lõhmus. IPhO 2012: how magnets curve the water. European J. Physics, 2013, 34(4), S35–S48.

19. J.Kalda. The 'Physics Cup': interesting problems are difficult. European J. Physics, 2013, 34(4), S3–S14.

20. T.Kaevand, J.Kalda, Ü.Lille. On the charge carrier time-of-flight mobility and the ordering effects in the microcrystalline PEDOT/PSS complex: a morphology-based simulation study. International J. Renewable Energy and Biofuels, 2013 (Article ID 181762), 1–13.

21. A.Ravasoo. Bursts in exponentially graded material characterized by parametric plots. On CD -In: Proc. 20th International Congress on Sound and Vibration. Bangkok, Thailand, 2013, 7–11, 8 p.

22. A.Ravasoo. Modified constitutive equation for quasi-linear theory of viscoelasticity. J. Engng. Math., 2013, 78, 1, 111–118.

23. A.Ravasoo. Tone bursts in exponentially graded materials characterized by parametric plots. Proc. Estonian Acad. Sci., 2013, 62, 4, 258–266.

24. J.-P.Suuronen, A.Kallonen, M.Eik, J.Puttonen, R.Serimaa, H.Herrmann. Analysis of short fibres orientation in steel fibre-reinforced concrete (SFRC) by X-ray tomography. J. Materials Science, 2013, 48(3), 1358–1367.

25. M.Eik, K.Lõhmus, M.Tigasson, M.Listak, J.Puttonen, H.Herrmann. DC-conductivity testing combined with photometry for measuring fibre orientations in SFRC. J. Materials Science, 48(10), 3745–3759.

26. R.Haber, J.Prehl, H.Herrmann, K.-H.Hoffmann. Diffusion of oriented particles in porous media. Physics Letters A, 377(40), 2840–2845.

27. E.Pastorelli, H.Herrmann. A small-scale, low-budget semi-immersive virtual environment for scientific visualization and research. Procedia Computer Science, 25, 14–22.

Laboratory of Systems Biology

28. J.Branovets, M.Sepp, S.Kotlyarova, N.Jepihhina, N.Sokolova, D.Aksentijevic, CA.Lygate, S.Neubauer, M.Vendelin, and R.Birkedal. Unchanged mitochondrial organization and compartmentation of high-energy phosphates in creatine-deficient GAMT-/- mouse hearts American J. of Physiology – Heart and Circulatory Physiology, 2013, 305(4), H506–520.

29. P.Peterson, M.Kalda, and M.Vendelin. Real-time determination of sarcomere length of a single cardiomyocyte during contraction American J. of Physiology – Cell Physiology, 2013, 304(6):C519–C531.

30. N.Sokolova, S.Pan, S.Provazza, G.Beutner, M.Vendelin, R.Birkedal, and S.Sheu. ADP Protects Cardiac Mitochondria under Severe Oxidative Stress PLoS ONE, 2013, 8(12):e83214.

Laboratory of Photoelasticity

31. H.Aben, J.Anton, A.Errapart. Photoelasticity for the Measurement of Thermal Residual stresses in Glass. -In: Encyclopedia of Thermal Stresses. Hetnarski, R.B., Ed., Springer, Berlin, 2013.

32. H.Aben, J.Anton, M.Paemurru, M.Õis. A new method for tempering stress measurement in glass panels. -In: Proc. Conf. GlassPerformance Days, Tampere, Finland, 2013, 216–217.

33. Y.Chen, D.Lochegnies, R.Defontaine, J.Anton, H.Aben. R.Langlais. Measuring the 2D residual surface stress mapping in tempered glass under the cooling jets: the influence of process parameters on the stress homogeneity and isotropy. Strain, 2013, vol. 49, 61–67.

34. H.Aben, J.Anton, M.Paemurru, M.Õis. A new method for tempering stress measurement in glass panels. Estonian J. Engng., 2013, vol. 19, 292–297.

Laboratory of Wave Engineering

35. I.Didenkulova. Tsunami runup in narrow bays: the case of Samoa 2009 tsunami. Natural Hazards, 2013, 65(3), 1629–1636.

36. I.Didenkulova, I.Nikolkina, E.Pelinovsky. Rogue waves in the basin of intermediate depth and the possibility of their formation due to the modulational instability. JETP Letters, 2013, 97(4), 221–225.

37. N.C.Delpeche-Ellmann, T.Soomere. Investigating the Marine Protected Areas most at risk of current-driven pollution in the Gulf of Finland, the Baltic Sea, using a Lagrangian transport model. Marine Pollution Bulletin, 2013, 67(1–2), 121–129.

38. P.Denissenko, I.Didenkulova, A.Rodin, M.Listak, E.Pelinovsky. Experimental statistics of long wave runup on a plane beach. J. Coastal Research, Special Issue 65, 2013, 195–200.

39. I.Didenkulova, P.Denissenko, A.Rodin, E.Pelinovsky. Effect of asymmetry of incident wave on the maximum runup height. J. Coastal Research, Special Issue 65, 2013, 207–212.

40. I.Didenkulova, A.Sheremet, T.Torsvik, T.Soomere. Characteristic properties of different vessel wake signals. J. Coastal Research, Special Issue 65, 2013, 213–218.

41. A.Giudici, T.Soomere. Identification of areas of frequent patch formation from velocity fields. J. Coastal Research, Special Issue 65, 2013, 231–236.

42. D.C.Kim, K.O.Kim, E.Pelinovsky, I.Didenkulova, B.H.Choi. Three-dimensional tsunami runup simulation for the port of Koborinai on the Sanriku coast of Japan. J. Coastal Research, Special Issue 65, 2013, 266–271.

43. T.Soomere. Extending the observed Baltic Sea wave climate back to the 1940s. J. Coastal Research, Special Issue 65, 2013, 1969–1974.

44. I.Nikolkina, T.Soomere, I.Didenkulova. Wave climate in Lake Peipsi. J. Coastal Research, Special Issue 65, 2013, 2035–2040.

45. B.Viikmäe, T.Torsvik. Quantification and characterization of mesoscale eddies with different automatic identification algorithms. J. Coastal Research, Special Issue, 2013, 65, 2077–2082.

46. E.Pelinovsky, I.Didenkulova, F.Mendez, D.Rybski, S.Tinti. Preface "Sea Hazards." Natural Hazards and Earth System Sciences, 2013, 13, 1063–1067.

47. I.Zaitseva-Pärnaste, T.Soomere. Interannual variations of ice cover and wave energy flux in the north-eastern Baltic Sea. Annals of Glaciology, 2013, 54(62), 175–182.

48. B.Viikmäe, T.Torsvik, T.Soomere. Impact of horizontal eddy-diffusivity on Lagrangian statistics for coastal pollution from a major marine fairway. Ocean Dynamics, 2013, 63(5), 589–597.

49. I.Didenkulova, E.Pelinovsky. Transformation of an irregular wave field along a quartic bottom profile. Proc. Estonian Acad. Sci, 2013, 62(3), 155–160.

50. I.Didenkulova, E.Pelinovsky. Analytical solutions for tsunami waves generated by submarine landslides in narrow bays and channels. Pure and Applied Geophysics, 2013, 170(9-10), 1661–1671.

51. T.Soomere, K.Pindsoo, S.R.Bishop, A.Käärd, A.Valdmann. Mapping wave set-up near a complex geometric urban coastline. Natural Hazards and Earth System Sciences, 2013, 13(11), 3049–3061.

52. M.Viška, T.Soomere. Simulated and observed reversals of wave-driven alongshore sediment transport at the eastern Baltic Sea coast. Baltica, 2013, 26(2), 145–156.

53. I.Nikolkina, I.Didenkulova, E.Pelinovsky, E.Shurgalina, A.Naumov, A.Pankratov, E.Rouvinskaya. Hazardous landslides along water basins of Nizhny Novgorod region. Nizhny Novgorod State Techn. n.a. U.Alekseev, 2013, 4(101), 157–166.

54. T.Soomere, K.Pindsoo, S.R.Bishop, A.Käärd, A.Valdmann. Mapping wave set-up near a complex geometric urban coastline. Natural Hazards and Earth System Sciences Discussion, 2013, 1, 1651–1688.

55. T.Soomere, M.Eelsalu, K.Pindsoo, M.Zujev. Lessons from the almost seven decades of visual wave observations from the eastern Baltic Sea coast. -In: 7th Study Conference on BALTEX, 10–14 June 2013, Borgholm, Island of Öland, Sweden, Conf. Proc., Marcus Reckermann and Silke Köppen, Eds, International BALTEX Secretariat, Publication No. 53, 91–92.

56. M.Viška, T.Soomere. Long-term variations of simulated sediment transport along the eastern Baltic Sea coast as a possible indicator of climate change. -In: 7th Study Conference on BALTEX, 10–14 June 2013, Borgholm, Island of Öland, Sweden, Conf. Proc., Marcus Reckermann and Silke Köppen, Eds, International BALTEX Secretariat, Publication No. 53, 99–100.

57. T.Soomere. BalticWay: Towards the use of ocean dynamics for pollution control. -In: 7th Study Conference on BALTEX, 10–14 June 2013, Borgholm, Island of Öland, Sweden, Conf. Proc., Marcus Reckermann and Silke Köppen, Eds, International BALTEX Secretariat, Publication No. 53, 180–181.

58. T.Soomere, M.Viška, M.Eelsalu. Spatial variations of wave loads and closure depth along the eastern Baltic Sea coast. Estonian J. Engng., 2013, 19(2), 93–109.

59. I.Didenkulova, T.Soomere, K.Pindsoo, S.Suuroja. On the occurrence of non–reflecting cross–shore profiles along Estonian coasts of the Baltic Sea. Estonian J. Engng., 2013, 19(2), 110–123.

60. E.Averbukh, P.Dussouillez, C.Kharif, O.Khvostova, A.Kurkin, P.Rochette, T.Soomere. Exposure of a coastal city to a landslide tsunami: a case study of Cassis, France. Estonian J. Engng., 2013, 19(2), 124–142.

61. T.Soomere. Towards mitigation of environmental risks. -In: T.Soomere, E.Quak Eds, 2013. Preventive methods for coastal protection. Springer, 2013, 1–27.

62. T.Torsvik. Introduction to computational fluid dynamics and ocean modelling. -In: T.Soomere, E.Quak Eds, 2013. Preventive methods for coastal protection. Springer, 2013, 65–100.

63. K.Myrberg, T.Soomere. The Gulf of Finland, its hydrography and circulation dynamics. -In: T.Soomere, E.Quak Eds, 2013. Preventive methods for coastal protection. Springer, 2013, 181–222.

64. J.Kjellsson, K.Döös, T.Soomere. Evaluation and tuning of model trajectories and spreading rates in the Baltic Sea using surface drifter observations. -In: T.Soomere, E.Quak Eds, 2013. Preventive methods for coastal protection. Springer, 2013, 251–281.

65. T.Soomere. Statistics of Lagrangian transport reveals hidden features of velocity fields. -In: T.Soomere, E.Quak Eds, 2013. Preventive methods for coastal protection. Springer, 2013, 283–318.

66. T.Soomere. Applications of the inverse problem of pollution propagation. -In: T.Soomere, E.Quak Eds, 2013. Preventive methods for coastal protection. Springer, 2013, 319–366.

67. T.Soomere. Using wave and current dynamics to find solutions to the challenges of environmental change. -In: V International conference "Frontiers of Nonlinear Physics" FNP2013, Nizhny Novgorod–Yelabuga, Russia, July 28–August 2, 2013. Proc. Institute of Applied Physics, Russian Academy of Science, Nizhny Novgorod, Russia, 2013, 172–173.

IoC Department of Control Systems

68. S.Avanessov, Ü.Nurges. Stability domain approximation for the robust PID controller parameters by reflection segments approach. -In: CCDC 2013: 25th Chinese Control and Decision Conf. 25–27 May, 2013, Guiyang, China, Singapore: IEEE, 2013, 2004–2009.

69. Z.Bartosiewicz, Ü.Kotta, E.Pawłuszewicz, M.Tõnso. Algebraic formalism of differential p-forms and vector fields for nonlinear control systems on homogeneous time scales. Proc. Estonian Acad. Sci., 2013, 62(4), 215–226.

70. Z.Bartosiewicz, Ü.Kotta, E.Pawłuszewicz, M.Tõnso, M.Wyrwas. Reducibility condition for nonlinear discrete-time systems: behavioral approach. Control and Cybernetics, 2013, 42(2), 329–347.

71. J.Belikov, Ü.Kotta, S.Srinivasan, A.Kaldmäe, K.Halturina. On exact feedback linearization of HVAC systems. -In: PC 2013: 19th Intern. Conf. Process Control, 18–21 June, 2013, Štrbské Pleso, Slovakia. Eds M.Fikar, M.Kvasnica, Piscataway, NJ: IEEE, 2013, 353–358.

72. J.Belikov, Ü.Kotta, M.Tõnso. NLControl: Symbolic package for study of nonlinear control systems. -In: MSC 2013: 2013 IEEE Multi-conf. Systems and Control, 28–30 August, 2013, Hyderabad, India: Piscataway, NJ: IEEE, 2013, 322–327.

73. J.Belikov, S.Nõmm, E.Petlenkov, K.Vassiljeva. Application of neural networks based SA-NARX model for identification and control liquid level tank system. -In: ICMLA 2013: IEEE 12th Intern. Conf. Machine Learning and Applications, 4–7 December, 2013, Miami, FL, USA: IEEE, 2013.

74. J.Belikov, E.Petlenkov, K.Vassiljeva, S.Nõmm. Computational intelligence methods based design of closed-loop system. -In: ICONIP 2013: 20th Intern. Conf. Neural Information Processing, 3–7 November, 3013, Daegu, Korea. Eds M.Lee, A.Hirose, Z.-G.Hou, R.M.Kil, Berlin: Springer, 2013, 215–224.

75. K.Halturina, A.Kaldmäe, Ü.Kotta, M.Tõnso. Computation of flat outputs for discrete-time nonlinear systems with Mathematica. -In: PC 2013: 19th Intern. Conf. Process Control, 18–21 June, 2013, Štrbské Pleso, Slovakia. Eds M.Fikar, M.Kvasnica, Piscataway, NJ: IEEE, 2013, 107–112.

76. A.Kaldmäe, Ü.Kotta. Comparison of two methods for computing flat outputs. -In: PC 2013: 19th Intern. Conf. Process Control, 18–21 June, 2013, Štrbské Pleso, Slovakia. Eds M.Fikar, M.Kvasnica, Piscataway, NJ: IEEE, 2013, 7–12.

77. A.Kaldmäe, Ü.Kotta. Input-output linearization by dynamic output feedback. -In: ECC'13: 12th European Control Conf., 17–19 July, 2013, Zurich, Switzerland: 978-3-9524173-4-8: EUCA, 2013, 1728–1733.

78. A.Kaldmäe, Ü.Kotta. On flatness of discrete-time nonlinear systems. -In: NOLCOS 2013: 9th IFAC Symposium on Nonlinear Control Systems, 4–6 September, 2013, Toulouse, France. Eds S.Tarbouriech, M.Krstic. Toulouse: IFAC-Elsevier, 2013, 588–593.

79. A.Kaldmäe, Ü.Kotta, A.Shumsky, A.Zhirabok. Measurement feedback disturbance decoupling in discrete-time nonlinear systems. Automatica, 2013, 49(9), 2887–2891.

80. A.Kaldmäe, Ü.Kotta, A.Ye.Shumsky, A.N.Zhirabok. Fault accommodation in discrete time dynamic systems: fault decoupling based approach. -In: SysTol'13: 2nd Intern. Conf. Control and Fault-Tolerant Systems, 9–11 October, 2013, Nice, France: IEEE, 2013, 450–455.

81. V.Kaparin, Ü.Kotta, T.Mullari. Extended observer form: simple existence conditions. Intern. J. Control, 2013, 86(5), 794–803.

82. Ü.Kotta, C.H.Moog, M.Tõnso. The minimal time-varying realization of a nonlinear time-invariant system. -In: NOLCOS 2013: 9th IFAC Symposium on Nonlinear Control Systems, 4–6 September, 2013, Toulouse, France. Eds S.Tarbouriech, M.Krstic. Toulouse: IFAC-Elsevier, 2013, 518–523.

83. Ü.Kotta, M.Tõnso, J.Belikov, A.Kaldmäe, V.Kaparin, A.Ye.Shumsky, A.N.Zhirabok. A symbolic software package for nonlinear control systems. - In: PC 2013: 19th Intern. Conf. Process Control, 18–21 June, 2013, Štrbské Pleso, Slovakia. Eds M.Fikar, M.Kvasnica. Piscataway, NJ: IEEE, 2013, 101–106.

84. Ü.Kotta, M.Tõnso, A.Ye.Shumsky, A.N.Zhirabok. Feedback linearization and lattice theory. Systems & Control Letters, 2013, 62(3), 248–255.

85. A.Kuusik, S.Nõmm, S.Ovsjanski, L.Orunurm, E.Reilent. Wearable system for patient motor condition assessment and training monitoring. -In: PHT 2013: IEEE Point-of-Care Healthcare Technologies, 16–18 January, 2013, Bangalore, India, Piscataway, NJ: IEEE, 2013, 192–195.

86. H.Liu, J.Vain. An agent-based modeling for price-responsive demand simulation. -In: ICEIS 2013: 15th Intern. Conf. Enterprise Information Systems, 4–6 July, 2013, Angers, France. Eds S.Hammoudi, L.Maciaszek, J.Cordeiro, J.Dietz. SciTePress, 2013, 405–412.

87. Ü.Nurges, S.Avanessov. Robust fixed order controller design by a mixed randomized/deterministic method. -In: MSC 2013: 2013 IEEE Multi-conf. Systems and Control, 28–30 August, 2013, Hyderabad, India: Piscataway, NJ: IEEE, 2013, 170–175.

88. S.Nõmm, K.Buhhalko. Monitoring of the human motor functions rehabilitation by neural networks based system with Kinect sensor. -In: 12th IFAC/IFIP/IFORS/IEA Symposium on Analysis, Design, and Evaluation of Human – Machine Systems, 11–14 August, 2013, Las Vegas, NV, USA. Eds S.Narayanan. Las Vegas: IFAC/Elsevier, 2013, 249–253.

89. S.Nõmm, A.Toomela. An alternative approach to measure quantity and smoothness of the human limb motions. Estonian J. Engng., 2013, 19(4), 298–308.

90. S.Nõmm, A.Toomela, J.Borushko. Alternative approach to model changes of human motor functions. -In: EMS2013: UKSim-AMSS 7th European Modelling Symposium on Mathematical Modelling and Computer Simulation, 20–22 November, 2013, Manchester, UK. Eds D.Al-Dabass, A.Orsoni, Z.Xie. Los Alamitos: IEEE, 2013, 161-166.

91. S.Nõmm, K.Vassiljeva, A.Kuusik. Human limb model structure selection with genetic algorithm. -In: EMS2013: UKSim-AMSS 7th European Modelling Symposium on Mathematical Modelling and Computer Simulation, 20–22 November, 2013, Manchester, UK. Eds D.Al-Dabass, A.Orsoni, Z.Xie. Los Alamitos: IEEE, 2013, 124–129.

92. S.Srinivasan, Ü.Kotta, S.Ramaswamy. A layered architecture for control functionality implementation in smart grids. -In: ICNSC13: 2013 IEEE Intern. Conf. Networking, Sensing and Control, 10–12 April, 2013, Paris-Evry, France: IEEE, 2013, 100–105.

93. S.Srinivasan, R.Kumar, J.Vain. Integration of IEC 61850 and OPC UA for Smart Grid Automation. -In: ISGT 2013: Innovative Smart Grid Technologies Conf., 10–13 November, 2013, Bangalore, India: Piscataway, NJ: IEEE, 2013, [1 - 6].

94. S.Srinivasan, M.Vallabhan, S.Ramaswamy, Ü.Kotta. Adaptive regulator for networked control systems: MATLAB and True Time implementation. -In: CCDC 2013: 25th Chinese Control and Decision Conf., 25–27 May, 2013, Guiyang, China: Singapore: IEEE, 2013, 2551–2555.

95. S.Srinivasan, M.Vallabhan, S.Ramaswamy, Ü.Kotta. Adaptive LQR controller for networked control systems subjected to random communication delays. -In: ACC 2013: 2013 American Control Conf., 17–19 June, 2013, Washington, DC, USA: Piscataway, NJ: IEEE, 2013, 783–787.

96. A.Tepljakov, E.Petlenkov, J.Belikov. Efficient analog implementations of fractional-order controllers. -In: ICCC 2013: 14th Intern. Carpathian Control Conf., 26–29 May, 2013, Rytro, Poland. Eds I.Petráš, I.Podlubny, J.Kačur, A.Nawrocka, B.Sapiński. Rytro: IEEE, 2013, 377–382.

97. A.Tepljakov, E.Petlenkov, J.Belikov, S.Astapov. Digital fractional-order control of a position servo. -In: MIXDES 2013: 20th Intern. Conf. Mixed Design of Integrated Circuits and Systems, 20–22 June, 2013, Gdynia, Poland. Eds A.Napieralski. Lodz: IEEE, 2013, 462–467.

98. A.Tepljakov, E.Petlenkov, J.Belikov, J.Finajev. Fractional-order controller design and digital implementation using FOMCON toolbox for MATLAB. -In: MSC 2013: 2013 IEEE Multi-conf. Systems and Control, 28–30 August, 2013, Hyderabad, India: Piscataway, NJ: IEEE, 2013, 340–345.

99. A.Tepljakov, E.Petlenkov, J.Belikov, M.Halás. Design and implementation of fractional-order PID controllers for a fluid tank system. -In: ACC 2013: 2013 American Control Conf., 17–19 June, 2013, Washington, DC, USA: Piscataway, NJ: IEEE, 2013, 1777–1782.

UT Optics Group

100. P.Piksarv, A.Valdmann, H.Valtna-Lukner, R.Matt, P.Saari. Spatiotemporal characterization of ultrabroadband Airy pulses. Opt. Lett., 2013, 38 (7), 1143–1145.

101. P.Saari. X-type waves in ultrafast optics. -In: Non-diffractive waves. Eds H.E.Hernández-Figueroa, M.Zamboni-Rached, and E.Recami, Wiley, 2013, 109–134.

102. P.Piksarv, H.Valtna-Lukner, A.Valdmann, R.Matt, P.Saari. Measuring the suppression of ultrashort pulses into Airy-Bessel light bullets with almost single-cycle temporal resolution. -In: EPJ Web of Conferences, EDP Sciences. Eds M.Chergui, A.Taylor, S.Cundiff, R.de Vivie-Riedle, K.Yamagouchi, 2013, 1002, 1–3.

103. V.Peet. The far-field structure of Gaussian light beams transformed by internal conical refraction in a biaxial crystal, Opt. Commun., 2013, 311, 150–155.

5.2.1 Research Reports

1.	Mech 305/13	J.Engelbrecht, A.Berezovski. On deformation waves in functionally graded materials.
2.	Mech 306/13	M.Mustonen, D.Kartofelev, A.Stulov. Experimental measurements of string motion.
3.	Mech 307/13	A.Stulov, D.Kartofelev. Wave propagation and dispersion in microstructured wool felt.

5.2.2 Lecture Notes

1.	Mech 10/2013	D.Kartofelev, J.Engelbrecht. Fractality in music.
2.	Mech 11/2013	LOFY.04.072 13/14 P.Saari: Quantum mechanics I, http://www.physic.ut.ee/instituudid/efti/loengumaterjalid/KvMeh1/.

5.2.3 Submitted papers

1. M.Berezovski, A.Berezovski, and J.Engelbrecht. Numerical simulation of one-dimensional microstructure dynamics. Int. J. Structural Stability and Dynamics (submitted).
2. J.Engelbrecht, A.Salupere. Scaling and hierarchies of wave motion in solids. ZAMM (accepted).
3. I.Sertakov, J.Engelbrecht, J.Janno. Modelling 2D wave motion in microstructured solids Mech. Res. Comm. 2014, 56, 42–49 (for 2014).
4. A.Berezovski, J.Engelbrecht, P.Van. Weakly nonlocal thermoelasticity for microstructured solids: microdeformation and microtemperature. Arch. Appl. Mech. (accepted).
5. J.Engelbrecht, A.Berezovski. Reflections on mathematical models of deformation waves in elastic microstructured solids. Mathematics & Mechanics of Complex Systems (submitted).
6. A.Salupere, M.Lints, J.Engelbrecht. On solitons in media modelled by the hierarchical KdV equation. Arch. Appl. Mech. (accepted).
7. A.Berezovski, W.-X.Tang. Elastic wave Talbot effect in solids with inclusions. Mechanics Research Communications (submitted).
8. H.Aben, J.Anton, A.Errapart. Measuring residual stresses in homogeneous and composite glass materials using photoelastic techniques. In Residual Stresses in Composite Materials (Shokrieh, M., ed.). Woodhead Publ. Comp. (submitted).
9. H.Aben. Stress measurement in glass tubes made easy. GlassWorldwide, UK. (submitted).
10. J.Kalda. Mate, Vigh. Seagull competition: difficult problems, easy answers. European J. Physics (submitted).
11. D.Kartofelev, A.Stulov. Propagation of deformation waves in wool felt. Acta Mechanica (submitted).
12. A.Stulov, D.Kartofelev. Vibration of strings with nonlinear supports. Applied Acoustics, 2014, 76, 223–229.

13. A.Valdmann, P.Piksarv, H.Valtna-Lukner, P.Saari. Realization of laterally nondispersing ultrabroadband Airy pulses. Opt. Lett., (to be published in 2014).

14. P.Piksarv, A.Valdmann, H.Valtna-Lukner, P.Saari. Ultrabroadband Airy light bullets. Laser Physics, (to be published in 2014).

15. A.Ravasoo. Interaction of bursts in exponentially graded materials characterized by parametric plots. Wave Motion (submitted).

16. A.Braunbrúck. Determination of inhomogeneous properties of materials by analysis of ultrasonic wave motion. Acta Acustica United with Acustica (submitted).

17. M.Eik, J.Puttonen, and H.Herrmann. An orthotropic material model for short fibre reinforced materials based on the fibre orientation distribution function. ZAMM, (submitted).

18. H.Herrmann, M.Eik, V.Berg and J.Puttonen. Phenomenological and numerical modelling of short fibre reinforced cementitious composites. Meccanica, (submitted).

19. J.Belikov, E.Petlenkov. Model based control of a water tank system. - In: IFAC'14: The 19th World Congress of the IFAC, 24–29 August, 2014, Cape Town, South Africa, (submitted).

20. J.Belikov, Ü.Kotta, M.Tõnso. Adjoint polynomial formulas for nonlinear state-space realization. IEEE Transactions on Automatic Control, (in press).

21. J.Belikov, Ü.Kotta, M.Tõnso. Comparison of LPV and nonlinear system theory: a realization problem. Systems & Control Letters, (in press).

22. A.Kaldmäe, Ü.Kotta. Input-output Linearization of discrete-time systems by dynamic output feedback. European J. Control, (accepted).

23. A.Kaldmäe, Ü.Kotta. Input-output decoupling of discrete-time nonlinear systems by measurement feedback. - In: MTNS 2013: The 21th Intern. Symp. on Mathematical Theory of Networks and Systems, 7–11 July, 2014, Groningen, the Netherlands, (submitted).

24. A.Kaldmäe, Ü.Kotta. Disturbance decoupling by measurement feedback. - In: IFAC'14: The 19th World Congress of the IFAC, 24–29 August, 2014, Cape Town, South Africa, (submitted).

25. V.Kaparin, Ü.Kotta, M.Wyrwas. Observable Space of Nonlinear Control System on Homogeneous Time Scale. Proc. Estonian Acad. Sci., 2014, 63(1) (in press).

26. Ü.Nurges, S.Avanessov. Fixed order stabilizing controller design by a randomized method. Intern. J. of Control, (submitted).

27. Ü.Kotta, M.Tõnso. Polynomial accessibility condition for MIMO nonlinear control system. Proc. Estonian Acad. Sci., 2014, 63(2) (accepted).

28. E.Averbukh, O.Kurkina, A.Kurkin, T.Soomere. Edge-wave-driven durable variations in the thickness of the surfactant film and concentration of surface floats. Physics Letters A, 2014, 378(1-2), 53–58, doi: 10.1016/j.physleta.2013.10.019

29. J.Kalda, T.Soomere, A.Giudici. On the finite-time compressibility of the surface currents in the Gulf of Finland, the Baltic Sea. J. Marine Systems, 2014, 129, 56–65, doi: 10.1016/j.jmarsys.2012.08.010

30. T.Soomere, A.Räämet. Decadal changes in the Baltic Sea wave heights. J. Marine Systems, 2014, 129, 86–95, doi: 10.1016/j.jmarsys.2013.03.009

31. T.Soomere, M.Viška. Simulated sediment transport along the eastern coast of the Baltic Sea. J. Marine Systems, 2014, 129, 96–105, doi: 10.1016.j.jmarsys.2013.02.001

32. B.Viikmäe, T.Soomere. Spatial pattern of hits to the nearshore from a major marine highway in the Gulf of Finland. J. Marine Systems, 2014 129, 106–117, doi: 10.1016/j.jmarsys.2013.06.014

5.2.4 Popular science

1. R.Weiler, J.Engelbrecht. The Network Society. In: WAAS Newsletter, April 2013. Conference Report: Impact of Science and Technology on Society and Economy, Trieste, March 4–7, 2013, pp 8–9.

2. J.Engelbrecht. Komplekssüsteemid ja süsteemibioloogia (Complex systems and system biology), Schola biotheoretica XXXIX, Süsteemibioloogia, Tartu 2013, 7–11, – in Estonian.

3. R.Weiler, J.Engelbrecht. The Science of Complexity: a Transdisciplinary Exploration of Theory and Applications. In: WAAS Newsletter, June 2013, p.16

4. J.Engelbrecht. Teerajaja ja innustaja (Akadeemik Nikolai Alumäest). Horisont, 2013, No 5, 12–13 (Pathfinder and Inspirer – on Nikolai Alumäe) – in Estonian

5. R.Weiler, J.Engelbrecht. The new sciences of networks & complexity: a short introduction. Cadmus, 2013, vol 2, issue 1, 131–141.

6. P.Saari. Footoni elu. Ettekanne akad. Agu Laisa 75. juubeli-konverentsil 03.05. 2013

7. T.Soomere. Teadustõbistest (Diagnosis: a scientist), Sirp, 05.04.2013, 24–25 (in Estonian).

8. T.Soomere. Teaduspreemia tehnikateaduste alal uurimuste tsükli "Merelt lähtuvate ohtude kvantifitseerimine ja minimeerimine Läänemere ranniku kontekstis" eest (National science prize in engineering: Quantification and mitigation of marine coastal hazards in the context of the eastern Baltic Sea), in: Eesti Vabariigi teaduspreemiad 2013 (Estonian National Science Prize 2013. Eesti Teaduste Akadeemia, Tallinn 2013, 64–115 (in Estonian).

9. T.Soomere. Keskkonnahoidliku merekasutuse matemaatika (Mathematics of environmentally safe use of the sea). Horisont 4/2013, 59–60 (in Estonian).

10. T.Soomere. Eesti on võrdlemisi immuunne (Climate warming affects Estonia only a little; comment on the paper by Peter Singer Dethroning King Coal), Eesti Päevaleht No 153 (8.08.2013), 11 (in Estonian).

11. T.Soomere. Teaduse ja raha muutuvad suhted (Changing interrelations of science and its funding). In: Teadusmõte Eestis (VIII). Teaduskultuur (Scientific thought in Estonia (VIII). Scientific culture. J.Engelbrecht, H.-L.Help, S.Jakobson, G.Varlamova (eds.), Eesti Teaduste Akadeemia, Tallinn, 2013, 25–37 (in Estonian).

12. T.Soomere. Mismoodi on su vaimu seis? (a shorter comment to the question "What's the status of your spirit?" asked by the Editor in the last issue of the year 2013), Sirp 28(3470), 20.12.2013, 3 (in Estonian).

5.2.5 Other papers / Science policy

1. J.Engelbrecht, Akadeemiast - Kuidas on möödunud 75 aastat Eesti Teaduste Akadeemias (On the Academy – What has happened in the Estonian Academy of Sciences over 75 years). Horisont, 2013, No 1, p 4 – in Estonian.
2. J.Engelbrecht, Baltimaade vaimse koostöö konverents 2013 (The Baltic Conference on Intellectual Cooperation 2013), Horisont, 2013, No 1, p. 14 – in Estonian.
3. J.Engelbrecht, Eesti teaduse tippkeskuste nõukogu. Eesti TA Aastaraamat XVIII (45), 2012, 36–38 (in English: Council of Estonian Centres of Excellence in Research. Estonian Academy of Sciences, Year Book XVIII (45), 2012, 39–41).
4. J.Engelbrecht, Märkamisi aastast 2012 (Notices on 2012). Eesti TA Aastaraamat XVIII (45),2012, 229–232 – in Estonian.
5. J.Engelbrecht, ALLEA 2006–2011. Estonian Academy of Sciences, Year Book XVIII (45), 2012, 187–191.
6. J.Engelbrecht, J.Järv. Editorial – Academy 75. Proc Estonian Acad. Sci, 2013, 62, No 4, 213–214.
7. J.Engelbrecht, D.Givoli, T.Hagstrom, G.Maugin. Editorial to the special issue of Wave Motion: Advanced Modelling of Wave Propagation in Solids, Wave Motion, 2013, 50, no 7, 1061–1062.
8. J.Engelbrecht. Eestlased välismaal – minek ja tulek. Rmt Eesti ustest – sisse, välja, Tartu Ülikooli eetikakeskus, Tartu, 2013, 104–107 (Estonians abroad – going and coming. In: Estonian Doors – in and out) – in Estonian.
9. J.Engelbrecht. World university: global strategy for higher education. Eruditio (e-Journal of the WAAS), 2013, vol I, 3, Part 1, 11–13.
10. J.Engelbrecht. Eesti teadlastest välismaal (Estonian scientists abroad). Horisont, 2013, No 6, 63 – in Estonian.
11. J.Engelbrecht. Teaduse rahastamisest: Kes ees, see sees. Kes kannab teaduse rahastamise eest vastutust? Sirp, 2013, No 43, 16–17 (On research funding – Who is first, is in. Who is responsible?) – in Estonian.
12. J.Engelbrecht. Sissejuhatus. Rmt. Teadusmõte Eestis: Teaduskultuur. Eesti Teaduste Akadeemia, Tallinn, 2013, 7–9 (Introduction to: Scientific Thought in Estonia: Science culture) – in Estonian.
13. J.Engelbrecht. Teaduse sees ja ümber. Rmt. Teadusmõte Eestis: Teaduskultuur. Eesti Teaduste Akadeemia, Tallinn, 2013, 63–72 (In and around science. In: Scientific Thought in Estonia: Science culture) – in Estonian.
14. P.Saari. Merisea sündroom teaduse rahastamises. Tartu Postimees 24.04.2013 – in Estonian.
15. J.Kalda. Reaalharidusest füüsiku pilgu läbi : suur osa õppeajast kulub hoopis filosoofilist laadi jutupuhumisele. Sirp: Eesti kultuurileht, 15. nov., lk. 16–17 – in Estonian.
16. J.Kalda. Study guide: Electrical circuits.
Available online, http://www.ioc.ee/ kalda/ipho/e-circuits.pdf.

5.3 Conferences

1. The 6^{th} Fenno-Ygric Days of Mechanics (FUDoM 2013), Rackeve, Hungary, 11–15 August, 2013.
   J.Engelbrecht. On complexity of mechanics.
   J.Engelbrecht, D.Kartofelev, K.Tamm, T.Peets. Negative group velocity in microstructured materials.
   D.Kartofelev, J.Engelbrecht. Algorithmic melody composition based on fractal geometry of music.
   A.Berezovski, J.Engelbrecht, P.Van. Weakly nonlocal thermoelasticity with dual internal variables.

2. SIAM Conference on Computational Science & Engineering (CSE13). The Westin Boston Waterfront, Boston, Massachusetts, USA, February 25 – March 1, 2013.
   A.Berezovski, M.Berezovski. Dispersive wave propagation in solids with microstructure.

3. 3rd International Conference on Material Modelling incorporating the 13th European Mechanics of Materials Conference, September 8–11, 2013, Warsaw, Poland.
   A.Berezovski, J.Engelbrecht, M.Berezovski. Numerical simulation of elastic wave diffraction.

4. International Conference "Glass Performance Days", Tampere, Finland, June 13–15, 2013.
   H.Aben. A new method for tempering stress measurement in glass panels.

5. International Congress on Glass, Prague, June 30 – July 6, 2013.
   H.Aben. Modern photoelasticity for residual stress measurement in glass.

6. Conference "Living Glass", Cambridge, September 11–13, 2013, organized by the British Society of Glass Technology.
   H.Aben. Modern photoelastic technology for residual stress measurement in glass.

7. The 20th International Congress on Sound and Vibration. Bangkok, Thailand, 7–11 July 2013.
   A.Ravasoo. Bursts in exponentially graded material characterized by parametric plots.

8. The 17th International Conference on Composite Structures (ICCS17), 17–21 June 2013, Porto, Portugal.
   A.Braunbrück, J.Majak. Characterisation of exponentially graded materials by ultrasound.

9. The Eighth IMACS International Conference on Nonlinear Evolution Equations and Wave Phenomena: Computation and Theory, The University of Georgia, Athens, USA, March 25-28, 2013.
   K.Tamm, A.Salupere. Numerical study of the wave propagation in Mindlin-type microstructured solids.
   A.Salupere, M.Lints. On existence of hidden solitons in solitonic structures.

10. 7th International Workshop NDT in Progress, Fraunhofer Institute for Nondestructive Testing, Dresden, Germany, November 7–8, 2013.
    M.Lints, A.Salupere, S.Dos Santos. Formation and detection of solitonic waves in dilatant granular materials: potential application for nonlinear NDT.

11. STATPHYS-25, 22–26 July, Seoul, Korea, 2013.
    I.Mandre. Intersections of moving fractal sets.

12. SMAC 2013: 4th Stockholm Music Acoustics Conference, July 30 – 3 August, 2013.
D.Kartofelev, A.Stulov, V.Välimäki, H-M.Lehtonen. Modeling a vibrating string terminated against a bridge with arbitrary geometry.

13. Biophysical Society 57th Annual Meeting, Philadelphia, Pennsylvania, USA, February 2–6, 2013.
S.Kotlyarova, M.Mandel, N.Sokolova, D.Aksentijevic, Cr.A.Lygate, St.Neubauer, M.Vendelin, R.Birkedal. Cardiomyocytes from creatine deficient AGAT-/- mice show no changes in mitochondrial organization and cellular compartmentation.
P.Simson, A.Illaste, N.Jepihhina, P.Peterson, M.Vendelin. Using raster image correlation spectroscopy for the detection of ADP/ATP diffusion restrictions in rat cardiomyocytes.
J.Branovets, M.Sepp, S.Kotlyarova, N.Jepihhina, N.Sokolova, D.Aksentijevic, Cr.A.Lygate, St.Neubauer, M.Vendelin, R.Birkedal. Unchanged mitochondrial organization and compartmentation in creatine deficient GAMT-/- mouse heart.
M.Sepp, S.Jugai and M.Vendelin. NA/K ATPase affects respiration kinetics and provides evidence for intracellular diffusion restrictions in permeabilized rat cardiomyocyes.
M.Laasmaa, R.Birkedal, M.Vendelin. An integrated method to quantify calcium fluxes in cardiac excitation-contraction coupling.
P.Peterson, M.Kalda, M.Vendelin. Real-time determination of sarcmere lebgth of a single cardiomtocyte during contraction.

14. 37th Congress of the International Union of Physiological Sciences, Birmingham, UK, 21–26 July 2013.
M.Laasmaa, M.Vendelin, R.Birkedal. An integrated method to quantify calcium fluxes in cardiac excitation-contraction coupling.
S.Kotlyarova, M.Mandel, N.Sokolova, D.Aksentijevic, Cr.A.Lygate, St.Neubauer, M.Vendelin, R.Birkedal. Cardiomyocytes from creatine deficient AGAT-/- mice show no changes in mitochondrial organization and cellular compartmentation.
P.Simson, N.Jepihhina, P.Peterson and M.Vendelin. Detecting diffusion barriers in rat cardiomyocytes with extended raster image correlation spectroscopy.
J.Branovets, M.Sepp, S.Kotlyarova, N.Jepihhina, N.Sokolova, D.Aksentijevic, Cr.A.Lygate, St.Neubauer, M.Vendelin, R.Birkedal. Unaltered mitochondrial organization and compartmentation in creatine deficient GAMT-/- mouse cardiomyocytes.

15. Nordic Physics Days, June 12–14, 2013, Swedish Physical Society, 2013.
P.Saari. Accelerating and nondiffracting waves.

16. 22nd International Laser Physics Workshop (LPHYS'13) 15–19 July 2013, Prague, Czech Republic, 2013.
P.Piksarv, A.Valdmann, H.Valtna-Lukner, R.Matt, P.Saari. Ultrabroadband Airy light bullets.

17. Ultrafast Optics (UFO IX), Davos, Switzerland; March 4–8, 2013.
A.Valdmann, P.Piksarv, H.Valtna-Lukner, R.Matt, P.Saari. Spatio-temporal characterization of white-light Airy pulses.
P.Piksarv, H.Valtna-Lukner, A.Valdmann, R.Matt, P.Saari. Optical ultra-broadband spatial spectral interferometry with single-cycle temporal resolution.

18. The 34th Progress in Electromagnetics Research Symposium (PIERS), Stockholm, Sweden, August 12–15, 2013.
P.Piksarv, A.Valdmann, H.Valtna-Lukner, R.Matt, P.Saari. Generation and characterization of ultrawideband Airy pulses.
P.Saari, O.Rebane, I.Besieris. Energy transport velocity for various localized and accelerating pulsed waves.

19. Euromech Colloquium 541, Senigallia, Italy, June 3–6, 2013.
H.Herrmann, M.Eik, V.Berg, J.Puttonen. Phenomenological and numerical constitutive modelling of short fibre reinforced materials and control of fibre orientation distribution.

20. ICCS17, Porto, Portugal. June 17–21, 2013.
H.Herrmann, M.Eik, J.Puttonen. Phenomenological and numerical constitutive modelling of short fibre reinforced materials taking into account the fibre orientation distribution.
H.Herrmann, V.Berg. Fracture simulation of short fibre reinforced material using the discrete element method (poster).

21. FIBRE CONCRETE 2013 – Technology, Design, Application, Prague, Czech Rep. September 12–13, 2013.
M.Eik, J.Puttonen, H.Herrmann. Fibre orientation phenomenon in concrete composites: measuring and theoretical modelling.

22. Aalto Research day, Aalto University, Otaniemi, Finland, September 26, 2013.
M.Eik, J.Puttonen, H.Herrmann. Fibre orientation phenomenon in concrete composites: measuring and theoretical modelling.

23. Virtual and Augmented Reality in Education (VARE), Tenerife, Spain, November 7–8, 2013.
E.Pastorelli, H.Herrmann. A small-scale, low-budget semi-immersive virtual environment for scientific visualization and research.

24. 19th International Conference on Process Control (PC 2013), Štrbské Pleso, High Tatras, Slovak Republic, 18-21 June 2013.
J.Belikov, Ü.Kotta, S.Srinivasan, A.Kaldmäe, K.Halturina. On exact feedback linearization of HVAC systems.
K.Halturina, A.Kaldmäe, Ü.Kotta, M.Tõnso. Computation of flat outputs for discrete-time nonlinear systems with Mathematica.
A.Kaldmäe, Ü.Kotta. Comparison of two methods for computing flat outputs.
Ü.Kotta, M.Tõnso, J.Belikov, A.Kaldmäe, V.Kaparin, A.Ye.Shumsky, A.N.Zhirabok. A symbolic software package for nonlinear control systems.

25. The 2013 Progress on Difference Equations (PODE 2013), Białystok, Poland, 21–26 July 2013.
Ü.Kotta. Polynomial tools for discrete-time nonlinear control systems (plenary talk).

26. Robotics: Science and Systems 2013, Berlin, Germany, 24–28 June 2013.
K.Halturina – participant.

27. The 15th International Conference on Enterprise Information Systems (ICEIS 2013), Angers, France, 4–6 July 2013.
H.Liu, J.Vain. An agent-based modeling for price-responsive demand simulation.

28. The 12th biannual European Control Conference (ECC'13), Zürich, Switzerland, 17–19 July 2013.
A.Kaldmäe, Ü.Kotta. Input-output linearization by dynamic output feedback.

29. The 25th Chinese Control and Decision Conference (CCDC 2013), Guiyang, China, 25–27 May 2013.
S.Avanessov, Ü.Nurges. Stability domain approximation for the robust PID controller parameters by reflection segments approach.

30. The 12th IFAC/IFIP/IFORS/IEA Symposium on Analysis, Design, and Evaluation of Human – Machine Systems, Las Vegas, NV, USA, 11–14 August 2013.
S.Nõmm, K.Buhhalko. Monitoring of the human motor functions rehabilitation by neural networks based system with Kinect sensor.

31. The 2013 IEEE Multi-Conference on Systems and Control (MSC 2013), Hyderabad, India, 28–30 August 2013.
J.Belikov, Ü.Kotta, M.Tõnso. NLControl: Symbolic package for study of nonlinear control systems.
Ü.Nurges, S.Avanessov. Robust fixed order controller design by a mixed randomized/deterministic method.
A.Tepljakov, E.Petlenkov, J.Belikov, J.Finajev. Fractional-order controller design and digital implementation using FOMCON toolbox for MATLAB.

32. 9th IFAC Symposium on Nonlinear Control Systems (NOLCOS 2013), Toulouse, France, 4–6 September 2013.
A.Kaldmäe, Ü.Kotta. On flatness of discrete-time nonlinear systems.
Ü.Kotta, C.H.Moog, M.Tõnso. The minimal time-varying realization of a nonlinear time-invariant system.

33. 7th European Modelling Symposium on Mathematical Modelling and Computer Simulation (EMS2013), Manchester, UK, 20–22 November 2013.
S.Nõmm, A.Toomela, J.Borushko. Alternative approach to model changes of human motor functions.
S.Nõmm, K.Vassiljeva, A.Kuusik. Human limb model structure selection with genetic algorithm.

34. 25th Nordic Workshop on Programming Theory (NWPT'13), Tallinn, Estonia, 20–22 November 2013.
F.Siavashi, M.Waldén, L.Tsiopoulos, J.Vain. Modelling critical systems with time constraints in Event-B.

35. The 12th International Conference on Machine Learning and Applications (ICMLA'13), Miami, FL, USA, 4–7 December 2013.
J.Belikov, S.Nõmm, E.Petlenkov, K.Vassiljeva. Application of neural networks based SA-NARX model for identification and control liquid level tank system.

36. Open discussion session of the partnership of the Estonian Academy of Sciences and Tallinn University of Technology on the problems of the transfer to the new scheme of financing of scientific research, 23 January 2013, TUT.
T.Soomere was the key organiser and moderator.

37. 2nd International Conference "Caribbean Waves", Gosier, Guadeloupe, France, 21–25 January 2013.
I.Didenkulova. Effects of wave asymmetry on its runup on a beach: theory and experiment.

38. 13th Baltic Conference on Intellectual Co-operation "European Research Area and Small Countries". Tallinn, Estonian Academy of Sciences, 28–29 January 2013.
T.Soomere. Baltic Sea–the bridge between many countries.

39. Annual meeting and conference of the EU Regional Development Foundation-supported Environmental Conservation and Environmental Technology R&D Programme initiative "Science-based forecast and quantification of risks to properly and timely react to hazards impacting Estonian mainland, air space, water bodies and coasts". Jäneda, Estonia, 07–08

April 2013 .
T.Soomere. Marine coastal hazards for Estonia.
M.Zujev. Statistics of the Baltic Sea wave climate).
M.Eelsalu. Wave energy potential in the Estonian coastal waters.
K.Pindsoo. Mapping of dangerous wave set-up in the urban area of Tallinn.
B.Viikmäe. Preventive methods for the protection of coastal environment.

40. Alexander von Humboldt Network Meeting in Hannover, 20–22 March 2012, Germany.
I.Didenkulova participated.

41. EGU General Assembly. Vienna, Austria, 7–12 April, 2013.
I.Didenkulova, A.Sheremet, T.Torsvik, T.Soomere. Identification of characteristic properties in different vessel wake signals.
I.Didenkulova, I.Nikolkina, E.Pelinovsky. Observations of rogue waves in a basin of intermediate depth and discussion on a possibility of their formation due to the modulational instability.
T.Talipova, E.Pelinovsky, O.Kurkina, I.Didenkulova. Solitary interface wave propagation in two-layer flow of slowly varied bottom.
I.Didenkulova, A.Zaitsev, E.Pelinovsky, B.Ranguelov. Tsunami forecast for Bulgarian coasts of the Black Sea (poster).
I.Didenkulova, E.Pelinovsky, A.Rybkin. Generalization of the Carrier-Greenspan approach for nonlinear wave runup in bays of arbitrary cross-section (poster).
I.Didenkulova, E.Pelinovsky. Irregular wave transformation along a quartic bottom profile (poster).
I.Nikolkina, T.Soomere, I.Didenkulova. Wave characteristics in Lake Peipsi (poster).
I.Didenkulova, P.Denissenko, A.Rodin, E.Pelinovsky. Statistics of long wave runup on a plane beach, based on the data from the Large Wave Flume (GWK), Hannover, Germany (poster).
I.Nikolkina, I.Didenkulova, E.Pelinovsky. Landslides along the rivers of Nizhny Novgorod region (poster).
E.Pelinovsky, I.Didenkulova, D.Pelinovsky, D.Tyugin, A.Giniyatullin. Travelling long waves in water channels of specific configurations (poster).
I.Didenkulova. Convener and a chair of sessions NH5.3 "Nonlinear Dynamics of the Coastal Zone" and NH5.1 "Tsunami". She is also a scientific officer of the Natural Hazards (HN) division for "Sea and Ocean Hazards" (poster).

42. 12th International Coastal Symposium ICS 2013. 08–12 April 2013, Plymouth, UK.
T.Soomere, T.Torsvik, I.Nikolkina, B.Viikmäe, A.Giudici, and A.Rodin. Participated.
N.C.Delpeche-Ellmann, T.Soomere. Using Lagrangian models to assist in maritime management of Coastal and Marine Protected Areas.
P.Denissenko, I.Didenkulova. Experimental measurements of statistics of long wave runup on a plane beach.
A.Giudici, T.Soomere. Identification of coastal areas of frequent patch formation from velocity fields.
I.Didenkulova, A.Sheremet, T.Torsvik, T.Soomere. Characteristic properties of different vessel-wake signals.
T.Soomere. Extending the observed Baltic Sea wave climate back to the 1940s.
B.Viikmäe, T.Torsvik. In search for hidden transport patterns governing the coastal pollution.
A.Rodin. Effects of wave asymmetry on its runup on a beach (poster).
I.Nikolkina. Wave climate in Peipsi Lake (poster).
T.Soomere was chairman of the session "Coastal Engineering 4".

43. School-conference "Mathematics and mathematical modeling", 16–19 April 2013, Sarov, Russia.
E.Averbukh participated and gained a diploma in the section "Simulation of physical processes and phenomena".

44. HYDRALAB User Community Workshop on the Hydraulic Response of Structures. 13–16 May 2013, IFREMER, Brest.
I.Didenkulova. Rogue waves at the coast: extreme wave statistics on a slopping beach.

45. 33rd EARSeL Symposium "Towards Horizon 2020: Earth observation and Social Perspectives". 03–06 June 2013, Matera, Italy.
I.Nikolkina. Rogue waves in the sea.

46. 15th Meeting of the Domain Committee for Individuals, Societies, Cultures and Health (ISCH) and 7th ISCH Annual Progress Conference (APC), 3–4 June 2013, Meriton Grand Conference & Spa, Tallinn, Estonia.
T.Soomere. The life and death of the Baltic Sea: is it in the hands of wind direction?

47. 7th Study Conference on BALTEX. 10–14 June 2013, Borgholm, Island of Öland, Sweden).
T.Soomere. Baltic Way: Towards the use of ocean dynamics for pollution control.
M.Viška, T.Soomere. Long-term variations of simulated sediment transport along the eastern Baltic Sea coast as a possible indicator of climate change.
T.Soomere, M.Eelsalu, K.Pindsoo, M.Zujev. Lessons from the almost seven decades of visual wave observations from the eastern Baltic Sea coast (poster).

48. 5th International Workshop on Modeling the Ocean. IWMO 2013, 17–20 June 2013, Bergen, Norway.
T.Torsvik. Methods for automated detection of sea surface eddy structures.

49. World Conference of Science Journalists 2013. WCSJ2013, Helsinki, Finland, June 24–28, 2013.
T.Soomere. The mathematics of environmentally safe sea traffic.

50. IAHS-IAPSO-IASPEI Joint Assembly in Gothenburg, Sweden, 22–26 July 2013.
T.Soomere. Extremes of wave-induced water level setup in the urban area of City of Tallinn, Estonia (co-author K.Pindsoo).

51. V International conference "Frontiers of Nonlinear Physics" FNP2013, 28 July–02 August 2013, Nizhny Novgorod–Yelabuga, Russia.
T.Soomere. Using wave and current dynamics to find solutions to the challenges of environmental change.

52. 9th Baltic Sea Science Congress. 26–30 August 2013, Klaipeda, Lithuania.
I.Didenkulova, A.Giudici, M.Eelsalu, I.Nikolkina, K.Pindsoo, A.Rodin, T.Soomere, T.Torsvik, B.Viikmäe, M.Viška, I.Zaitseva-Pärnaste, M.Zujev. Changing wave climate in the Baltic Sea basin.
I.Didenkulova, A.Rodin. Peculiarities of the ship wake structure.
I.Didenkulova, A.Rodin. Properties of shallow water rogue waves in the Baltic Sea.
A.Giudici, T.Soomere. In search for the areas of natural patch generation in the Gulf of Finlands.
M.Eelsalu, T.Soomere. Wave energy potential in the north-eastern Baltic Sea.
T.Torsvik, T.Soomere, J.Kalda, B.Viikmäe. Improving the forecast of coastal pollution using surface drifter trajectories.
I.Nikolkina, T.Soomere, R.Weisse, B.Geyer. Simulated statistics of extreme wave events

in the Baltic Sea.
E.Averbukh, O.Kurkina, A.Kurkin. Numerical simulation of trapped waves in coastal areas (poster).
I.Didenkulova, K.Pindsoo, S.Suuroja. Power laws for the cross-shore profiles along Estonian coasts (poster).
I.Didenkulova, A.Rodin. "Parabolic cap" model for gravity flows and shallow water waves (poster).
M.Eelsalu, T.Soomere, M.Viška. Closure depth along the north-eastern coast of the Baltic Sea (poster).
I.Nikolkina, T.Soomere, I.Didenkulova. Monitoring of extreme wave conditions in Lake Peipsi (poster).
K.Pindsoo, T.Soomere. Wave set-up in the urban area of the City of Tallinn, Estonia (poster).
T.Torsvik, I.Didenkulova. Analysis of ship-generated waves-a case study for port protection (poster).
B.Viikmäe, T.Torsvik. Analysis and comparison of automatic eddy detection methods (poster).
M.Zujev. Spatio-temporal variations in the wave-driven sediment transport along the eastern Baltic Sea coast (poster).
M.Viška, T.Soomere. Statistical properties of wave climate in the eastern Baltic Sea (poster).
T.Soomere and T.Torsvik were chairmen of Session IV "Interplay of physical, biological, geological and coastal processes."

53. International Tsunami Symposium 2013, 25–28 September 2013, Gocek, Turkey.
I.Didenkulova. Nonlinear wave run-up in bays of arbitrary cross-section: generalization of the Carrier-Greenspan approach.
I.Didenkulova. Chair of the session "Analytical and others".

54. BCAM Workshop on Computational Mathematics (17–18 October 2013, Basque Center for Applied Mathematics, Bilbao, Basque Country, Spain, 18.10.2013).
T.Soomere. Retrieving the signal of climate change from simulated sediment transport along the eastern Baltic Sea coast.

55. Conference "Non-equilibrium Statistical Mechanics and the Theory of Extreme Events in Earth Science" at the Isaac Newton Institute for Mathematical Sciences, 29 October–1 November 2013, Cambridge, UK.
I.Didenkulova. Extreme sea waves in the coastal zone.

56. The VI research conference of the faculty of mathematics and natural sciences of the Tallinn University of Technology, 6 November 2013, Tallinn, Estonia.
T.Soomere. Mathematics of environmentally sustainable use of marine space.

57. On-line Seminar (virtual conference) "Disaster Resilience: The many approaches to a concept and best practices" organized by ANDROID, the Disaster Resilience Network coordinated by the Center for Social Studies, University of Coimbra, 9 September 2013, Portugal.
I.Didenkulova. Participated.

58. The Gulf of Finland year 2014 Data/Modelling Fusion Workshop, 19 September 2013, Helsinki, Finland.
T.Soomere. Smart use of currents for minimizing the consequences of marine hazards.

59. The COST Action TED0902 final conference Under the sea: "Archaelogy and palaeolandscapes" and the final workshop of the CoPaF project "Coastline changes of the southern Baltic Sea-Past and future projection", 23–27 September 2013, Szczecin, Poland.
T.Soomere. Retrieving the signal of climate change from numerically simulated sediment transport along the eastern Baltic Sea coast.

5.4 Seminars

5.4.1 Tallinn Seminars on Mechanics (CENS 2013)

1. 07.01.2013, J.Kalda: Scaling behaviour reveals creative problems of physics contests.
2. 21.01.2013, T.Torsvik: Identification of ship wake characteristics by means of a time-frequency analysis method.
3. 04.02.2013, M.Heidelberg, K.Kallip: Mixing efficiently nanoparticles.
4. 11.02.2013, B.Viikmäe: Modelling and structure identification of surface currents in shallow, microtidal sea basins.
5. 18.02.2013, K.Tamm: Numerical study of the wave propagation in Mindlin-type microstructured solids.
6. 25.02.2013, I.Didenkulova:"Rogue waves in the basin of intermediate depth and the possibility of their formation due to the modulational instability.
7. 04.03.2013, E.Pastorelli: Dynamic time warping : method and applications on electric cars behavior analysis.
8. 11.03.2013, A.Giudici: Residence time of water and pollution Kin semi-enclosed seas.
9. 25.03.2013, M.Kree: Mixing properties of stationary flows in porous media.
10. 01.04.2013, I.Zaitseva-Pärnaste: Mathematical description of wave climate and extreme wave storms in the context of the Baltic Sea.
11. 08.04.2013, H.Aben: 200 years from the discovery of the photoelastic effect in glass;
    J.Anton: Glasstress – a company between science and glass industry;
    Visit to the laboratory of photoelasticity.
12. 22.04.2013, A.Berezovski: Waves and discontinuities in solids.
13. 29.04.2013, I.Mandre: Intersections of moving fractal sets.
14. 06.05.2013, A.Udal: Intro to quantum philosophy and quantum-IT.
15. 20.05.2013, B.Viikmäe: Background of circulation and wave modelling: equations, scales, basic types of motion.
16. 27.05.2013, E.Pastorelli: Immersive virtual reality for scientific visualization.
17. 03.06.2013, M.Vallikivi (Princeton University): Nano-Scale Sensors and Extreme Reynolds Numbers.
18. 17.06.2013, P.Peterson: Complexity of the new computing cluster at CENS.
19. 26.06.2013, S.M.Varlamov (JAMSTEC, Yokohama, Japan): Ocean Downscaled Modeling Activities in Japan Agency for Marine-Earth Science and Technology (JAMSTEC).

20. 06.09.2013, Prof. K.Dholakia (University of St Andrews, Scotland): Shaping light for biophotonics.
21. 16.09.2013, 1. Opening words – Prof. J.Engelbrecht; 2. CENS during the new academic year; work plans and their fulfillment; 3. Financing and procurements; 4. Conferences which took place during the summer – overview from the participants; 5. CENS flyers, IUTAM symposium 2014; 6. Discussions.
22. 23.09.2013, Dr. R.Appadu (Dept Math & Appl Math, Univ of Pretoria, South Africa): Numerical Solution of the 1D Advection-Diffusion Equation Using Standard and Non-Standard Finite Difference Schemes.
23. 30.09.2013, I.Medvedev (P.P.Shirshov Institute of Oceanology): Spectrum of sea level oscillations in the Baltic Sea: influence of internal and external factors.
24. 09.10.2013, Prof. C.Hedberg and Prof. L.Håkansson (Blekinge Institute of Technology, Sweden): Remote health monitoring of structures and machines .
25. 21.10.2013, T.Peets: Dispersion in 2-layer bar.
26. 04.11.2013, J.Jõgi: MD modeling of mechanical properties of nanowires.
27. 08.11.2013, I.Zaitseva-Pärnaste: Wave Climate and its Decadal Changes in the Baltic Sea Derived from Visual Observations.
28. 11.11.2013, K.Tamm: Numerical study of the wave propagation in Mindlin-type double microstructured solids.
29. 18.11.2013, A.Berezovski: On the structure of generalized continuum theories.
30. 25.11.2013, D.Kartofelev, A.Stulov: Propagation of deformation waves in wool felt.
31. 03.12.2013, Prof. E.Niggli: (University of Bern, Department of Physiology): Adrenergic Stimulation: Protein Kinase Modulation of Cardiac Rynodine Receptors.
32. 09.12.2013, A.Ravasoo: Qualitative acoustodiagnostics with parametric plots.

5.4.1.1 Seminars of the Wave Engineering Group

1. 22.01.2013, T.Torsvik. Reporting seminar.
2. 29.01.2013, I.Nikolkina: "Rogue waves in the basin of intermediate depth and the possibility of their formation due to the modulational instability".
3. 29.01.2013, I.Didenkulova. Discussion on the abstracts for Baltic Sea Science Congress. Reports.
4. 30.01.2013, T.Torsvik. Represented during a visit from the German Ambassador and the 1st embassy secretary from the Norwegian embassy. During the visit at IoC, Torsvik gave a short presentation about the research activities at the Laboratory of Wave Engineering.
5. 19.02.2013, I.Didenkulova. Overview of experiments planned for 2013.
6. 05.03.2013, M.Zujev: "Statistical parameters of Baltic Sea wave climate".
7. 12.03.2013, T.Soomere: "Basic equations for surface waves".

8. 19.03.2013, T.Soomere: "Basic equations for surface waves, part II".
9. 26.03.2013, T.Soomere: "Basic equations for surface waves, part III".
10. 02.04.2013, T.Soomere: "Plymouth presentation practice" (With Bert Viikmäe and Andrea Giudici).
11. 16.04.2013, T.Soomere. Reporting seminar.
12. 23.04.2013, T.Torsvik. Presentations: "Interannual variations of ice cover and wave energy flux in the northeastern Baltic Sea" (I.Zaitseva-Pärnaste) and "Remote Sensing of Baltic Sea Ice" (M.Viška).
13. 30.04.2013, I.Nikolkina. The German Research Landscape. Current Developments and the DAAD Scholarship Programme.
14. 14.05.2013, T.Soomere: "Basic equations for surface waves, part IV".
15. 04.06.2013, T.Torsvik. Planning the Aegna experiment.
16. 11.06.2013, T.Torsvik. Overview of the North Sea experiment.

5.4.1.2 Seminars Nonlinear Control Group

1. 01.10.2013, Dr. Alban Quadrat (INRIA Saclay – Île-de-France, France): Algebraic analysis of linear functional systems.
2. 02.10.2013, Dr. Thomas Cluzeau (University of Limoges, France): An algebraic analysis approach to the simplification of systems of linear functional equations.
3. 27.11.2013, Monika Ciulkin (Bialystok University of Technology, Poland): Linearization by input-output injections on homogeneous time scales.

5.4.1.3 Seminars of Optics Group

1. 05-06.09.2013, Weekly seminar of Laboratory of physical optics. Prof. Kishan Dholakia (University of St Andrews, Scotland) "Shaping light for biophotonics".
   Dr. Cord Arnold (Atomic Physics, Lund University), "Ultrafast spectroscopy of atoms".

5.4.2 Lectures and seminars outside CENS

1. J.Engelbrecht. Harold J.Gay invited lecture in the WPI, 18.Jan., Modeling of deformation waves in microstructured solids, Worcester, MA, USA.
2. J.Engelbrecht. 75 years of the Estonian Academy of Sciences, 28. Jan., Baltic Conference on Intellectual Cooperation, Tallinn.
3. J.Engelbrecht. Complex systems and system biology, Schola biotheoretica XXXIX, Systems Biology, Mustjõe, Estonia.
4. J.Engelbrecht. World University: global strategy for higher education, 3. June, WAAS and UNOG conference, Opportunities and Challenges for the 21st Century – Need for a New Paradigm. Geneva, Switzerland.

5. J.Engelbrecht. Nonlinearities and fractality. 24. Aug., Summer School Beautiful Numbers, Käsmu, Estonia.

6. J.Engelbrecht. Activities of CENS, 22.Oct., Conference "Excellence in Research", Tallinn, Estonia.

7. J.Engelbrecht. Role of the Estonian Centres of Excellence in Research in graduate studies, 14. Nov., EU Conference Invest in Researchers, Vilnius, Lithuania.

8. A.Berezovski. Waves and discontinuities in solids: numerical simulation. Graduate seminar at Worchester Polytechnic Institute, Massachusetts, USA, 27 February 2013.

9. A.Berezovski. Generalized thermomechanics with dual internal variables. Research seminar at International Research Center for Mathematics & Mechanics of Complex Systems (M&MoCS), Cisterna di Latina, Italy, 21 October 2013.

10. P.Saari. Valguskuulid. Ettekanne Loodusuurijate Seltsis 26 september, 2013 (in Estonian).

11. H.Lukner. Exotic 3D light bullets propagating in linear media, in the Max Planck Institute for the Science of Light; Erlangen, Germany, 29 April, 2013.

12. H.Lukner. Valgus, mis levib iseendast kiiremini, ettekanne Füüsika Üliõpilaste Seltsis, Tartu, 2 may 2013 (in Estonian).

13. J.Kalda. Turbulentse segunemise kirju maailm. 27 March 2013, University of Tartu (in Estonian).

14. H.Herrmann. Scientific Visualization and Virtual Reality, KBFI physics, 28.11.2013.

15. M.Tõnso. NLControl – package for modeling, analysis and synthesis of nonlinear control systems. Seminar at INRIA Saclay – Île-de-France, Paris, France, 28 May 2013.

16. J.Vain. On the analysis of emerging behavior of robot swarms (invited talk). Invited talk at the Conference of Estonian Doctoral School in Information and Communication Technology, Haapsalu, Estonia, 15,16 November, 2013.

17. T.Torsvik. Identification of flow structures by Lagrangian trajectory methods, in the faculty of Natural Sciences and Mathematics in Klaipeda University (Klaipeda, Lithuania), 15.01.2013.

18. I.Didenkulova. Beach profile change caused by vessel wakes and wind waves in Tallinn Bay, the Baltic Sea, in the Department of Geophysical Sciences of Klaipeda University (Klaipeda, Lithuania), 16.01.2013.

19. T.Soomere. The Baltic Sea wave fields mirror the climate change, to the annual seminar of the Department of Geography, University of Tartu (Kääriku, Estonia, in Estonian), 05.02.2013.

20. T.Soomere. How the waves talk to us, to the winter school of molecular biology (Nelijärve, Estonia, in Estonian), 09.02.2013.

21. T.Soomere. From Newton's laws to surface wave motion to PhD and MSc students in Earth Sciences, Marine Systems Institute, 06.03.2013.

22. T.Soomere. Wave-driven sediment dynamics along the eastern Baltic Sea coast, to the international PhD school "LIDAR-based palaeogeographic reconstructions of the Baltic Sea" (Tartu, 15–19.04.2013).

23. T.Soomere. The coasts of the Baltic Sea under joint pressure of natural and anthropogenic factors, in the Estonian Academy of Science (Tallinn, Estonia, Academic Lecture 60), 08.05.2013.
24. I.Didenkulova. Dynamics of long sea waves in the coastal zone with applications to marine hazards, in Nizhny Novgorod State Technical University (Nizhny Novgorod, Russia), 10.06.2013.
25. I.Didenkulova. Dynamics of long sea waves in the coastal zone with applications to marine hazards, in P.P.Shirshov Institute of Oceanology (Moscow, Russia), 14.06.2013.
26. A.Rodin. Influence of breaking effects on transformation and run-up of long waves to the shore, in Nizhny Novgorod State University (Nizhny Novgorod, Russia), 18.06.2013.
27. I.Didenkulova. Dynamics of hazardous waves in the coastal zone. A.Ishlinski Institute for Problems in Mechanics of Russian Academy of Sciences (Moscow, Russia), 10.09.2013.
28. Wave Engineering Laboratory and the Commission on Marine Sciences of the Estonian Academy of Sciences organised the first Sparkling Seminar on marine science, limnology and coastal engineering. The keynote lecture "Climate and marine life" was given by Dr. Jonne Kotta (Estonian Marine Institute), 10.09.2013.
29. T.Soomere. Wave-driven longshore sediment transport along the eastern Baltic Sea coast, to the seminar of the Department of Geosciences, University of Aveiro (Aveiro, Portugal), 09.10.2013.
30. T.Soomere. Changing wave climate in the Baltic Sea to the ERC-NUMERIWAVES Seminar, at the Basque Center for Applied Mathematics (Bilbao, Basque Country, Spain), 18.10.2013.
31. The second Sparkling Seminar on marine science, limnology and coastal engineering, organised jointly by the Wave Engineering Laboratory and the Commission on Marine Sciences of the Estonian Academy of Sciences organised and hosted by the Marine Systems Institute at Tallinn University of Technology. The keynote lecture "Arctic becomes hot" was given by Dr. Kalle Olli (University of Tartu, Institute of Ecology and Earth Sciences), 29.10.2013.
32. T.Soomere. The Baltic Sea coasts under anthropogenic pressure, to the autumn school on physics (Voore, Estonia), 03.11.2013.
33. I.Didenkulova. Extreme sea waves in the coastal zone, at the Department of Mathematics and Statistics of the University of Reading (Reading, UK), 14.11.2013.

5.5 Meetings and events

5.5.1. Meetings and events in CENS

Intense day on waves and climate tolerance – Institute of Cybernetics, 08.11.2013

1. Leonid Lopatukhin, Department of Oceanology, Saint Petersburg State University and Mechanics and Optics, Saint Petersburg University of Information Technology, Russia: New generation of wind wave climate handbooks;
2. Leandro Farina, Department of Mathematics, Instituto de Matemática, UFRGS, Porto Alegre, RS, Brasil and Basque Center for Applied Mathematics, BCAM Bilbao, Basque Country, Spain: Ocean wave modes in the South Atlantic by a short-scale simulation;

3. Piia Post, Institute of Physics, University of Tartu: Temperature tolerance: Describing temporal variability of air temperature in climate time scale;
4. Discussion: Future directions of wave science.

Annual Seminar of the Institute of Cybernetics, Roosta, 29–30.11.2013

1. T.Soomere. "Wave dynamics and Lagrangian transport for coastal and maritime engineering".
2. I.Nikolkina. "Catalogue of rogue waves reported in media in 2006–2010".
3. T.Torsvik. "Recentdevelopments in the data analysis of ship wake and surface current measurements".
4. J.Engelbrecht, T.Peets, K.Tamm. "Wave equations – universality and richness".
5. D.Kartofelev, A.Stulov. "How is sound of musical instruments influenced by small imperfections".
6. A.Šeletski. "Reconstruction of coefficients of higher-order wave equations".
7. M.Kree. "Colorful turbulent mixing".
8. T.Soomere. "Recipes for an appealing presentation".
9. H.Aben, J.Anton, M.Õis. "A new approach to stress measurements in tempered glass panels".
10. M.Ciulkin. "Linearization by input-output injections on homogeneous time scales".
11. K.Halturina. "Computation of flat outputs for discrete-time nonlinear systems with Mathematica".
12. M.Sepp. "How to mend a broken heart?".
13. S.Jugai. "Mitochondrial organization and compartmentation in cardiomyocytes from creatine-deficient AGAR mice".

6. Research and teaching activities

6.1. Meetings and events organised elsewhere

1. M.Kalda. Mechanoenergetics of a Single Cardiomyocyte" Department of Physiology, University of Bern, (talk), 04.04.13.
2. M.Vendelin. Energy transfer and intracellular diffusion obstacles in heart, Department of Physiology, University of Bern, (talk), 5.11.13.
3. P.Saari organized a Special Session "Ultrawideband Nondiffracting and Accelerating Waves" in the 34th Progress in Electromagnetics Research Symposium (PIERS); Stockholm, Sweden; August 12–15, 2013.
4. H.Herrmann: Special Topics in Scientific Visualization, ITI8910, 2013/2014 Autumn.

5. The Wave Engineering Laboratory team visited the Centre of Biorobotics, Faculty of Information Technology of Tallinn University of Technology, almost for a full day. The visit was mostly filled by ten presentations reflecting highlights of the research of both teams, followed by an overview of the research environment of the centre and a discussion of options for collaboration, 03.09.2013.

6.2 International cooperation

Nonlinear Control Group:

- A.Kaldmäe. Joint PhD studies with Ecole Centrale de Nantes, France.
- Collaboration with French scientists A.Quadrat (INRIA Saclay – Île-de-France) and T.Cluzeau (University of Limoges) within the framework of G.F.PARROT programme.
- Collaboration with (1) Slovak University of Technology: Dr. Miroslav Halás, (2) Institut de Recherche en Communications et en Cybernétique de Nantes (IRCCyN): Prof. Claude H. Moog, (3) Far Eastern Federal University: Prof. Alexey N.Zhirabok, (4) Osaka Unimersity: Dr. Yu Kawano. Collaboration includes joint publications, exchange visits, seminars for graduate students.

Nonlinear Dynamics Group:

- Mutual cooperation between the Department of Signal Processing and Acoustics. (Aalto University, School of Electrical Engineering, Espoo, Finland) and the Institute of Cybernetics at Tallinn University of Technology (A.Stulov, D.Kartofelev, M.Mustonen).
- Laboratory of Photoelasticity together with the company Glasstress Ltd is involved in informal cooperation in the framework of two projects.
- Project "Development of highly strong glasses". The head of this project is Prof. Chuck Kurkjian from the University of South Maine, USA. The other participants are Prof. S.Chandrasekar (Purdue University, USA), Prof. S.Yoshida (University of the Shiga Prefecture, Japan) and Nippon Electric Glass. New glass compositions are being developed and tested by indenters. Stresses are measured with micropolariscopes and calculated using numerical algorithms. The role of the Laboratory of Photoelasticity has been development of the algorithms and software for the interpretation of the photoelastic measurement results.
- Project "Investigation of real stress fields in tempered glass panels". This is a cooperation with the University of Valenciennes, France (Prof. Dominique Lochegnies).The laboratory of Prof. Lochegnies is world leader in mathematical modelling of glass tempering processes. Both calculations and measurements with the scattered light polariscope SCALP have shown that due to discrete location of cooling jets in glass tempering ovens residual stress field in tempered glass panels is highly inhomogeneous. This problem is being now investigated both numerically and experimentally.
- Estonian-Hungarian Joint Research Project under the Agreement on Scientific Cooperation between the Estonian Academy of Sciences and the Hungarian Academy of Sciences 2013–2015 "Thermal and mechanical phenomena in media with multiscale microstructure".
- Scientific cooperation on "Nonlinear waves in inhomogeneous solids" for 2012–2014 between Institute of Thermomechanics of Academy of Sciences of Czech Republic and Centre for Nonlinear Studies of Institute of Cybernetics at TUT.

- Memorandum of Understanding between Worcester Polytechnic Institute (WPI), US and CENS on studies in "Wave propagation in dynamic materials" for 2012–2014.
- Agreement of Scientific Cooperation between the International Research Centre for Mathematics and Mechanics of Complex Materials, Cisterna di Latina, Italy and CENS on studies "Influence of microstructure on dynamic materials response" for 2014–2016.
- Agreement of Scientific Cooperation between PRES Centre Val de Loire University, Sweden and CENS on studies "Nonlinear wave propagation in complex media" for 2012–2015.
- Agreement of Scientific Cooperation between Blekinge Institute of Technology (BTH), Sweden and CENS on studies "Dynamics of nonlinear and strongly inhomogeneous materials" for 2013–2015.
- Agreement of Scientific Cooperation between Tampere University of Technology, Finland on Studies "On crack propagation and damage description" for 2013–2015.

6.3 Teaching activities

6.3.1 Courses:

1. J.Engelbrecht – courses in TUT (MSc level):
   – Nonlinear Dynamics and Chaos (assistant D.Kartofelev).
2. J.Engelbrecht – Teaching abroad:
   – in the Graduate School of the University of Turin:
   Complexity (a short course).
3. A.Salupere – courses in TUT:
   – Fundamentals of Elasticity (assistant K.Tamm);
   – Continuum Mechanics;
   – Theory of Elasticity;
   – Seminars and Special Seminars for MSc and PhD students.
4. J.Kalda – course at the University of Tartu:
   – Nonlinear Dynamics, spring 2013.
5. J.Kalda, M.Kree:
   – Training of the Esonian team of the International Physics Olympiad – June 2013.
6. A.Braunbrück – courses in TUT:
   – Technical Mechanics I;
   – Technical Mechanics II;
   – Statics;
   – Dynamics.
7. P.Peterson – courses in TUT:
   – EMR9740 Scientific programming with Python.
8. J.Belikov – courses in TUT:
   – ISS0010 System Theory (BSc);
   – ISS0031 Modeling and Identification (MSc).
9. Ü.Nurges – course in TTK University of Applied Sciences:
   – TLM394 System Theory (BSc).

10. S.Nõmm – courses in EBS:
– ECO234 Introduction to Econometrics, eng (BSc);
– ECO234 Introduction to Econometrics, rus (BSc);
– ECO134 Introduction to Econometrics, est (BSc);
– MAT105 Mathematics and Statistics for Business I (BSc).

11. J.Vain – courses in TUT:
– ITI0021, Logic Programming (BSc);
– ITX8025, Formal methods in system design (MSc);
– ITI0135, Project on Formal Methods (MSc);
– ITI9191, Special topics of Formal Methods (PhD);
– IXX9601, Doctoral Seminar I (PhD);
– ITI0060, Formal Methods (in Embedded Systems Design) (MSc);
– ITX8025, Formal Methods (in Embedded Systems Design) (MSc);
– ITI0021, Logic Programming (BSc and MSc).

12. A.Giudici – course in Kybi/TUT:
– Introduction to Matlab for wave and coastal engineering applications.

13. A.Räämet – course in Tallinn University of Technology:
– Structural Mechanics.

14. I.Zaitseva-Pärnaste – courses in Estonian Marine Academy:
– Basics of Scientific Research;
– Port Structures.

15. M.Zujev – courses in Estonian Marine Academy:
– Hydromechanics;
– Marine Physics;
– Coastal Sea Hydrodynamics;
– Port Structures;
– Introduction into Hydrography;
– Hydrographic Project.

16. 14–15.01.2013, I.Didenkulova gave a series of popular lectures "Rogue waves in the Sea: observations, instrumental detection and mechanisms of their generation" in Klaipeda University (Klaipeda, Lithuania). The program was funded by the The Research Council of Lithuania through the project "The competitive funding of short-term researcher visits" under the EU structural support.

17. 11–22.11.2013, T.Soomere presented the lecture courses "Wave dynamics" (32 academic hours) and "Scientific writing" (12 academic hours) to Klaipeda University, Lithuania.

Courses in University of Tartu:

18. P.Saari:
– Quantum mechanics;
– Advanced quantum mechanics;
– Quantum computing and cryptography.

19. H.Lukner:
- Physics and technology, lectures of optics.

20. P.Piksarv:
    – Practical course in physics III – Optics.

6.3.2. Participation in other events, transfer of knowledge:

1. J.Kalda, participation in the organization of the 2nd World Physics Olympiad as a Board member, 27. Dec. 2012 – 04. Jan. 2013; Organization of the online competition "Selection Round of the 3rd World Physics Olympiad - Physics Cup", 1. Feb. 2013 – 31. Jul.2013; Participation at the 44th International Physics Olympiad as a team leader and as a member of the Advisory Board; Academic Advisor of the Saudi Arabian team of the International Physics Olympiad.

2. J.Belikov, participation in module "Optimality, Stabilization, and Feedback in Nonlinear Control" (Prof. F.Clark). HYCON-EECI Graduate School on Control, L'Aquila, Italy, 20-24 May, 2013.

3. A.Kaldmäe and K.Halturina, participation in module "Normal Forms for Nonlinear Control Systems and Their Applications" (Prof. W.Respondek). HYCON-EECI Graduate School on Control, Paris, France, 18–22 February, 2013.

4. Ü.Kotta, lecture course for graduate students "An overview of polynomial tools in the study of nonlinear control systems" in IRCCyN, Nantes, France, 1–12 June, 2013.

5. M.Viška, participation in the winter school "Remote sensing of Baltic Sea ice", 4–9 March 2013, held in Tvärminne Zoological Station of the University of Helsinki, Finland and organised by Laboratory of Geophysics, Department of Physics, University of Helsinki. The course is part of the education programme of the Nordic Network for Baltic Sea Remote Sensing.

6. I.Nikolkina, participation in German Research Day in Tartu in the History Museum of the University of Tartu. The event was organised by the German Academic Exchange Service (DAAD) in collaboration with www.research-in-germany.de, 24 April 2013.

7. I.Nikolkina, participation in Conservation Holiday for International Researchers organized by EURAXESS Estonia together with the Estonian Fund for Nature (ELF) and Environmental Board, the holiday combined voluntary conservation work on the coastal meadows of Pärnu with sightseeing in Matsalu National Park (Estonia), 11–12 May 2013.

8. T.Torsvik, M.Eelsalu and V.Pavlov deployed 4 new drifters (with internal memory) at the east coast of Naissaar, 15 May 2013.

9. T.Soomere, A.Giudici, M.Eelsalu, K.Pindsoo and E.Averbukh made a field trip to Aegna in preparation for field experiment in June – July, to survey possible measurement sites.

10. T.Torsvik and V.Pavlov deployed 4 old drifters near the east coast of Naissaar, 19 May 2013.

11. The entire Wave Engineering Laboratory team organised field experiment at the south-western part of the Island of Aegna, Tallinn Bay, 26 June – 7 July 2013. The goals were as follows:

    - to identify and quantify water transport by ship wakes towards the coast and related effects;
    - to record velocity profiles in highly nonlinear ship wakes in order to properly quantify the potential of ship wakes to relocate sediment with different grain size;

- to quantify run-up of leading waves from fast ferries and to associate these with the properties of approaching waves;
- to further understand the structure of ship wakes by means of distinguishing the stationary parts of ship wakes from the nonstationary wave system;
- to quantify wave-driven transport of gravel of different size along and across the coast and associated changes to the coastal profile under the impact of ship wakes and wind waves.

12. M.Eelsalu and K.Pindsoo participated in the field-work in Saaremaa, Harilaid organized by Tallinn University Insitute of Ecology scientists, 29 July–01 August 2013.

13. T.Torsvik and I.Didenkulova deployed 3 new drifters at the east coast of Naissaar, and 3 new and 3 old drifters at the west coast of Naissaar, 14 September 2013.

14. K.Pindsoo, M.Eelsalu and H.Tõnisson visited the Island of Aegna to make sediment measurements, 10 October 2013.

15. M.Eelsalu and K.Pindsoo participated in a training course for scuba-diving and received the relevant licence, October–November 2013.

16. M.Eelsalu participated in the field-work of terrestrial laser scanning at Pirita beach, organized by Prof. Artu Ellmann (Department of Road Engineering, Tallinn University of Technology), 12 December 2013.

17. T.Soomere was the first opponent of the PhD thesis "Numerical study of the Baltic Sea dynamics: A contribution to designing environmentally safe fairways" by Ms. Xi Lu (University of Oldenburg, Germany), 12 February 2013.

18. I.Didenkulova, T.Torsvik and B.Viikmäe participated in a coastal wave field experiment at Norderney island, Germany 27–29 May 2013, organized by Christian Winter, MARUM, Bremen University. The Tallinn group organized deployment of a Nortek Vector velocimeter in the surf zone. The experiment also included video monitoring of waves, wave runup measurement by acoustic measurements and wave measurements by pressure sensor and echo sounder.

19. I.Didenkulova and A.Rodin conducted an experimental study "Long wave dynamics and statistics of the shoreline motion: influence of the asymmetry and nonlinearity of incoming waves" in the Large wave flume (Grosser Wellenkanal) in Forschungszentrum Küste (FZK), Hannover, Germany. The program was funded by Hydralab IV (Joint Research Activities, within the FP7 European Commission Funded Collaborative Research Project, 2010–2014), 15 July–09 August 2013.

20. I.Didenkulova participated in the experimental studies "Long wave generation and propagation" and "Large wave focusing" organized in the Large wave flume (Grosser Wellenkanal) by Forschungszentrum Küste (FZK), Hannover, Germany, 12–14 August 2013.

21. I.Didenkulova and T.Torsvik visited the Space and Solar-terrestrial Research Institute, Bulgarian Academy of Science (Sofia, Bulgaria), 02–08 September 2013, in the framework of the Estonian-Bulgarian project "Tsunamis in Inland Seas (Black and Baltic Seas)". During the visit they participated in the tsunami field survey along the Northern coasts of Bulgaria (cities Balchik and Varna). T.Torsvik gave a seminar presentation "Ship wakes as source of extreme wave impact at the coast" on 2 September.

22. T.Torsvik participated in deployment of 6 old drifters in the western part of the Gulf of Riga, near the village Kolka, 02 October 2013.

23. I.Didenkulova participated in the program "Mathematics for the Fluid Earth" at the Isaac Newton Institute for Mathematical Sciences (Cambridge, UK), 21 October–23 November 2013.

6.4. Visiting fellows

For shorter period

1. Prof. Kishan Dholakia (University of St Andrews, Scotland) - 3 days.
2. Dr. Cord Arnold (Atomic Physics, Lund University) - 3 days.
3. Dr. Rao Appadu: Department of Mathematics, University of Pretoria, South Africa, September 22-28, 2013.
4. Prof. Alexey N. Zhirabok, Far Eastern State Technical University, Russia, 24 June, 2013.
5. Dr. Ronald K. Pearson, The Travelers Companies, Inc. (Sr. Statistician), 30 August – 1 September, 2013.
6. Prof. Zbiginiew Bartosiewicz, Białystok University of Technology, Poland, 15–20 September, 2013.
7. Dr. Małgorzata Wyrwas, Białystok University of Technology, Poland, 15–20 September and 14–17 November, 2013.
8. Prof. Witold Respondek, INSA de Rouen, France, 22–26 September, 2013.
9. Prof. Xiaohua Xia, University of Pretoria, Republic of South Africa, 23–25 September, 2013.
10. Dr. Alban Quadrat, INRIA Saclay – Île-de-France, France, 29 September – 4 October and 9–13 December, 2013.
11. Dr. Thomas Cluzeau, University of Limoges, France, 29 September – 4 October and 9–13 December, 2013.
12. Dr. Yu Kawano, Osaka University, 15–21 December, 2013.
13. Dr. Sergey Varlamov (Research Institute for Global Change, JAMSTEC, Yokohama, Japan), to give a seminar on ocean downscaled modeling and to discuss options for joint studies, 26 May 2013.
14. Prof. Alex Sheremet, Mr. Uriah Gravois (Civil and Coastal Engineering, University of Florida) and Mrs. Zahra Khorsand (Department of Mathematics, University of Bergen) to participate in field experiments organised by the Wave Engineering Laboratory team, 27 June–09 July 2013.
15. Mr. Igor Medvedev (Tsunami laboratory, P.P.Shirshov Institute of Oceanology, RAS, Moscow, Russia), for joint research into low-frequency sea level variability in the Baltic Sea, 27 September–09 October 2013.
16. Prof. Dr. Leonid Lopatukhin (Department of Oceanology, Saint Petersburg State University and Mechanics and Optics, Saint Petersburg University of Information Technology, Russia), Dr. Piia Post (Institute of Physics, University of Tartu), Dr. Leandro Farina (Department of Mathematics, Instituto de Matemática, UFRGS, Porto Alegre, RS, Brasil and Basque Center for Applied Mathematics, BCAM Bilbao, Basque Country, Spain) and Dr. Loreta Kelpšaite (Klaipeda University, Lithuania) to participate in the Intense Day

on Waves and Climate Tolerance and in the defence of the PhD thesis of Inga Zaitseva-Pärnaste (08 November 2013). Prof. Lopatukhin and dr. Post were opponents of this thesis. 04–11 November 2013.

17. Mr. Artem Rybin (Department of Applied Mathematics, Nizhny Novgorod State Technical University), to work on the analysis of variations in vertical structure of the Baltic Sea water masses and associated variations in the generation and propagation conditions of internal waves, 27 November–17 December 2013.

For longer periods

1. Elena Averbukh, Fellowship of the President of Russian Federation, 1 September 2012 – 30 June 2013.
2. Kirill Sorudeykin, Kharkov National University of Radioelectronics, 1 September 2012 – 30 June 2013, Activity 5 of the ESF DoRa programme visiting PhD student under supervision of J.Vain.
3. Monika Ciulkin, PhD student of Bialystok University of Technology, 14 October – 15 December 2013, Activity 5 of the ESF DoRa programme visiting PhD student under supervision of Ü.Kask and V.Kaparin.
4. Emiliano Pastorelli (DoRa) – PhD student.
5. Andrea Giudici, MSc Technician, PhD student
6. Irina Nikolkina, PhD Researcher Post Doc.
7. Shahabedin Chatraee, Technician, April 2012 – March 2013.
8. Maija Viška, MSc Technician, PhD student.
9. Artem Rodin, MSc Technician, PhD student.
10. Arturs Macanovskis, Riga Technical University, Latvia, 01.05.2013–30.06.2013 (DoRa 5).
11. George Psistakis, Krete, Greece, 1.10.2013–31.3.2014 (ERASMUS internship).

6.5 Graduate studies

Department of Mechanics and Applied Mathematics:
Promoted:

1. MSc:

I.Georgievskaja (Jelissejeva)	Numerical simulation of wave propagation using finite element method (supervisor A.Berezovski).
M.Lints.	Formation and detection of hidden solitons in the hierarchical Korteweg-de Vries system (supervisor A.Salupere).

In progress:

1. PhD:
   - M.Lints. Application of solitary waves for nonlinear medical imaging and non destructive testing of materials (supervisors A.Salupere, S.Dos Santos (France)).
   - D.Kartofelev. Piano string vibration: the role of bridge impedance (supervisor A.Stulov).
   - M.Eik. Short fibre orientation phenomenon in concrete composites: measuring and theoretical modelling (supervisor H.Herrmann).
   - E.Pastorelli. 3D virtual reality visualization techniques for microstructured materials and virtual reality systems improvements (supervisors H.Herrmann, J.Engelbrecht).
   - I.Mandre. Percolation phenomena in complex systems (supervisor J.Kalda).
   - S.C.Azizabadi. Nonlinear dynamics of solids: energy transport in deformed crystal lattice and defects formation (supervisors V.Hižnjakov, J.Kalda, University of Tartu).
   - S.Ainsaar. Stochastic transport in two- and three-dimensional structures (supervisors J.Kalda, Teet Örd – University of Tartu).
   - M.Heidelberg. Transfer processes in fluctuating media (supervisors J.Kalda, T.Örd, University of Tartu).
   - J.Jõgi. Semiempirical modeling of structure and functional properties relationships of micro- and nanostructured materials (supervisors J.Kalda, A.Romanov, A.Lõhmus).

2. MSc:
   - M.Mustonen. Electric guitar sound modelling based on experimental data (supervisor A.Stulov, co-supervisor D.Kartofelev).

Laboratory of Systems Biology:
Promoted:

1. PhD:
   - M.Sepp. Estimation of diffusion restrictions in cardiomyocytes using kinetic measurements (supervisor M.Vendelin).

2. MSc:
   - S.Kotlyarova. Mitochondrial organization and compartmentation in cardiomyocytes from creatine-deficient AGAT mice (supervisors: R.Birkedal, N.Sokolova).

In progress:

1. PhD:
   - J.Branovets. Structural and energetic modifications in cardiomyocytes from mice with modified creatine kinase system (supervisor R.Birkedal).
   - N.Jepihhina. Heterogeneity of energetic parameters in cardiomyocytes (supervisor M.Vendelin).
   - M.Kalda. Mechanoenergetics of a single cardiomyocyte (supervisors M.Vendelin, P.Peterson).
   - M.Laasmaa. Studies of the relationship between excitation-contraction coupling and energetics on trout cardiomyocytes (supervisors P.Peterson, R.Birkedal).

P.Simson. Localization of diffusion restrictions in cardiomyocytes (supervisors P.Peterson, M.Vendelin).

N.Sokolova. Energetics and contractility in heart of rainbow trout (supervisor R.Birkedal).

M.Mandel. Bioenergetics of mitochondrial dynamics in neurons (supervisors A.Kaasik – University of Tartu, M.Vendelin).

2. MSc:

M.Poroson. Deconvolution of fluorescence microscopy images (supervisors M.Laasmaa and P.Peterson).

Laboratory of Wave Engineering:

Promoted:

1. Dr. Sci.:

I.Didenkulova. Long wave dynamics in the coastal zone with application to marine induced hazards.

2. Cand. Sci.:

A.Rodin. Influence of wave breaking effects on long wave transformation and runup on a beach.

3. PhD:

I.Zaitseva-Pärnaste. Wave climate changes of the Baltic Sea and their economical consequences (supervisor T.Soomere).

4. MSc:

K.Pindsoo. Wave set-up at the coasts of Tallinn Bay (supervisor T.Soomere).

M.Eelsalu. Wave energy potential in the Estonian coastal sea (supervisor T.Soomere).

M.Zujev. Wave climate at the eastern Baltic Sea coast (supervisor T.Soomere).

In progress:

1. PhD:

B.Viikmäe. Optimizing Fairways in the Baltic Sea Using Patterns of Surface Currents (supervisor T.Soomere), promotion expected 2014.

M.Viška. Evolution and forecast of open sedimentary coasts in the Baltic Sea conditions (supervisor T.Soomere), promotion expected 2014.

N.Delpeche-Ellmann. Using improved understanding of the circulation pattern in the Gulf of Finland to minimize coastal pollution (supervisor T.Soomere), promotion expected 2014.

A.Rodin. Evolution, runup and breaking of strongly nonlinear sea waves in the nearshore (supervisors I.Didenkulova and T.Soomere).

A.Giudici. Quantification and visualisation of current-induced risk of coastal pollution (supervisor T.Soomere).

M.Eelsalu. Quantification of the reaction of Estonian beaches to changing wave loads (supervisors T.Soomere and A.Ellmann).

K.Pindsoo. Quantification of wave-driven hazards at the Estonian beaches (supervisor T.Soomere).

Control Systems Department:
Promoted:

1. PhD:

V.Kaparin.	Transformation of nonlinear state equations into observer form (co-supervisor Ü.Kotta).

In progress:

1. PhD:

A.Kaldmäe.	Advanced design of nonlinear discrete-time and delayed systems (supervisors Ü.Kotta and C.H.Moog).
S.Avanessov.	Robust adaptive output controller (co-supervisor Ü.Nurges).
A.Anier.	Distributed model based testing and control framework (supervisor J.Vain).
K.Sarna.	Methods and architectures of distributed testing: Aspect-oriented model construction for distributed testing (supervisor J.Vain).
M.Markvardt.	The method of model-based generation of test data for reactive planning testers (supervisor J.Vain).
K.Haavik.	Model-based distributed testing method for web-based banking applications (supervisor J.Vain).
J.Irve.	Simulational analysis of emergent behaviour of multi-agent systems (supervisor J.Vain).
E.Halling.	Distributed intelligent control of cooperative robotic systems (supervisor J.Vain).
G.Kanter.	Cognitive context-aware planning in autonomous robot systems (supervisor J.Vain).
P.Lump.	Quality assurance of safety critical software systems using quantitative methods (supervisor J.Vain).
A.Tepljakov.	Fractional-order calculus based identification and control of complex dynamic systems (co-supervisor J.Belikov).

2. MSc:

K.Halturina.	Computer algebra tools for feedback linearization and computation of flat outputs (co-supervisors M.Tõnso, A.Quadrat).
Je.Borushko.	Modelling of human gesture for medical application (supervisor S.Nõmm).
M.Borkenstain.	Technische Universität Ilmenau. Development of a gesture based user interface in medical environment on requirements by medical doctors by using the Microsoft Kinect sensor (supervisor S.Nõmm).
D.Rampal.	(Erasmus exchange student from NIT Rourkela, India). Compositional Technique For Model-Based Ioco Test Generation (supervisor J.Vain).
F.Siavashi.	(Åbo Akademi University, Finland). Modelling critical systems with time constraints in event-b (external supervisor J.Vain).

Optics group:
Promoted:

1. PhD:
   P.Piksarv. Spatiotemporal characterization of diffractive and non-diffractive light pulses (supervisor P.Saari).

2. MSc:
   A.Valdmann. Ultrabroadband Airy pulses and their direct measurement.

3. BSc:
   R.Matt. Ghost imaging with pseudothermal light.
   S.-M.Valdma. Modelling optical wave propagatin in material structures with gradient refrective index.
   D.Zolotukhin. Transformation of focused Gaussian beams by the effect of conical refraction in a biaxial crystal.

In progress:
PhD – A.Valdmann.

6.6 Distinctions and awards
Fellows:

1. A.Salupere: The Order of the White Star, IV class.
2. J.Kalda: The Order of the White Star, V class.
3. J.Engelbrecht: was elected to the Board of Trustees of The World Academy of Art and Science (WAAS).
4. T.Soomere: Medal of the Baltic Academies of Sciences for outstanding results in research cooperation between Estonia, Latvia and Lithuania in marine sciences.
5. T.Soomere: was awarded a 2013 National Science Award in engineering sciences for his work "Quantification and mitigation of marine coastal hazards in the Baltic Sea basin".
6. T.Soomere: received the award Ökul – The friend of science journalism 2013 by Estonian Science Writers Association.
7. J.Kalda: Annual award of the Estonian Physical Society – Academic Committe of the 43rd International Physics Olympiad (the head of the theoretical examination).
8. J.Kalda: the President of the Republics Special Physical Sciences Award.

Students:

1. P.Piksarv: National student research competition organized by Estonian Research Council, 1st prize (for doctoral thesis).
2. A.Valdmann: National student research competition organized by Estonian Research Council, 2st prize (for master thesis).
3. R.Matt: National student research competition organized by Estonian Research Council, honourary mention (for bachelor thesis).
4. E.Pastorelli, H.Herrmann: Best paper award at VARE conference, Tenerife.

5. E.Pastorelli: IT Akadeemia ICT Scholarship.

6. D.Kartofelev: Best student paper award, FUDOM 2013 conference, Rackeve, Hungary.

7. M.Lints: award in student research competition of the Estonian Academys of Sciences for the master thesis "Formation and detection of hidden solitons in the hierarchical Korteweg-de Vries system" (supervisor A.Salupere).

6.7 Other activities

6.7.1 Participation on programme committees, reviewing papers:

1. A.Berezovski: reviewer for Journal of Mechanical Science and Technology, Proceedings of the Royal Society A, Continuum Mechanics and Thermodynamics; ZAMM – Zeitschrift für Angewandte Mathematik und Mechanik, Composites Part B.

2. A.Stulov: reviewer for INTAS, Georgian NSF, Austrian Science Fund (FWF) and ERA.NET RUS – evaluator of grant applications.

3. A.Salupere: reviewer for journal Physica D.

4. P.Saari: committee member for International Program Committee of the symposium Laser Physics 2013.

5. P.Saari, P.Piksarv, H.Lukner: reviewers for Optics Letters, Optics Communications, Optics Express, Journal of Optics, PIERS Proceedings.

6. H.Herrmann: reviewer for Nondestructive Testing and Evaluation; International Conference "Innovative Materials, Structures and Technologies".

7. Ü.Kotta: IPC-IFAC Symposium on Nonlinear Control Systems 2013 (NOLCOS'2013), Toulouse, France (committee member);
   The 2013 Progress on Difference Equations (PODE'2013), Białystok, Poland (member of scientific committee);
   IFAC World Congress 2014 (associate editor).

8. T.Soomere: member for Steering committee of the Baltic Sea Science Congress; Scientific council of the Laboratory of Multiphase Flows at TUT; Commission on science of the TUT Council.

6.7.2. Participation in journal editorial boards:

1. Proceedings of Estonian Academy of Sciences – Ü.Kotta.

2. Acta Mechanica et Automatica – Ü.Kotta.

3. Journal of Laser Physics – P.Saari.

4. Applied and Computational Mechanics – A.Berezovski, J.Engelbrecht.

5. Estonian Journal of Engineering – J.Engelbrecht (chief editor); T.Soomere (co-editor), H.Aben (co-editor).

6. Estonian Journal of Earth Sciences – T.Soomere (co-editor).

7. Journal of Marine Systems – T.Soomere.

8. Oceanologia – T.Soomere.
9. Boreal Environment Research – T.Soomere.
10. Fundamental and Applied Hydrodynamics – T.Soomere.
11. Natural Hazards and Earth System Sciences – I.Didenkulova.
12. The Scientific World Journal – I.Didenkulova.
13. Trames – J.Engelbrecht.
14. Applied Mechanics – J.Engelbrecht.
15. Journal of Theoretical and Applied Mechanics – J.Engelbrecht.
16. Applied and Computational Mechanics – J.Engelbrecht, A.Berezovski.

6.7.3. Participation in professional organizations:

1. IFAC technical committee for nonlinear control systems (member): Ü.Kotta.
2. IFAC contact person in Estonia: S.Nõmm.
3. IEEE TC-CACSD Action Group on Polynomial Methods for Control System Design (chair): Ü.Kotta,
4. Optical Society of America (OSA): P.Saari, senior member.
5. Estonian Physical Society: P.Saari, member.
6. Nordic Association for Computational Mechanics: A.Berezovski, member of executive committee.
7. EUROMECH – European Mechanics Society: A.Berezovski, J.Engelbrecht, A.Ravasoo, A.Salupere, K.Tamm.
8. ISIMM – The International Society for the Interaction of Mechanics and Mathematics: A.Berezovski, J.Engelbrecht.
9. International Research Centre for Mathematics and Mechanics of Complex Materials – A.Berezovski, member.
10. European Geosciences Union, scientific officer of Sea hazard devision: I.Didenkulova.
11. International Tsunami Comission, member, Estonian representative: I.Didenkulova.
12. Marine Board of the European Science: Estonian representative and vice-chair: T.Soomere.
13. Marine Board of the Estonian Academy of Sciences: chair: T.Soomere.
14. EASAC Environmental Steering Panel: Estonian representative: T.Soomere.
15. EC evaluation of Integrated Project proposals for the ICT Call 7: E.Quak.
16. EC evaluation of the call for Marie Curie Industry Academia Fellowships and Pathways: E.Quak.
17. Expert Council of the Rogue Wave Research Center: I.Didenkulova.

6.7.4 Estonian public bodies:

1. J.Engelbrecht, T.Soomere, P.Saari. The Board of the Estonian Academy of Sciences.
2. P.Saari. R.Kitt. The Academic Council of the State President.

6.7.5 Science and Politics:

1. P.Saari, member of the Advisory Board of the Program ”Internationalization of Research” at the Estonian Ministery of Education and Research.
2. T.Soomere participated in the ExCom meeting of the European Marine Board in Brussels, 30.01.2013.
3. T.Soomere participated in the ExCom meeting and the spring Plenary Meeting of the European Marine Board (Bergen, Norway), 23–25.04.2013.
4. T.Soomere participated as the expert in marine science and marine meteorology in the official consultation between Finland and Estonia on the potential transboundary impacts of the planned LNG terminal in Inkoo, Finland (Tallinn, Embassy of Finland), 11.09.2013.
5. T.Soomere participated in the ExCom meeting and the autumn Plenary Meeting of the European Marine Board (Lisbon, Portugal), 22–24.10.2013.
6. T.Soomere participated in the autumn meeting of the European Academies Scientific Advisory Council Environment Steering Panel (Brussels, Belgium), 25.10.2013,
7. T.Soomere participated in the foresight workshop of the JPI (Joint Programming Initiative) Oceans ”What role for research concerning microplastics in the oceans” (JPI Oceans headquarters, Brussels, Belgium), 20.11.2013.
8. I.Didenkulova participated in the Validation Seminar to discuss the findings of the study: Marie Curie researchers and their long-term career development: a comparative study commissioned by the Directorate-General for Education and Culture (Covent Garden, Brussels, Belgium), 22.11.2013.

6.7.6. Media reflections
About us

1. Ü.Kotta, interview: ”Mente et manu”, April 2013.
2. H.Lukner, interview: ”Laser and light”, ERR Raadio 2, ”Puust ja punaseks” (in Estonian).
3. P.Saari, interview: ”Role of Academy of Sciences”, Tartu Postimees, november, 2013 (in Estonian).
4. P.Piksarvest ”Valgusimpulsside uurija valgustab teadust”, Tartu Postimees, 03.10.2013 (in Estonian).
5. Person story ”Peeter Piksarv ja laineoptika”, miks.ee, 20.11.2013 (in Estonian).

Media outreach

1. 17 October 2013, J.Engelbrecht: Kuku Radio. Talk on the Estonian Academy of Sciences 75.

2. 14 January 2013, I.Didenkulova was interviewed by the "KL.lt" (the Klaipeda newspaper) about the possibility of tsunami and other natural hazards in the Baltic Sea.

3. 15 January 2013, an interview of I.Didenkulova to the commercial Lithuanian TV channel TV6 for the program "Universitetai.lt" (the program reflecting scientific news) about rogue wave phenomenon.

4. 31 March 2013, an interview of I.Didenkulova to the Nizhny Novgorod city on-line newspaper WWW.NN.RU about rogue wave phenomenon.

5. 17 April 2013, T.Soomere introduced and commented the film "Planet Ocean" by Y.Arthus-Bertrand and M.Pitiot during the Film programme "Estonian Green Movement 25!" in Kumu Kunstimuuseum (Tallinn, Estonia).

6. 05 May 2013, an overview by T.Soomere about the basic properties of wind wave climatology in the Baltic Sea and about the role of Baltic Sea wave fields as an indicator of climate change; broadcast by the state radio channel Vikerraadio as a part of series Labor.

7. 30 May 2013, Ceri Perkins, Physicists rethink celebrated Kelvin wake pattern for ships, Physics World (the member magazine of the IOP/Institute of Physics), reflects among others comments the opinion of T. Soomere on the paper Ship Wakes: Kelvin or Mach Angle? by Marc Rabaud and Frdric Moisy (Phys. Rev. Lett. 2013, 110, 214503).

8. 16 June 2013, a longer interview (40 min) with T.Soomere about the series of publications that received the national science prize 2013 in engineering sciences; broadcast in series Kukkuv Õun of the radio channel Kuku Raadio.

9. 08 August 2013, Daily newspaper "Eesti Päevaleht" published a short comment by T.Soomere Eesti on võrdlemisi immuunne (Climate warming affects Estonia only a little) to the paper Dethroning King Coal by Peter Singer (Eesti Päevaleht 153, 08.08.2013, p. 11).

10. 11 September 2013, a comment of T.Soomere on the quality of meteorological data presented by Finnish company Gasum during the official consultation between Finland and Estonia (11.09) on the potential transboundary impacts of the planned LNG terminal in Inkoo, Finland, was included into the news Postimees Online (12.09.2013 [Gasum: Comments from Estonian on the inconsistency of a LNG terminal are based on incorrect data]).

11. 27 September 2013, a comment of T.Soomere on possible impacts of climate changes on Estonia was broadcast in the major news program Aktuaalne Kaamera of the state TV channel. The main points were reflected in on-line news of the major daily newspaper "Postimees" 27.09.2013.

12. 28 October 2013, a comment of T.Soomere on properties of the approaching storm St. Jude/Simone was broadcast in the major news program Aktuaalne Kaamera of the state TV channel. The main points were reflected in on-line news of the major daily newspaper "Postimees" 28.09.2013.

13. 28 October 2013, a comment of T.Soomere on the approaching storm St. Jude/Simone was broadcast in the major news program Reporter of the TV channel TV2.

14. 29 October 2013, a live-on-air comment of T.Soomere by phone to the state radio channel "Vikerraadio" on the occasion of the storm St. Jude/Simone within the news program Uudis+.

15. 14 November 2013, a longer comment of T.Soomere about marine induced hazards in autumn stormy season was broadcast in the major news program Reporter of the TV channel TV2.

16. 04 December 2013, an interview by phone of I.Didenkulova about rogue waves, and where this research area is headed, by New Scientist magazine.

17. 11 December 2013, a comment of T.Soomere on chemical weapons dumped into the Baltic Sea in the past; broadcast in the major news program Reporter of the TV channel TV2.

18. 19 December 2013, Der Spiegel (Germany) reflected the studies of I.Didenkulova and I.Nikolkina on freak waves: Axel Bojanowski, Unglück in Portugal: Wenn Monsterwellen auf Strände krachen, http://www.spiegel.de/wissenschaft/natur/monsterwellen-im-meer-freak-waves-an-kuesten-und-straenden-a-851324.html (SpiegelOnline, 19.12.2013).

19. 28 December 2013, a longer comment of T.Soomere to the Marine Hour (Kuku Raadio) about highlights in marine science and science policy in 2013 from the viewpoint of the Commission on Marine Sciences of the Estonian Academy of Sciences.

7. Summary

In general, the year 2013 was successful in the scientific sense. Excellent results in all the areas of CENS (see Sections 3 and 5) demonstrate the trends and vitality of research. Although the number of PhD promotions was only 4, many PhD students are close to their finishing stage. Some our post-docs returned from their positions abroad, some of them continue, our visitors and PhD students from abroad demonstrate clearly the visibility of CENS. There are many agreements on joint research with other centres abroad.

Besides research (see Section 3), attention is paid to links with the society and education. Jaan Kalda together with his PhD students is actively involved in preparing the Estonian team of high-school students for the International Physics Olympiads. He got a special prize from the President of Estonia as the best science educator in 2013. J.Kalda gave also a course in physics in Saudi Arabia. Heli Lukner is one of the judges for the Estonian Television young scientists contents. This content got a special European prize as an educational programme. Tarmo Soomere got a special prize from Estonian Science journalists for his numerous talks and explanations for large public. Peeter Saari and Robert Kitt are the members of the Academic Council of the State President. Jüri Engelbrecht organized the conference ”Excellence in Research” where top scientists from other contries together with their Estonian collegues shared their experience in fostering high-level research.

The articles by R.Kitt and J.Engelbrecht on complexity have been used as a teaching material for Estonian High School students. The discussion booklet published 2013 has a special Chapter ”Order on the Edge of Chaos” with questions about complexity and possible interpretations (see Annex N 6).

However, we faced difficulties in further funding. A new system of research funding was introduced in Estonia where the reviewers were not explained what is a project and what is sustainability of research. As a result, couple of our applications were turned down by the Estonian Research Agency with the main reasoning — CENS should divide its research between various faculties because usually it is done so! In our applications, the synergy and interdisciplinarity were definitely stressed and explained. Nevertheless, without any site visits the punishment followed. We were not alone in this situation which demonstrates clearly the short-sighted understanding and the biased decisions of the Agency. However, we were able to restructure our budget from the Programme of the Centres of Excellence so that the salaries for the staff were not changed for 2014. One of the highlights for 2014 in CENS will be the IUTAM Symposium on Complexity of Nonlinear Waves (September, 8–12, 2014).

Annex

1. The staff of research teams
2. Abstracts
3. Glas Stress AP client list
4. Glas Stress SCALP client list
5. Cover sheet of Physics of Fluids, March 2013.
6. Cover sheet of Practical Estonian for High Schools – exercises for discussion. Topic 2: Order on edge of chaos.

Annex 1: The staff of research teams in CENS in 2013:

Nonlinear dynamics

Head of team: Jüri Engelbrecht, DSc.
Leading scientist: Hillar Aben, DSC. *Senior researchers:* Leo Ainola, DSc; Johan Anton, PhD; Arkadi Berezovski, PhD; Heiko Herrmann, PhD; Jaan Kalda, PhD; Arvi Ravasoo, PhD; Andrus Salupere, PhD; Anatoli Stulov, PhD. *Researchers:* Mihhail Berezovski, PhD; Olari Ilison, PhD; Robert Kitt, PhD; Kert Tamm PhD; Tanel Peets, PhD; Marika Eik, MSc. *PhD students:* Dmitry Kartofelev, Martin Lints, Mihkel Kree, Emeliano Pastorelli, Indrek Mandre, Jakob Jõgi, Siim Ainsaar. *Other:* Kristi Juske, Mati Kutser PhD, Tatjana Kosmatšova, Pilvi Veeber.

Wave engineering

Head of team: Tarmo Soomere, DSC.
Senior researchers: Irina Didenkulova, PhD; Ewald Quak, PhD; Tomas Torsvik, PhD. *Researchers:* Irina Nikolkina, PhD; Andrus Räämet, PhD; *PhD students:* Nicole Delpeche-Ellmann, Bert Viikmäe, Andrea Giudici, Artem Rodin, Inga Zaitseva-Pärnaste, Maija Viška, Katri Pindsoo, Mihhail Zujev, Maris Eelsalu. *Other:* Vitali Pavlov, Marika Org.

Systems biology

Head of team: Marko Vendelin, PhD.
Senior researchers: Rikke Birkedal Nielsen, PhD; Janus Karo, PhD; Pearu Peterson, PhD; Hena Ramay, PhD. *Researchers:* Ardo Illaste, PhD; David Schryer, PhD. *PhD students:* Jelena Branovets, Natalja Jepihhina, Mari Kalda, Martin Laasmaa, Päivo Simson, Mervi Sepp, Niina Sokolova. *Other:* Merle Mandel, Sirel Rootsmaa, Svetlana Kotlyarova.

Optics

Head of team: Peeter Saari, DSC.
Senior researchers: Rein Kink, PhD; Viktor Peet, PhD. *Researchers:* Heli Lukner, PhD. *PhD students:* Peeter Piksarv. *Other:* Agu Anijalg.

Nonlinear control theory

Head of team: Ülle Kotta, DSc.
Senior researchers: Ülo Nurges, PhD; Sven Nõmm, PhD; Jüri Vain, PhD; Seshadri Srinivasan, PhD, Maris Tõnso, PhD. Researchers: Tanel Mullari, PhD, Jüri Belikov, PhD. *PhD students:* Vadim Kaparin, Arvo Kaldmäe + *PhD students in TUT* (Aivo Anier, Sergei Avanesov, Kristjan Haavik, Jaagup Hirve, Maili Markvart, Külli Sarna). *Other:* Kristina Halturina. As a rule PhD students have part-time positions.

Annex 2: Abstracts

1. A.Berezovski, M.Berezovski. Dispersive wave propagation in solids with microstructure. SIAM Conference on Computational Science & Engineering (CSE13), The Westin Boston Waterfront, Boston, Massachusetts, USA, February 25 – March 1, 2013, Book of Abstracts, p.141.

2. A.Berezovski, J.Engelbrecht, P.Van, Weakly nonlocal thermoelasticity with dual internal variables. FUDoM 2013, Rackeve, Hungary, 11–15 August 2013, Programme and Abstracts, p.42.

3. A.Berezovski, J.Engelbrecht, M.Berezovski, Numerical simulation of elastic wave diffraction.13th European Mechanics of Materials Conference, Warsaw, Poland, September 8th – 11th, 2013, Book of Abstracts, p.201.

4. A.Ravasoo. Bursts in exponentially graded material characterized by parametric plots. Book of Abstracts, 20th Intern.Congress on Sound and Vibration. Bangkok, Thailand, 7–11 July 2013, p.153.

5. A.Braunbrück, J.Majak, Characterisation of exponentially graded materials by ultrasound. Book of Abstracts, The 17th Intern. Conf.on Composite Structures (ICCS17), 17–21 June, 2013, Porto, Portugal, p. 55.

6. K.Tamm, T.Peets. On the influence of internal degrees of freedom on dispersion in microstructured solids. Mechanics Research Communications, 2013, 47, 106–111.

7. I.Didenkulova, I.Nikolkina. Rogue waves in the sea. -In: Proc. 33rd EARSeL Symposium, Matera, Italy, June 3–6, 2013, 66.

8. N.Delpeche-Ellmann, T.Soomere. Using Lagrangian Models to Assist in Maritime Management of Coastal and Marine Protected Areas. -In: Proc. of the International Coastal Symposium, Plymouth, United Kingdom, April 8–12, 2013, 65.

9. P.Denissenko, I.Didenkulova, M.Listak, E.Pelinovsky. Experimental measurements of statistics of long wave runup on a plane beach. -In: Proc. Intern. Coastal Symp., Plymouth, United Kingdom, April 8–12, 2013, 368.

10. I.Didenkulova, P.Denissenko, M.Listak, A.Rodin, E.Pelinovsky. Effects of wave asymmetry on its runup on a beach. -In: Proc. Intern. Coastal Symp., Plymouth, United Kingdom, April 8–12, 2013, 370.

11. I.Didenkulova, A.Sheremet. Characteristic properties of different vessel-wake signals. -In: Proc. Intern. Coastal Symp., Plymouth, United Kingdom, April 8–12, 2013, 67.

12. A.Giudici, T.Soomere. Identification of coastal areas of frequent patch formation from velocity fields. -In: Proc. Intern.Coastal Symp., Plymouth, United Kingdom, April 8–12, 2013, 105.

13. B.Viikmäe, T.Torsvik. In search for hidden transport patterns governing the coastal pollution. -In: Proc. Intern Coastal Symp, Plymouth, United Kingdom, April 8–12, 2013, 105.

14. D.C.Kim, K.O.Kim, E.Pelinovsky, I.Didenkulova, S.Chatraee, B.H.Choi. Tsunami-dimensional tsunami runup simulation at the Koborinai port, Sanriku coast, Japan. -In: Proc. Intern. Coastal Symp., Plymouth, United Kingdom, April 8–12, 2013, 132.

15. I.Nikolkina, I.Didenkulova. Wave climate in Peipsi Lake. -In: Proc. Intern. Coastal Symp., Plymouth, United Kingdom, April 8–12, 2013, 483.

16. T.Soomere. Extending the observed Baltic Sea wave climate back to the 1940s. -In: Proc. Intern. Coastal Symp., Plymouth, United Kingdom, April 8–12, 2013, 538.

17. T.Torsvik, T.Soomere, J.Kalda, B.Viikmäe. Improving the forecast of coastal pollution using surface drifter trajectories. -In: BSSC 9th Baltic Sea Science Congress 2013: New Horizons for Baltic Sea Science, 26–30 August, 2013, Klaipeda, Lithuania, Abstract Book: Klaipeda: Coastal Research and Planning Institute of Klaipeda University (KU CORPI), 2013, 118.

18. I.Didenkulova, I.Nikolkina, E.Pelinovsky. Discussion on possibility of rogue wave formation in a basin of intermediate depth due to the modulational instability. -In: Proc. Joint Assembly IAHS IAPSO IASPEI, Gothenburg, Sweden, July 22–26, 2013.

19. I.Didenkulova, I.Nikolkina, E.Pelinovsky. Observations of rogue waves in a basin of intermediate depth and discussion on a possibility of their formation due to the modulational instability. Geophysical Research Abstracts, 15, EGU2013–1761, 2013.

20. I.Nikolkina, T.Soomere, I.Didenkulova. Wave characteristics in Lake Peipsi. 2013. Geophysical Research Abstracts, 15, EGU2012–3626.

21. I.Nikolkina, I.Didenkulova, E.Pelinovsky. Landslides along the rivers of Nizhny Novgorod region. 2013. Geophysical Research Abstracts, 15, EGU2012–3630.

22. I.Didenkulova, E.Pelinovsky, A.Rybkin. Generalization of the Carrier-Greenspan approach for nonlinear wave runup in bays of arbitrary cross-section. 2013. Geophysical Research Abstracts, 15, EGU2013–275.

23. I.Didenkulova, A.Sheremet, T.Torsvik, T.Soomere. Identification of characteristic properties in different vessel wake signals. 2013. Geophysical Research Abstracts, 15, EGU2013–276.

24. I.Didenkulova, E.Pelinovsky. Irregular wave transformation along a quartic bottom profile. 2013. Geophysical Research Abstracts, 15, EGU2013–1765.

25. I.Didenkulova, P.Denissenko, A.Rodin, E.Pelinovsky. Statistics of long wave runup on a plane beach, based on the data from the Large Wave Flume (GWK). Hannover, Germany, 2013. Geophysical Research Abstracts, 15, EGU2013–3641.

26. E.Pelinovsky, I.Didenkulova, D.Pelinovsky, D.Tyugin, A.Giniyatullin. Travelling long waves in water channels of specific configurations. 2013. Geophysical Research Abstracts, 15, EGU2013–1763.

27. I.Didenkulova, A.Zaitsev, E.Pelinovsky, B.Ranguelov. Tsunami forecast for Bulgarian coasts of the Black Sea. 2013. Geophysical Research Abstracts, 15, EGU2013–5478.

28. T.Soomere. Changing wave climate in the Baltic Sea basin. -In: Baltic Sea Science Congress 2013: New horizons for Baltic Sea science, 26–30 August, Klaipeda, Lithuania. Coastal Research and Planning Institute of Klaipeda University (KU CORPI), 12.

29. I.Didenkulova, A.Rodin. Peculiarities of the ship wake structure. -In: Baltic Sea Science Congress 2013: New horizons for Baltic Sea science, 26–30 August, Klaipeda, Lithuania. Coastal Research and Planning Institute of Klaipeda University (KU CORPI), 32.

30. I.Didenkulova, A.Rodin. Properties of shallow water rogue waves in the Baltic Sea. -In: Baltic Sea Science Congress 2013: New horizons for Baltic Sea science, 26–30 August, Klaipeda, Lithuania. Coastal Research and Planning Institute of Klaipeda University (KU CORPI), 33.

31. M.Eelsalu, T.Soomere. Wave energy potential in the north-eastern Baltic Sea. -In: Baltic Sea Science Congress 2013: New horizons for Baltic Sea science, 26–30 August, Klaipeda, Lithuania. Coastal Research and Planning Institute of Klaipeda University (KU CORPI), 34.

32. A.Giudici, T.Soomere. In search for the areas of natural patch generation in the Gulf of Finland. -In: Baltic Sea Science Congress 2013: New horizons for Baltic Sea science, 26–30 August, Klaipeda, Lithuania. Coastal Research and Planning Institute of Klaipeda University (KU CORPI), 40.

33. I.Nikolkina, T.Soomere, R.Weisse, B.Geyer. Simulated statistics of extreme wave events in the Baltic Sea. -In: Baltic Sea Science Congress 2013: New horizons for Baltic Sea science, 26–30 August, Klaipeda, Lithuania. Coastal Research and Planning Institute of Klaipeda University (KU CORPI), 95.

34. T.Torsvik, T.Soomere, J.Kalda, B.Viikmäe. Improving the forecast of coastal pollution using surface drifter trajectories. -In: Baltic Sea Science Congress 2013: New horizons for Baltic Sea science, 26–30 August, Klaipeda, Lithuania. Coastal Research and Planning Institute of Klaipeda University (KU CORPI), 118.

35. E.Averbukh, O.Kurkina, A.Kurkin. Numerical simulation of trapped waves in coastal areas. -In: Baltic Sea Science Congress 2013: New horizons for Baltic Sea science, 26–30 August, Klaipeda, Lithuania. Coastal Research and Planning Institute of Klaipeda University (KU CORPI), 136.

36. I.Didenkulova, K.Pindsoo, S.Suuroja. Power laws for the cross-shore profiles along Estonian coasts. -In: Baltic Sea Science Congress 2013: New horizons for Baltic Sea science, 26–30 August, Klaipeda, Lithuania. Coastal Research and Planning Institute of Klaipeda University (KU CORPI), 157.

37. I.Didenkulova, A.Rodin. "Parabolic cap" model for gravity flows and shallow water waves. -In: Baltic Sea Science Congress 2013: New horizons for Baltic Sea science, 26–30 August, Klaipeda, Lithuania. Coastal Research and Planning Institute of Klaipeda University (KU CORPI), 158.

38. M.Eelsalu, T.Soomere, M.Viška. Closure depth along the north-eastern coast of the Baltic Sea. -In: Baltic Sea Science Congress 2013: New horizons for Baltic Sea science, 26–30 August, Klaipeda, Lithuania. Coastal Research and Planning Institute of Klaipeda University (KU CORPI), 165.

39. I.Nikolkina, T.Soomere, I.Didenkulova. Monitoring of extreme wave conditions in Lake Peipsi. -In: Baltic Sea Science Congress 2013: New horizons for Baltic Sea science, 26–30 August, Klaipeda, Lithuania. Coastal Research and Planning Institute of Klaipeda University (KU CORPI), 215.

40. K.Pindsoo, T.Soomere. Wave set-up in the urban area of the City of Tallinn, Estonia. -In: Baltic Sea Science Congress 2013: New horizons for Baltic Sea science, 26–30 August, Klaipeda, Lithuania. Coastal Research and Planning Institute of Klaipeda University (KU CORPI), 224.

41. T.Torsvik, I.Didenkulova. Analysis of ship-generated waves - a case study for port protection. -In: Baltic Sea Science Congress 2013: New horizons for Baltic Sea science, 26–30 August, Klaipeda, Lithuania. Coastal Research and Planning Institute of Klaipeda University (KU CORPI), 261.

42. B.Viikmäe, T.Torsvik. Analysis and comparison of automatic eddy detection methods. -In: Baltic Sea Science Congress 2013: New horizons for Baltic Sea science, 26–30 August, Klaipeda, Lithuania. Coastal Research and Planning Institute of Klaipeda University (KU CORPI), 265.

43. M.Viška, T.Soomere. Spatio-temporal variations in the wave-driven sediment transport along the eastern Baltic Sea coast. -In: Baltic Sea Science Congress 2013: New horizons for Baltic Sea science, 26–30 August, Klaipeda, Lithuania. Coastal Research and Planning Institute of Klaipeda University (KU CORPI), 267.

44. M.Zujev. Statistical properties of wave climate in the eastern Baltic Sea. -In: Baltic Sea Science Congress 2013: New horizons for Baltic Sea science, 26–30 August, Klaipeda, Lithuania. Coastal Research and Planning Institute of Klaipeda University (KU CORPI), 279.

45. T.Soomere, M.Viška. Retrieving the signal of climate change from numerically simulated sediment transport along the eastern Baltic Sea coast. -In: Under the sea: Archaelogy and palaeolandscapes. Final conference of COST Action TD0902 Submerged Prehistoric Archaeology and Landscapes of the Continental Shelf, 23–27 September 2013, Szczecin, Poland. Incorporating the final workshop of the CoPaF Project: Coastline Changes of the Southern Baltic Sea – Past and Future Projection. Szczecin, 93.

46. H.Herrmann, V.Berg. Fracture simulation of short fibre reinforced material using the discrete element method. -In: ICCS17: 17th Intern. Conf. Composite Structures, Book of Abstracts, 17–21 June, University of Porto, Porto, Portugal. Ed. A.J.M.Ferreira, 2013, 127.

47. H.Herrmann, M.Eik, J.Puttonen. Phenomenological and numerical constitutive modelling of short fibre reinforced materials. -In: ICCS17: 17th International Conference on Composite Structures, Book of Abstracts, 17–21 June, University of Porto, Porto, Portugal. Ed. A.J.M.Ferreira, 2013, 182.

48. H.Herrmann, M.Eik, V.Berg, J.Puttonen. Phenomenological and numerical constitutive modelling of short fibre reinforced materials and control of fibre orientation distributions. Euromech Colloquium n. 541 – New Advances in the Nonlinear Dynamics and Control of Composites for Smart Engineering Design – Senigallia (Ancona), Italy, 3–6 June 2013, 2013, 1.

49. M.Eik, J.Puttonen, H.Herrmann. Fibre orientation phenomenon in concrete composites: measuring and theoretical modelling. -In: Aalto Research Day 2013 Proc. 26 of September 2013, Otaniemi, Finland. Eds K.Kauppi et al. Helsinki: Aalto University, 2013, 38 (Aalto University publication series. CROSSOVER; 9/2013).

50. J.Branovets, M.Sepp, S.Kotlyarova, N.Jepihhina, N.Sokolova, D.Aksentijevic, C.A.Lygate, S.Neubauer, M.Vendelin, R.Birkedal. Unchanged mitochondrial organization and compartmentation in creatine deficient GAMT-/- mouse heart. Biophysical Journal, 2013, 104, 2, Supplement 1, 314a-315a.

51. M.Kalda, M.Vendelin, P.Peterson. Real-time determination of sarcomere length of a single cardiomyocyte during contraction. Biophysical J., 2013, 104, 2, Supplement 1, 509a.

52. J.Belikov, Ü.Kotta, M.Tõnso. NLControl: Symbolic package for study of nonlinear control systems. -In: IEEE Multi-conference on Systems and Control : August 28–30, 2013, Hyderabad, India. Piscataway, NJ: IEEE, 2013, 31–32.

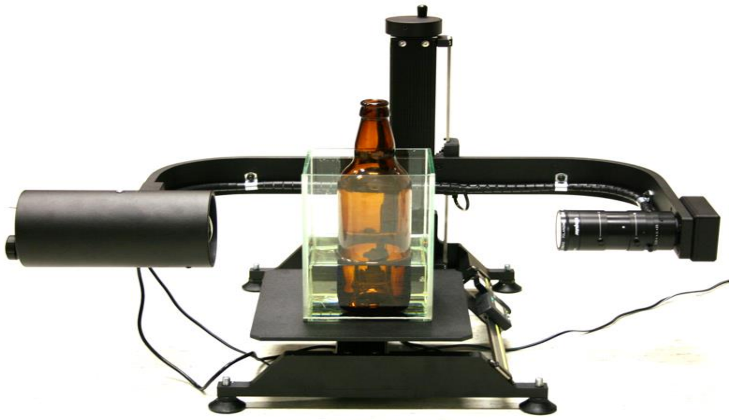
53. Ü.Kotta, J.Belikov, M.Tõnso. Polynomial tools for discrete-time nonlinear control systems. -In: PODE2013. Progress on difference equations 2013, 21–26 July 2013, Bialystok, Abstracts, 2013, 50–51.

54. Ü.Kotta, C.H.Moog, M.Tõnso. The minimal time-varying realization of a nonlinear time-invariant system. -In: NOLCOS 2013: 9th IFAC Symposium on Nonlinear Control Systems, University of Toulouse, France, September 4–6, 2013, Final Program and Book of Abstracts. Toulouse, LAAS-CNRS, 2013, 35.

55. A.Kaldmäe, Ü.Kotta. On flatness of discrete-time nonlinear systems. -In: NOLCOS 2013: 9th IFAC Symp. on Nonlinear Control Systems, Univ. of Toulouse, France, September 4–6, 2013, Final Program and Book of Abstracts. Toulouse, LAAS-CNRS, 2013, 38.

GlasStress AP client list

#	Year	AP model	Company	Country
1	1999	AP-01	Philips CFT	Holland
2	2001	AP-02	Sisecam	Turkey
3	2001	AP-03	Schott	Germany
4	2002	AP-03	Philips	Holland
5	2002	AP-04	Emhart Glass	USA
6	2003	AP-04	Cebrace	Brazil
7	2003	AP-05	Pilkington PLC	UK
8	2004	AP-05	Coca-Cola	USA
9	2004	AP-06	ARC International	France
10	2004	AP-06	Indian Institute of Technology	India
11	2005	AP-06	Emhart Glass	USA
12	2005	AP-06	Saint-Gobain Research	France
13	2005	AP-06	Schott	Germany
14	2006	AP-06	Zwiesel Kristallglas	Germany
15	2006	AP-06	Schott	Germany
16	2007	AP-06	Pilkington	UK
17	2007	AP-07	ARC International	France
18	2008	AP-07	Ilis	Germany
19	2009	AP-07	Ilis	Germany
20	2010	AP-07	Schott Solar CSP	Germany
21	2010	AP-07	RSM Electron Power	USA
22	2010	AP-07	Cebrace	Brazil
23	2011	AP-07	BormioliRocco	Italy
24	2011	AP-07	Glass Technology Services	UK
25	2012	AP-07	AGC - Asahi Glass Company	Belgium
26	2012	AP-07	Vetropack	Austria
27	2012	AP-07	Indian Institute of Technology	India
28	2012	AP-07	AGC Glass Europe	Belgium
29	2012	AP-07	Vetropack Austria GmbH	Austria
30	2012	AP-07	University of Louisville	USA
31	2013	AP-07	Sisecam	Turkey
32	2013	AP-07	BD (Becton-Dickinson) Medical	France
33	2013	AP-07	Corning	USA



Polariscope AP-07

GlasStress SCALP client list

16.12.2013

#	Company	Country	#	Company	Country
1	Saint-Gobain Research	France	41	Technical University of Denmark	Denmark
2	Seele GmbH	Germany	42	EuropTec	Germany
3	Africa Glass Export	USA	43	University of Luxembourg	Luxembourg
4	Scheuten Solar	Holland	44	Glafo - Swedish Glass Research	Sweden
5	Schott VTF	France	45	VIM AGC	Switzerland
6	John Colvin Glass Consultant	UK	46	FIBAG	Austria
7	Technical University of Denmark	Denmark	47	Texas TU	USA
8	Thiele AG	Germany	48	TU Darmstadt	Germany
9	Hochschule Luzern	Switzerland	49	University of Gent	Belgium
10	TU Delft	Holland	50	Ducatt	Belgium
11	Pilkington	UK	51	GMC for Glass	France
12	FH Frankfurt	Germany	52	Lisec Maschinenbau	Austria
13	Gulf Glass Industries	UAE	53	Vetrosolar	Germany
14	RWTH Aachen	Germany	54	TU Freiberg	Germany
15	AGC Teplice	Czech Repl.	55	Ghent University	Belgium
16	Thiele AG	Germany	56	Orihara Industrial	Japan
17	Arcon-Dur Sicherheitsglas	Germany	57	Ducatt	Belgium
18	Orihara	Japan	58	G.M.C. For Glass Industry	France
19	PGW Glass	USA	59	Vetro Solar	Germany
20	Vetrotech SG	Switzerland	60	Mike Crossley Consult	UK
21	Saint-Gobain Sekurit	Germany	61	Saint-Gobain Sekurit Deutschlanc	Germany
22	Wirtschaft und Infrastruktur	Germany	62	Waagner-Biro	Austria
23	SG Research	France	63	HafenCity University	Germany
24	Fraunhofer IWM	Germany	64	Corning	USA
25	Pilkington Deutschland	Germany	65	Sisecam	Turkey
26	TU Dresden	Germany	66	Guardian Automotive	Luxembourg
27	Pilkington Lathom	UK	67	University of Cambridge	UK
28	Univ. Valenciennes	France	68	Institute of Technical Glass	Russia
29	RWTH Aachen	Germany	69	Nippon Sheet Glass	Japan
30	Circursa	Spain	70	Samsung (via Atromax)	S-Korea
31	Bellapart	Spain	71	G-James	Australia
32	Orihara	Japan	72	HKLab	S-Korea
33	MPSA Areva Mainco	France	73	Velux	Denmark
34	Stein-Heurtey	France	74	Kinestral	USA
35	TU Delft	Holland	75	Indian Institute of Techology	Inida
36	Glass Technology Services	UK	76	Mirit	Denmark
37	Seele	Germany	77	Stazione Sperimentale del Vetro	Italy
38	Orihara	Japan	78	Scheldebouw	Holland
39	Total Measuring Instruments	Korea	79	University of München	Germany
40	Building Design Asia Pacific	Malaysia	80	Andersen Corporation	USA

Polariscope SCALP-04

September 2013 Volume 25 Number 9

AIP | Physics of Fluids

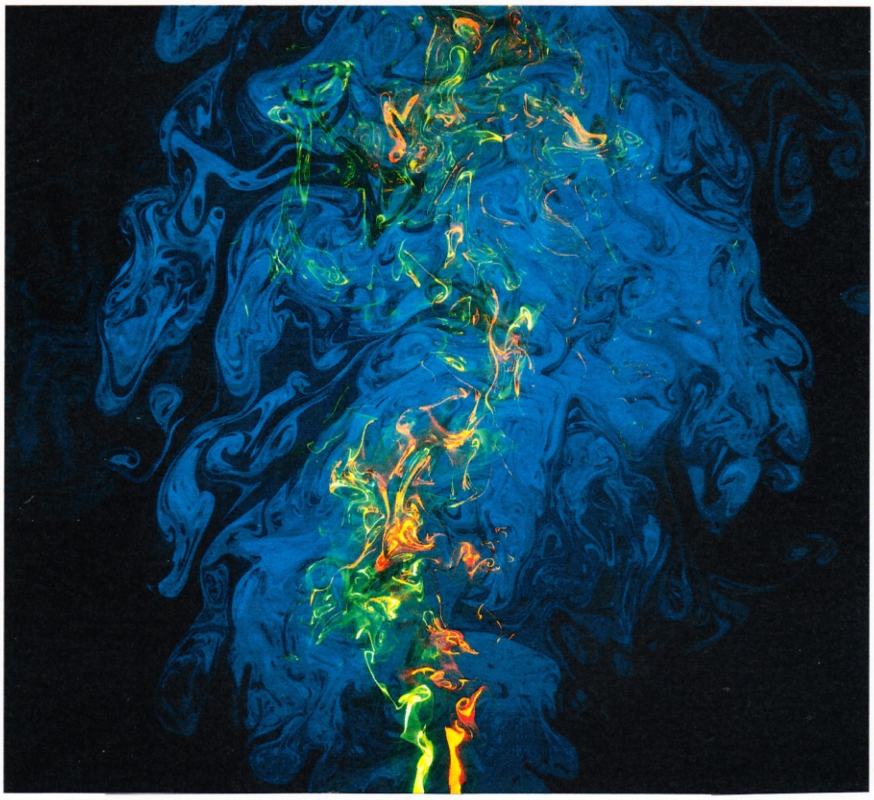


Fig. 1. from the paper by *M.Kree et al*. **The mixing of distant sources.** The image shows a two-dimensional cut through the instantaneous concentration fields c_1 and c_2 .

pof.aip.org

Practical Estonian for High Schools
(Exercises for discussion)
2013
Topic 2: Order on edge of chaos
(based on texts by R.Kitt and J.Engelbrecht)

MARTIN EHALA
MARE KITSNIK

PRAKTILINE EESTI KEEL

12. KLASS
1. VIHIK

	1. teema Projektikonkurss	2. teema Kord kaose piiril	3. teema Moodne perekond
Lugemine	T.E.I.P. Õpiring hakkab elama Projektipõhiselt rahastatud vabatahtlikkus	Komplekssed sotsiaalsüsteemid Keel kui iseorganiseeruv süsteem Kaose piiril	Kooselu kontseptsioon Deklaratsioon perekonna toetuseks Samasoopered ja adoptiivlapsed
Kõnelemine	Paarisettekanne Ajurünnak	Konspekti lühikokkuvõte	Ümarlauaarutelu
Kirjutamine	Projektikirjeldus Arutlus alustekstide põhjal	Konspekteerimine Alusteksti kokkuvõte Refereerimine	Ametlik kiri Memo Reportaaž
Keele-struktuurid	Projektitaotluse keelekasutus	Parafraseerimise keelevahendid	Segaliitlause
Sõnavara	Projektitaotluse sõnavara ja väljendid	Referatiivse ülevaate väljendid	Seadusteksti sõnavara Ümarlauaarutelu väljendid
Õigekiri	Käändsõna kokku- ja lahkukirjutus	Teoste pealkirjad ja väljaannete nimed	Segaliitlause kirjavahemärgistus

CENS

Institute of Cybernetics at TUT
Akadeemia tee 21
Tallinn 12618, Estonia
Phone: (+372) 620 4150
Fax: (+372) 620 4151
Prof. J. Engelbrecht, je@ioc.ee
Prof. H. Aben, aben@ioc.ee
Prof. T. Soomere, soomere@cs.ioc.ee
Dr. M. Vendelin, markov@sysbio.ioc.ee
Dr. Ü. Kotta, kotta@ioc.ee
Prof. P. Saari, peeter.saari@ut.ee

Internet: http://cens.ioc.ee

CENTRE FOR NONLINEAR STUDIES
Institute of Cybernetics at Tallinn University of Technology
Akadeemia 21
12618 Tallinn
ESTONIA

Phone: +372 620 4160
Fax: +372 620 4151
E-mail: je@ioc.ee
Web-site: http://cens.ioc.ee