



## VU Institute of Mathematics and Informatics Annual Report 2015



Akademijos str. 4, LT-08663 Vilnius  
Tel. (+370 5) 210 9300, fax (+370 5) 272 9209  
E-mail: [info@mii.vu.lt](mailto:info@mii.vu.lt)  
<http://www.mii.lt>

**Director** – Prof. Dr. Habil. *Gintautas Dzemyda*

### **STAFF**

73 research fellows (including 13 doctors habilitatus and 55 doctors),  
56 doctoral students.

1. [\*\*RESEARCH AREAS\*\*](#)
2. [\*\*DOCTORAL DISSERTATIONS MAINTAINED IN 2015\*\*](#)
3. [\*\*MAIN CONFERENCES ORGANIZED IN 2015\*\*](#)
4. [\*\*DEPARTMENTS OF THE INSTITUTE\*\*](#)
  - 4.1 [Department of Informatics Methodology](#)
  - 4.2 [Department of Numerical Analysis](#)
  - 4.3 [Department of Probability Theory and Statistics](#)
  - 4.4 [Department of Recognition Processes](#)
  - 4.5 [Department of Software Engineering](#)
  - 4.6 [Department of Stochastic Processes](#)
  - 4.7 [Department of Systems Analysis](#)

### **1. RESEARCH AREAS**

Integrated Development of Mathematics, Informatics and Information Technologies for the Knowledge Society Advanced Products and Services

## 2. DOCTORAL DISSERTATIONS MAINTAINED IN 2015

Raimondas MALUKAS – in *Mathematics (01 P)*, Scientific Supervisor: *Prof. habil. dr. Rimas Norvaiša*, [“Limit Theorems for H-Variation of Gaussian Processes”](#) [EN] ([abstract](#) [LT]);

Jolanta MILIAUSKAITĖ – in *Informatics Engineering (07 T)*, Scientific Supervisor: *Prof. Dr. Albertas Čaplinskas*, [“A Fuzzy Inference-Based Approach to Planning Quality of Enterprise Business Services”](#) [EN] ([abstract](#) [LT]);

Nerijus GALIAUSKAS – in *Informatics Engineering (07 T)*, Scientific Supervisor: *Prof. Dr. Julius Žilinskas*, [“Optimization Algorithms for Multidimensional Scaling with City-Block Distances and Their Parallelization”](#)[EN] ([abstract](#)[LT]);

Aurimas RAPEČKA – in *Informatics (09 P)*, Scientific Supervisor: *Prof. Dr. Habil. Gintautas Dzemyda*, [“Increase of Efficiency of Recommender Systems in Social Networks”](#)[LT] ([abstract](#)[EN]);

Sandra SVANIDZAITĖ – in *Informatics (09 P)*, Scientific Supervisor: *Prof. Dr. Albertas Čaplinskas*, [“Spiral Process Model for Capture and Analysis of Non-Functional Requirements of Service-Oriented Enterprise Systems”](#)[EN] ([abstract](#)[LT]);

Gediminas GRICIUS – in *Informatics (09 P)*, Scientific Supervisor: *Prof. Dr. Dalė Dzemydienė*, [“Development of Multi-agent Based Methods for Integration of Small-scale Embedded Systems”](#)[LT] ([abstract](#)[EN]);

Olegas NIAKŠU – in *Informatics Engineering (07 T)*, Scientific Supervisor: *Assoc. Prof. Dr. Olga Kurasova*, [“Development and Application of Data Mining Methods in Medical Diagnostics and Healthcare Management”](#)[EN] ([abstract](#)[LT]);

Joana KATINA – in *Informatics Engineering (07 T)*, Scientific Supervisor: *Prof. Dr. Habil. Jonas Mockus*, [“Investigation of Prediction Problems by the Virtual Stock Exchange”](#)[LT] ([abstract](#)[EN]);

Pavel STEFANOVIČ – in *Informatics (09 P)*, Scientific Supervisor: *Assoc. Prof. Dr. Olga Kurasova*, [“Visualization of Self-Organizing Maps and Estimation of Their Quality”](#)[LT] ([abstract](#)[EN]);

Irina VINOGRADOVA – in *Informatics (09 P)*, Scientific Supervisor: *Prof. Dr. Habil. Jonas Mockus*, [“Distance Course Selection Optimisation”](#)[LT] ([abstract](#)[EN]).

## 3. MAIN CONFERENCES ORGANIZED IN 2015

6<sup>th</sup> International Doctoral Consortium *Informatics Engineering Education Research*, December 8–12, 2015, Druskininkai, Lithuania  
<http://ims.mii.lt/ims/renginiai/Consortium/consortium.htm>

7<sup>th</sup> International Seminar *Data Analysis Methods for Software Systems*, December 3–5, 2015, Druskininkai, Lithuania  
[http://www.mii.lt/datamss/index.php?page=datamss\\_2015&lang=en](http://www.mii.lt/datamss/index.php?page=datamss_2015&lang=en)

IFIP TC3 Working Conference *A New Culture of Learning: Computing and Next Generations*, July 1-3, 2015, Vilnius, Lithuania <http://www.ifip2015.mii.vu.lt/>

ITiCSE 2015, the 20th Annual ACM SIGCSE Conference on *Innovation and Technology in Computer Science Education*, July 6-8, 2015, Vilnius, Lithuania  
<http://www.iticse2015.mii.vu.lt/>

## 4. DEPARTMENTS OF THE INSTITUTE

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### 4.1 DEPARTMENT OF INFORMATICS METHODOLOGY

Akademijos str. 4 , LT-08663 Vilnius

Tel. (+370 5) 210 9732

E-mail: [valentina.dagiene@mii.vu.lt](mailto:valentina.dagiene@mii.vu.lt)

**Head** - Prof. Dr. *Valentina Dagiene*

#### **STAFF**

**Chief research fellow:** Prof. Dr. V. Dagiene.

**Senior research fellow:** Dr. J. Kurilov.

**Affiliated senior research fellows:** Assoc. Prof. Dr. G. Grigas, Dr. L. Markauskaitė.

**Research fellows:** Dr. T. Jevsikova, Dr. S. Kubilinskienė, Dr. I. Žilinskienė.

Junior research fellows: Dr. E. Jasutė, Dr. A. Juškevičienė.

**Specialists:** V. Dagys, Dr. B. Skūpas, Dr. J. Skūpienė, G. Stupurienė, L. Vinikienė.

**Doctoral students:** G. Beresnevičius, A. Berniukevičius, V. Dvareckienė, V. Dolgopolovas, D. Gudonienė, A. Savickaitė, G. Stupurienė, L. Vinikienė.

#### **RESEARCH INTERESTS.**

Application of Intelligent Technologies in Education

Computer Science Education

Computing Engineering Education Research

Personalised Learning

Software Localisation

Technology Enhanced Learning

#### **RESEARCH PROJECTS CARRIED OUT IN 2015**

##### **Projects Supported by University Budget**

**Research on Intelligent Technologies Application for Teaching, Learning and Cultural Environment.** Prof. Dr. V. Dagiene, 2015-2019.

##### **Main results:**

Creation of engineering solutions for improving teaching and learning by implementing intelligent technologies; creation of personalised learning methods and activities as well as ontologies to teach and learn informatics engineering. Creation of personalised engineering solutions for mobile learning; creating of e-learning recommendations based on semantic web. Creation of methodologies to evaluate the quality of distance learning courses and learning object repositories

Creation of computational thinking operational model; research on its application in general education and in Informatics competition "Bebras"

##### **Main publications:**

Kurilov, J., Juškevičienė, A. 2015. Creation of Web 2.0 tools ontology to improve learning. *Computers in human behavior*, vol. 51, Part B, 1380-1386.

Kurilov, J., Žilinskienė, I., Dagiene, V. 2015. Recommending suitable learning paths according to learners' preferences: experimental research results. *Computers in human behavior*, vol. 51, Part B, 945-951.

Dagienė, V., Gudonienė, D., Burbaitė, R. 2015. Semantic web technologies for e-learning: models and implementation. *Informatica*, vol. 26, no. 22, 221-240.

### **International Research Projects**

F7-SCIENCE-IN-SOCIETY-2012-1 **Mathematics and Science for Life** – MaScil. Consortium Agreement for the Project *Mascil* 2013-06-12 Nr. 320.693, Coordinator: Pädagogische Hochschule Freiburg (Germany), Partners: Austria, Greece, Netherlands, Spain, Lithuania, Cyprus, United Kingdom, Czech Republic, Norway, Germany, Bulgaria, Romania, Turkey.

### **MAIN R&D&I (RESEARCH, DEVELOPMENT AND INOVATION) PARTNERS**

Aalto University (Finland)  
University of Eastern Finland of Joensuu and Kuopio (Finland)  
Freie Universitaet Berlin (Germany)  
Radboud University Nijmegen (The Netherlands)  
Lithuanian Computer Society (Lithuania)

### **OTHER SCIENTIFIC ACTIVITIES**

#### **Prof. V. Dagienė –**

- Editor-in-Chief of the journal *Informatics in Education*, ISSN: 1648-5831 [http://www.mii.lt/informatics\\_in\\_education/](http://www.mii.lt/informatics_in_education/) (Thomson Reuters Web of Science Core Collection)
- Editor of the journal *Olympiads in Informatics* (Scopus)
- Chair of International Conference ITiCSE 2015 (the 20th Annual Conference on Innovation and Technology in Computer Science Education) <http://www.iticse2015.mii.vu.lt/en/menu1/committee>
- Chair of IFIP working joint conference „A New Culture of Learning: Computing and Next Generations“ <http://www.ifip2015.mii.vu.lt/committee-3>
- Coordinator of the Nordplus Network on Innovative Computing Education
- Representative of Lithuania in Education Committee TC3 under the International Federation for Information Processing (IFIP)
- Member of Steering Committee of International Olympiads in Informatics

#### **Assoc. Prof. Dr. J. Kurilov –**

- Executive Editor of the journal *Informatics in Education*, ISSN: 1648-5831 [http://www.mii.lt/informatics\\_in\\_education/](http://www.mii.lt/informatics_in_education/) (Thomson Reuters Web of Science Core Collection)
- Guest Editor of the journal *International Journal of Engineering Education* (Tempus Publications, Ireland), Special Issue on Computer Engineering Education, ISSN 0949-149X <http://www.ijee.ie/> (Thomson Reuters Web of Science)
- Co-editor Europe of the journal *International Journal of Knowledge Society Research* (IGI Global, USA), ISSN: 1947-8429 <http://www.igi-global.com/journal/international-journal-knowledge-society-research/1180>
- Associate Editor of the *Journal of Engineering and Computer Innovations* (Academic Journals), ISSN: 2141-6508 <http://www.academicjournals.org/JECI/index.htm>
- Editorial board member of the journal *International Journal On Advances in Software* (IARIA journal, USA), ISSN: 1942-2628 <http://www.iariajournals.org/software/index.html>

- Editorial board member of the *Journal of Studies in Education* (Macrothink Institute, USA), ISSN: 2162-6952 <http://www.macrothink.org/journal/index.php/jse/index>

**Dr. T. Jevsikova –**

- International Federation for Information Processing (IFIP) TC3 WG 3.1 (Informatics for Secondary Education) member.
- Program Chair of international conference ITiCSE 2015 (the 20th Annual Conference on Innovation and Technology in Computer Science Education) (<http://www.iticse2015.mii.vu.lt/en/menu1/committee/>).
- Organising committee member of IFIP working joint conference „A New Culture of Learning: Computing and Next Generations“ (<http://www.ifip2015.mii.vu.lt/committee-3>).

## 4.2 DEPARTMENT OF NUMERICAL ANALYSIS

Akademijos str. 4, LT-08663 Vilnius  
 Tel. (+370 5) 210 9734  
 E-mail: kristina.skucaite-bingele@mii.vu.lt

**Head** – Assoc. Prof. Dr. *Artūras Štikonas*

**Chief research fellows:** Prof. Habil. Dr. M. Sapagovas, Assoc. Prof. Dr. A. Štikonas.

**Senior research fellow:** Prof. Dr. S. Rutkauskas.

**Research fellows:** Dr. S. Roman, Assoc. Prof. Dr. R. Čiupaila.

**Junior research fellow:** J. Novickij, A. Skučaitė.

**Specialists and engineering staff:** G. Paukštaitė, K. Skučaitė-Bingelė.

**Doctoral students:** A. Skučaitė; K. Skučaitė-Bingelė.

### **RESEARCH INTERESTS.**

Differential equations and applications

Investigation of the spectrum and boundary value problems for differential and difference operators with nonlocal conditions

### **RESEARCH PROJECTS CARRIED OUT IN 2015**

#### **Projects Supported by University Budget**

**The investigation of spectrum and boundary problems of differential and difference operators with non-local conditions.** Assoc. Prof. Dr. A. Štikonas. 2011-2015.

#### **Main results:**

Investigate features of the spectrum of elliptic operator with variable coefficients and integral conditions and to clarify the conditions for the convergence of iterative methods.

Examine stability areas of schemes for hyperbolic equations.

Investigate well posedness of system of Dirichlet elliptic equations with with additional asymptotic condition, obtain sufficient conditions for the existence of solution in the class of Holder functions.

Examine bifurcations of spectrum for problems with incomplete integral condition.

### Main publications:

Paukštaitė, G., Štikonas, A. 2015. Ordinary and generalized Green's functions for the second order discrete nonlocal problems. *Boundary Value Problems*, vol. 2015:207, 1–19.

Skučaitė, A., Štikonas, A. 2015. Spectrum curves for Sturm–Liouville Problem with Integral Boundary Condition. *Math. Model. Anal.*, vol. 20, no. 6, 802–818.

### National Research Projects

**Research Council of Lithuania. Investigation of stationary problems with nonlocal conditions, numerical analysis and applications** (No. MIP-047/2014). A. Štikonas. 2014–2016.

### MAIN R&D&I (RESEARCH, DEVELOPMENT AND INNOVATION) PARTNERS

Belarus State University, Minsk (Belarus)

### OTHER SCIENTIFIC ACTIVITIES

#### Prof. Dr. A. Štikonas -

- Deputy-Editor-in-Chief of the journal “*Nonlinear Analysis: Modelling and Control*”.
- Editorial board member of the journal “*Mathematical Modelling and Analysis*”.
- Editorial board member of the “*Lithuanian Mathematical Journal*”;

#### M. Sapagovas –

- Editorial board member of journal “*Lithuanian mathematical journal*”;
- Editorial board member of journal “*Nonlinear Analysis: Modelling and Control*”.

#### S. Rutkauskas –

- Editorial board member of journal “*Lithuanian mathematical journal*”.
- Associate Editor of journal “*Lietuvos matematikos rinkinys. Proc. of the Lithuanian Mathematical Society, Ser. A*” and Ser. B.
- Editorial board member of journal “*Mathematical Modelling and Analysis*”.

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## 4.3 DEPARTMENT OF PROBABILITY THEORY AND STATISTICS

Akademijos str. 4, LT-08663 Vilnius

Tel. (+370 5) 210 9731

E-mail: kestutis.kubilius@mii.vu.lt

**Head** – Prof. Dr. Habil. *Kęstutis Kubilius*

### STAFF

**Chief research fellows:** Prof. Habil. Dr. K. Kubilius, Prof. Habil. Dr. E. Manstavičius, Prof. Habil. Dr. J. K. Sunklodas.

**Affiliated chief research fellow:** Prof. Dr. J. J. Mačys.

**Senior research fellows:** Prof. Dr. O. Januškevičienė, Prof. Dr. S. Norvidas, Prof. Dr. M. Radavičius, Prof. Habil. Dr. R. Rudzkis.

**Research fellow:** A. Bakšajėvas, A. Čiginas, D. Dzindzalieta, V. Kurauskas, V. Skorniakov.

**Technicians:** V. Butkus, R. Šimėnas

**Doctoral students:** V. Butkus, L. Dreižienė, Š. Germanas, M. Lapėnaitė - Gedvilė, T. Rudys, R. Užupytė.

### **RESEARCH INTERESTS**

Applied probability theory, statistical hypothesis testing, econometrics  
Probability theory, random matrix theory, combinatorics, discrete mathematics  
Exponential dispersion models  
Finite population statistics and statistical analysis of data  
Extremal Problems in Harmonic Analysis  
Statistics of random process  
Random graphs

### **RESEARCH PROJECTS CARRIED OUT IN 2015**

#### **Projects Supported by University Budget**

**Asymptotic Analysis of Linear and Nonlinear Statistics.** Prof. Dr. Habil. K. Kubilius 2013–2015.

An upper bound on the tail probabilities for the normalized Rademacher sums with the smallest possible constant is obtained. A general differential equation is found, formed from the characteristic function, which allows us to obtain the optimal estimates of the rate of convergence of distributions to the normal distribution for one random variable and for some random sums of independent identically distributed random variables. Necessary and sufficient conditions for a distribution (generalized function) of several variables with the compact support to be positively definite are proposed. A new method was introduced in problems where estimates are needed for finite population domains with small or even zero sample sizes. Given training sample, the problem of classifying the scalar Gaussian random field observation into one of several classes specified by different regression mean models and common parametric covariance function is considered. The estimator that is similar in form to maximum likelihood estimator for Langevin equation with standard Brownian motion and unknown parameter  $\theta$  is constructed for Langevin equation driven by fractional Brownian motion with Hurst index  $H \in (0, 1/2)$ . It is proved that for positive  $\theta$  the estimator is strongly consistent and for negative  $\theta$  it is consistent. Algorithm of the estimation of stable law characteristic parameter  $\alpha$  was constructed. This algorithm is applied in the description of the fluctuation induced flux in the edge region of the plasma cord. Asymptotic probabilities of decomposable combinatorial structures with a fortiori prescribed properties are studied as the sizes unboundedly increase.

#### **Main publications:**

Bentkus, V.K., Dzindzalieta, D. 2015. A tight Gaussian bound for weighted sums of Rademacher random variables. *Bernoulli*, vol. 21, no. 2, 1231-1237.

Kubilius, K., Mishura, Y., Ralchenko, K., Seleznev, O. 2015. Consistency of the drift parameter estimator for the discretized fractional Ornstein Uhlenbeck process with Hurst index  $H \in (0, 1/2)$ . *Electronic Journal of Statistics*, vol. 9, no. 21, 799-1825.

Norvidas, S. 2015. On positive definite distributions with compact support. *Banach journal of mathematical analysis*, vol. 9, no. 3, 14-23.

## National Research Projects

**Research Council of Lithuania.** European Union Structural Funds project **Postdoctoral Fellowship Implementation in Lithuania** within the framework of the Measure for Enhancing Mobility of Scholars and Other Researchers and the Promotion of Student Research (VP1-3.1-ŠMM-01) of the Program of Human Resources Development Action Plan. Post doctoral research fellow A. Čiginas. Prof. Dr. M. Radavičius. 2013-2015.

Gini's mean difference statistic was considered as an universal alternative to the empirical variance in the settings of finite populations where simple random samples are drawn without replacement. Specific estimation strategies for a scale of the population were constructed, and asymptotic properties of both the statistics were explored and compared.

A new method was introduced in problems where estimates are needed for finite population domains with small or even zero sample sizes. The method was applied for several common cases of auxiliary information.

### Main publications:

Čiginas, A., Pumputis, D. 2015. Gini's mean difference and variance as measures of finite populations scales. *Lithuanian mathematical journal*, vol. 55, no. 3, 312-330.

**Research Council of Lithuania. Existence of solutions of stochastic differential equations and estimation of parameters** (No. MIP-048/2014). Prof. Habil. Dr. K. Kubilius. 2014-2016.

The exact confidence intervals for the estimator of the Orey index of Gaussian processes were obtained. We also proved the asymptotic normality of the Orey index. We examined the existence and uniqueness of an SDE with a polynomial drift driven by a fractional Brownian motion (fBm) and proposed strongly consistent and asymptotically normal estimators of the Hurst index and volatility. The existence and uniqueness of the solution of this equation didn't follow from the already known results. For general SDE driven by an fBm, a new strongly consistent and asymptotically normal estimator for the Hurst index was constructed under some restrictions for the diffusion coefficient. For the Hurst index and the volatility of a stochastic Gompertz diffusion process driven by an fBm, we gave a comparison of four different estimators using a computer simulation. We proposed a strongly consistent point estimator of the drift parameter of an SDE driven by an fBm. The estimator was based on discrete observations within an interval of a fixed length.

### Main publications:

Kubilius, K., Skorniakov, V. 2015. On some estimators of the Hurst index of the solution of SDE driven by a fractional Brownian motion. *Statistics and Probability Letters*, vol. 109, 159–167.

Kubilius, K., Melichov, D. 2015. Exact confidence intervals of the extended Orey index for Gaussian processes. *Methodology and Computing in Applied Probability*. First online: 21 August 2015

Kubilius, K., Skorniakov, V., Melichov, D. 2015. Estimation of parameters of SDE driven by fractional Brownian motion with polynomial drift. *Journal of statistical computation and simulation*. First published online: 09 Oct 2015.

## MAIN R&D&I (RESEARCH, DEVELOPMENT AND INOVATION) PARTNERS

Bielefeld University Collaborative Research Centre (Germany).  
Taras Shevchenko National University of Kyiv (Ukraine).



## ***OTHER SCIENTIFIC ACTIVITIES***

### **Prof. K. Kubilius –**

- Co-editor-in-chief of the *Modern Stochastics: Theory and Applications* <https://www.i-journals.org/vtxpp/VMSTA/> ;
- editorial board member of the *Lithuanian Mathematical Journal*, <http://www.springer.com/mathematics/journal/10986?detailsPage=editorialBoard>;
- editorial board member of the *Mathematical Modelling and Analysis*, <http://inga.vgtu.lt/~art/> ;
- board member of the Lithuanian Mathematical Society, [http://www.mif.vu.lt/lmd/index\\_en.html](http://www.mif.vu.lt/lmd/index_en.html).

### **Prof. E. Manstavičius –**

- section editor of the *Lithuanian Mathematical Journal*, <http://www.springer.com/mathematics/journal/10986?detailsPage=editorialBoard>;
- editorial board member of the *International Journal of Number Theory*, <http://www.worldscientific.com/page/ijnt/editorial-board>;
- editorial board member of the *ISRN Combinatorics*, <http://www.isrn.com/journals/combinatorics/editors/>;
- member of the Lithuanian Academy of Sciences, [http://lma.lt/index.php?option=com\\_k2&view=item&layout=item&id=366&Itemid=230&lang=en](http://lma.lt/index.php?option=com_k2&view=item&layout=item&id=366&Itemid=230&lang=en) .

### **Prof. S. Norvidas –**

- editorial board member of the *Lithuanian Mathematical Journal*, <http://www.springer.com/mathematics/journal/10986?detailsPage=editorialBoard> .

### **Doc. M. Radavičius –**

- editorial board member of the *Lithuanian Mathematical Journal*, <http://www.springer.com/mathematics/journal/10986?detailsPage=editorialBoard> ;
- editorial board member of the *Modern Stochastics: Theory and Applications*, <https://www.i-journals.org/vtxpp/VMSTA/> .

### **Prof. R. Rudzkis –**

- editorial board member of the *Lithuanian Mathematical Journal*, <http://www.springer.com/mathematics/journal/10986?detailsPage=editorialBoard> ;
  - editorial board member of the journal *Прикладная эконометрика*, <http://www.applieconometrics.ru/r/board/>;
  - editorial board member of the journal *Lietuvos statistikos darbai (Statistics Journal)*, <http://www.statisticsjournal.lt>;
  - editorial board member of the journal *Pinigų studijos (Monetary Studies)*, [http://www.lb.lt/pinigu\\_studijos\\_redkolegija](http://www.lb.lt/pinigu_studijos_redkolegija) .
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#### 4.4 DEPARTMENT OF RECOGNITION PROCESSES

Akademijos 4, LT-08663 Vilnius

Tel. (+370 5) 210 9304

E-mail: [julius.zilinskas@mii.vu.lt](mailto:julius.zilinskas@mii.vu.lt)

**Head** – Prof. Dr. (HP) *Julius Žilinskas*

##### **STAFF**

**Chief research fellows:** Prof. Dr. (HP) J. Žilinskas, Prof. Habil. Dr. K. Kazlauskas, Prof. Habil. Dr. A. Žilinskas.

**Senior research fellows:** Assoc. Prof. Dr. R. Pupeikis, Dr. R. Paulavičius.

**Affiliated chief research fellow:** Prof. Habil. Dr. A.L. Telksnys.

**Research fellows:** Dr. A. Lančinskas, Dr. G. Korvel, Dr. G. Tamulevičius.

**Junior research fellow:** G. Gimbutienė

**Specialists, engineering and expert staff:** G. Navickas, J. Kaukėnas, J. Katina.

**Doctoral students:** A. Dzidolikaitė, D. Eringis, T. Liogienė, G. Vaicekauskas, G. Graževičius, R. Smaliukas, T. Tišina, E. Zikarienė, R. Kriauzienė.

##### **RESEARCH INTERESTS**

Random processes analysis and recognition.

Optimization and high-performance computing.

##### **RESEARCH PROJECTS CARRIED OUT IN 2015**

###### **Projects Supported by University Budget**

**Analysis, recognition, optimization, and control of non-linear systems and signals with complex structure.** Prof. Dr. (HP) J. Žilinskas. 2014-2016.

Optimization algorithms for speech models, engineering structures, location and other problems. Analysis of the information protection methods and cryptanalysis strength enhancement. Identification and management methods algorithms of self-regulation of nonlinear systems, consisting of a linear block and a static nonlinearity combinations, analysis by the way of computer simulation.

###### **Main results:**

Proposed and investigated optimization algorithms;

Proposed and investigated an algorithm for the design of the substitution tables of the block cipher systems;

The fast Fourier transform procedure is modified in order to calculate the spectrum values in real time applications, when in a fixed period a small portion of old observations is changed by a new one;

Investigated characteristics of atrial fibrillation and atrial fibrillation recognition capabilities using Rythmogram.

###### **Main publications:**

Žilinskas, J., Goldengorin, B., Pardalos, P.M. 2015. Pareto-optimal front of cell formation problem in group technology. *Journal of Global Optimization*, vol. 61, no. 1, 91-108.

Kazlauskas, K., Vaicekauskas, G., Smaliukas, R. 2015. An algorithm for key-dependent S-box generation in block cipher system. *Informatika*, vol. 26, no. 1, 51-65.

Pupeikis, R. 2015. Revised 2D Fast Fourier Transform. *Electrical, Electronic and Information Sciences (eStream) : proceedings of the 2015 Open conference, 21 April, 2015, Vilnius, Lithuania*, 1-4.

### **National Research Projects**

**Research Council of Lithuania. Creation and development of algorithms for global optimization** (No. MIP-051/2014) Prof. Dr. (HP) J. Žilinskas. 2014-2016.

The aim of the project is to create and develop global optimization algorithms. Statistical, heuristic, and deterministic algorithms, their hybrids and parallel versions are developed and investigated in this project. We will aim to investigate which algorithms on which problems perform better and propose recommendations for solution of practical optimization problems.

European Union Structural Funds project. **Services controlled by the Lithuanian Speech - The project LIEPA** (No. VP2-3.1-IVPK-12-K-01-001) Prof. Laimutis Telksnys. 2013-2015.

The project LIEPA is aimed at developing tools which would open the possibilities of working and communicating with computers and smart things using the Lithuanian speech which presents numerous specific problems due to its abundant polysemy of inflection.

The services developed will be conducive to fostering pupils' abilities to use speech technologies, will aid adults in various work by talking to computers in Lithuanian, will provide people with advice how to correctly pronounce words in Standard Lithuanian.

European social fund agency **Theoretical and Engineering Aspects of e-Service Technology Development and Application in High-performance Computing Platforms** (No. VP1-3.1-ŠMM-08-K-01-010). Prof. Habil. Dr. G. Dzemyda. 2012-2015.

Utena A. and M. Miškiniai public library. **Common competence and social skills development in libraries for children with learning difficulties using games, IT and environmental technologies** (1/BS-580000-1566), G. Navickas. 2015

### **International Research Projects**

COST action **Mathematical Optimization in the Decision Support Systems for Efficient and Robust Energy Networks TD1207** Member of Managing Committee Prof. Dr. (HP) J. Žilinskas. 2013-2017, [http://www.cost.eu/domains\\_actions/ict/Actions/TD1207?management](http://www.cost.eu/domains_actions/ict/Actions/TD1207?management)

Energy Production and Distribution (EP&D) is among the biggest challenges of our time, since energy is a scarce resource whose efficient production and fair distribution is associated with many technical, economical, political and ethical issues like environmental protection and people health. EP&D networks have rapidly increased their size and complexity, e.g. with the introduction and interconnection of markets within the EU. Thus, there is an increasing need of systems supporting the operational, regulatory and design decisions through a highly inter-disciplinary approach, where experts of all the concerned fields contribute to the definition of appropriate mathematical models. This is particularly challenging because these models require the simultaneous use of many different mathematical optimization tools and the verification by experts of the underlying engineering and financial issues.

COST action **Onetwork for Sustainable Ultrascale Computing (NESUS) IC1305** Member of Managing Committee Dr. A. Lančinskas. 2014-2018, [http://www.cost.eu/COST\\_Actions/ict/Actions/IC1305](http://www.cost.eu/COST_Actions/ict/Actions/IC1305)

Ultrascale systems are envisioned as large-scale complex systems joining parallel and distributed computing systems that will be two to three orders of magnitude larger than today's systems. The EU is already funding large scale computing systems research, but it is not coordinated across researchers, leading to duplications and inefficiencies. The goal of the NESUS Action is to establish an open European research network targeting sustainable solutions for ultrascale computing aiming at cross fertilization among HPC, large scale distributed systems, and big data management. The network will contribute to glue disparate researchers working across different areas and provide a meeting ground for researchers in these separate areas to exchange ideas, to identify synergies, and to pursue common activities in research topics such as sustainable software solutions (applications and system software stack), data management, energy efficiency, and resilience. Some of the most active research groups of the world in this area are members of this proposal. This Action will increase the value of these groups at the European-level by reducing duplication of efforts and providing a more holistic view to all researchers, it will promote the leadership of Europe, and it will increase their impact on science, economy, and society.

### ***MAIN R&D&I (RESEARCH, DEVELOPMENT AND INOVATION) PARTNERS***

Hospital Kauno klinikos of Lithuanian University of Health Sciences (Lithuania)  
UAB "Algoritmu sistemas" (Lithuania)  
UAB "Inogama" (Lithuania)  
Universidad de Almería (Spain)  
Università della Calabria (Italy)  
University of Florida (USA)

### ***OTHER SCIENTIFIC ACTIVITIES***

**Prof. Dr. (HP) J. Žilinskas –**

- Member of editorial boards of international journals:
  - *Central European Journal of Computer Science* (Springer/Versita),  
<http://www.springer.com/computer/journal/13537?detailsPage=editorialBoard>
  - *Central European Journal of Engineering* (Springer/Versita),  
<http://www.springer.com/engineering/journal/13531?detailsPage=editorialBoard>
  - *Informatica* (IOSPress/VU), <http://www.mii.lt/informatica/editors.htm>
  - *Journal of Global Optimization* (Springer),  
<http://www.springer.com/business+%26+management/operations+research/journal/10898?detailsPage=editorialBoard>
  - *Mathematical Modelling and Analysis* (Taylor&Francis/VGTU),  
<http://www.tandfonline.com/action/journalInformation?show=editorialBoard&journalCode=tmma20>
  - *Optimization Letters* (Springer),  
<http://www.springer.com/mathematics/journal/11590?detailsPage=editorialBoard>
- Chair of managing board of Continuous Optimization Working Group of The Association of European Operational Research Societies (EURO),  
[http://europt.iam.metu.edu.tr/h\\_contactyeni.html](http://europt.iam.metu.edu.tr/h_contactyeni.html)
- Member of board of Lithuanian Operational Research Society (member society of EURO and IFORS), head of working group Optimization Methods and Applications,  
<http://www.mii.lt/LitORS/>
- Member of European Network of Excellence on High Performance and Embedded Architecture and Compilation (HiPEAC), <http://www.hipeac.net>
- Organizer

- Workshop „Applications of Parallel Computation in Industry and Engineering“ in conference „PPAM 2015: 11th International Conference on Parallel Processing and Applied Mathematics“, Krakow, Poland, 6-9 September 2015.
- Stream „Global Optimization“ in conference „27th European Conference for Operational Research, Glasgow, JK, 12-15 July 2015.
- Member of Program/Scientific Committees
  - PPAM 2015: 11th International Conference on Parallel Processing and Applied Mathematics, Krakow, Poland, 6-9 September 2015.
  - Euro-EDUPAR: Workshop on Parallel and Distributed Computing Education for Undergraduate Students konferencijoje Euro-Par 2015: 21st International European Conference on Parallel and Distributed Computing, Vienna, Austria, 24-28 August 2015.
  - EUROPT 2015: 13th EUROPT Workshop on Advances in Continuous Optimization, Edinburgas, JK, 8-10 July 2015.
  - Joint ORSC/EURO International Conference 2015 on Continuous Optimization, Shanghai, China, 10-12 May 2015.
  - WCGO 2015: World Congress on Global Optimization, Gainesville, USA, 22-25 February 2015.

**Prof. Habil. Dr. A. L. Telksnys –**

- Member of Council on Digitization of Lithuanian Cultural Heritage
- Board member of the Ministry of Culture of the Republic of Lithuania Archives
- Member of the IEEE Technical Committee on eHealth
- Member of the Working group WG 7.1 Modeling and Simulation of the International Federation of Information Processing (IFIP)
- Member of Lithuanian Academy of Sciences
- Member of Commission of the Seimas of the Republic of Lithuania on Lithuanian traditions and heritage actualization
- Editorial board member of the international journal *Informatica*, <http://www.mii.lt/Informatica/editors.htm>
- Editorial board member of the international journal *Information Technology and Control*, <http://www.itc.ktu.lt/index.php/ITC/about/editorialTeam>
- Editorial board member of the journal *Informacijos mokslai*, <http://www.leidykla.vu.lt/lt/mokslo-darbai/informacijos-mokslai/informacijos-mokslai-2011-55-tomas/redaktoriu-kolegija/>
- Editorial board member of the international journal *Tamkang Journal of Science and Engineering*, [http://www2.tku.edu.tw/~tkjse/editorial\\_board-en.htm](http://www2.tku.edu.tw/~tkjse/editorial_board-en.htm)
- Prepared the Concept of Lithuanian speech into Electronic Media Research Development in 2014-2020. LIEPA 2

**Prof. Habil. Dr. K. Kazlauskas –**

- member of Lithuanian Computer Society, <http://www.liks.lt>
- member of Lithuanian Mathematical Society, <http://www.mif.vu.lt/lmd/>
- Reviewer of international journals:
  - *IEEE Trans. On Signal Processing*
  - *IEEE Trans. On Circuits and Systems*
  - *Informatica*
  - *Information Technology and Control*

**Assoc. Prof. Dr. R. Pupeikis –**

- Reviewer for the international journals:
  - *Informatica*, <http://www.mii.lt/Informatica/>
  - *Information Technology and Control*
  - *Journal of Zhejiang University*
  - *Measurement*
  - *Signal Processing*
  - *Applied Mathematical Modelling*
- member of Lithuanian Computer Society, <http://www.liko.lt>;
- member of Lithuanian Mathematical Society, <http://www.mif.vu.lt/lmd/>;
- member of Lithuanian Scientific Society, <http://www.lms.lt/?q=en/members>.

**Dr. G. Tamulevičius –**

- reviewer for the international journal *Informatica*, <http://www.mii.lt/Informatica/>
- reviewer for the international journal *Baltic Journal of Modern Computing*, [www.lu.lv/baltic-journal-of-modern-computing](http://www.lu.lv/baltic-journal-of-modern-computing)
- Member of IEEE Computer society and Signal processing society section

**Dr. A. Lančinskis –**

- Affiliate member of European Network of Excellence on High Performance and Embedded Architecture and Compilation (HiPEAC), <http://www.hipeac.net>.
- Member of management committee of COST action IC1305 Network for Sustainable Ultrascale Computing (NESUS).
- Reviewer of international journals:
  - *Journal of Global Optimization*
  - *Central European Journal of Computer Science*
  - *Central European Journal of Engineering*
  - *Informatica*
  - *Optimization Letters*
  - *Baltic Journal of Modern Computing*

**Dr. R. Paulavičius –**

- Affiliate member of European Network of Excellence on High Performance and Embedded Architecture and Compilation (HiPEAC), <http://www.hipeac.net>.
- Reviewer of international journals:
  - *Journal of Global Optimization*
  - *Optimization Letters*
  - *Information Technology and Control*
  - *Central European Journal of Computer Science*
  - *Communications in Nonlinear Science and Numerical Simulation*
  - *Informatica*

**G. Navickas**

- Member of Lithuanian Computer Society, <http://www.liko.lt>
-

## 4.5 DEPARTMENT OF SOFTWARE ENGINEERING

Akademijos 4, LT-08663 Vilnius  
Tel. (+370 5) 2109 340, fax (+370 5) 2729209  
E-mail: saulius.gudas@khf.vu.lt  
WWW: <http://www.mii.lt/PSIS/indexEN.php>

**Head** – Prof. Dr. *Saulius.Gudas*

**Head of Mathematical Logic Sector at Software Engineering Department** – Assoc. Prof. Habil. Dr. *Regimantas Ričardas Pliuškevičius* (e-mail: [regimantas.pliuskevicius@mii.vu.lt](mailto:regimantas.pliuskevicius@mii.vu.lt))

### **STAFF**

**Chief research fellow:** Prof. Dr. S. Gudas.

**Affiliated chief researcher fellow:** Prof. Habil. Dr. S. Jukna.

**Senior reseach fellow:** Prof. Dr. D. Dzemydienė.

**Affiliated senior researcher:** Assoc. Prof. Habil. Dr. R. Pliuškevičius, Assoc. Prof. Dr. A. Pliuškevičienė.

**Research fellows:** Assoc. Prof. Dr. A. Lupeikienė, Dr. S. Maskeliūnas, Dr. R. Alonderis, Assoc. Prof. Dr. J. Sakalauskaitė.

**Junior reserach fellow:** Dr. J. Miliauskaitė.

**Chief Specialist:** Prof. Dr. A. Čaplinskas.

**Assistant research fellow:** L. Paliulionienė.

**Doctoral students:** A. Miliauskas, A. Šaikūnas, A. Valatavičius, E. Žulkas.

### **RESEARCH INTERESTS**

Information system engineering:

- Theoretical foundations
- Model driven development

Software engineering:

- Software service engineering
- Computer-aided software engineering

Knowledge-based systems

Proof theory of non-classical logics

Automated deduction

Decision procedures

Boolean function complexity

Lower bounds

### **RESEARCH PROJECTS CARRIED OUT IN 2015**

#### **Projects Supported by University Budget**

**Research of software engineering methods arrangement with semantic modelling methods of business management.** Prof. Dr. S. Gudas. 2015-2017.

#### **Main results:**

New concepts for the modelling of a subject domain of information systems are introduced: a management transaction and a management functional dependency (MFD). A management transaction is considered as a sequence of information transformations aimed to implement particular MFD. A semantic building block of enterprise management internal model is defined as the Elementary Management Cycle (EMC). An organizational system is defined as an entirety of management functional dependencies. Detailed Supply Chain model is introduced for the identification of management transactions in the subject domain. The

business process modelling languages (BPMN, UML, etc.) could be used for representation of EMC's components.

A normalized systems development life cycle is defined as a required component of knowledge-based IS development. The principle possibilities of using autonomic computing approach to implement the Elementary Management Cycle (EMC) are examined. This approach is aimed for the enterprise software system development and integration using autonomic computing.

An approach for representing interconnections and method of semi-automated e-service composition in the context of the water resource management information system are proposed.

#### **Main publications:**

A. Valatavičius, S. Gudas (2015). Enterprise software system integration using autonomic computing // BIRWS 2015. Joint Proceedings of the BIR 2015 Workshops and Doctoral Consortium co-located with 14th International Conference on Perspectives in Business Informatics Research (BIR 2015), Tartu, Estonia, August 26-28, 2015. Ser.: CEUR Workshop Proceedings. Vol. 1420. ISSN 1613-0073. Tartu: University of Tartu, p. 156-163.

D. Dzemydienė, S. Maskeliūnas, A. Miliauskas, R. Naujikienė, G. Dzemydaitė (2015). E-Service Composition for Decision Support, Based on Monitoring of Contamination Processes and Analysis of Water Resource Data // Technological and Economic Development of Economy, 21:6, p. 869-884.

**Construction of calculi and solving procedures for modal logics and lower bounds of complexity for discrete optimisation problems.** Assoc. Prof. Habil. Dr. R. Pliuškevičius. 2015-2017.

#### **Main results:**

Two finite proof search procedures for temporal logic of knowledge were constructed: one with the invariant rule and one with looping axioms.

The sound and complete sequent calculus for half-order modal logic was constructed.

The arithmetic schemes with addition and multiplication operations approximating given multidimensional polynomial were investigated; these schemes produce precise calculation for Boolean vectors only. It was proved that such schemes can be exponentially stronger than the arithmetic schemes which are calculating polynomials precisely, and exponentially weaker than monotone Boolean schemes.

#### **Main publications:**

S. Jukna, G. Schnitger (2015). On the optimality of Bellman-Ford-Moore shortest path algorithm, ECCC TR Nr. 127, 2015.

S. Jukna (2015). Lower bounds for tropical circuits and dynamic programs, Theory of Computing Systems 57:1, p. 160-194.

R. Alonderis, R. Pliuškevičius, A. Pliuškevičienė (2015). Finite Sequent Calculi for PLTL, Liet. matem. rink. Proc. LMS, Ser. A, 56, p. 1-6.

#### **National Research Projects**

European Social Fund Agency. **Theoretical and engineering aspects of e-service technology development and application in high-performance computing platforms** (No. VP1-3.1-



ŠMM-08-K-01-010). Prof. Dr. A. Čaplinskas, Doc. Dr. A. Lupeikienė, J. Miliauskaitė, L. Paliulionienė. 2012-2015.

### **MAIN R&D&I (RESEARCH, DEVELOPMENT AND INOVATION) PARTNERS**

University of Latvia (Latvia)  
Tallinn University of Technology (Estonia)  
University of Maribor (Slovenia)  
University of Geneva (Switzerland)  
University of Frankfurt (Germany)

### **OTHER SCIENTIFIC ACTIVITIES**

#### **Prof. Dr. S. Gudas**

- editorial board member of the journal *Transformations in Business and Economy*, <http://www.transformations.khf.vu.lt/about/board>;
- editorial board member of the journal *Informacijos mokslai*, <http://www.vu.lt/leidyba/lt/mokslo-zurnalai/informacijos-mokslai/redakcine-kolegija>.
- program committee member of the 20th International Conference on Information and Software Technologies (ICIST 2015), Druskininkai, Lithuania, October 15-16, 2015, <http://icist.if.ktu.lt/index.php/ICIST/pages/view/Chairs&Commitee>;
- scientific committee member of the 1st International Conference on Business Informatics and Modelling (IC-BIM), Online, Global, October 24-25, 2015, <http://www.icbim.net/index.php/about/committees>;
- reviewer of the Special Track on Management, Engineering and Informatics (MEI 2015) in the context of the 19th Multi-conference on Systemics, Cybernetics and Informatics (WMSCI 2015), Orlando, Florida, USA, July 12-15, 2015, <http://www.iiis2015.org/wmsci/Website/AdditionalReviewers.asp?vc=12>;
- program committee member of the Central and Eastern European Conference on Software Engineering Conference in Russia (CEE-SECR 2015), Moscow, Russia, October 22-24, 2015, <http://2015.secr.ru/lang/ru/about/program-committee>;
- program committee member of the 17th Computer Science Scientific Conference of “Computer Days – 2015”, Panevėžys, Lithuania, September 17-19, 2015, <http://www.liko.lt/en/modules/tinycontent/index.php?id=13>

#### **Prof. Dr. A. Čaplinskas**

- editorial board member of the journal *Informatica*, <http://www.mii.lt/informatica/editors.htm>;
- editorial board member of the *Baltic Journal of Modern Computing*, <http://www.bjmc.lu.lv/editorial-board/>
- editorial board member of the *Scientific Journal of Riga Technical University: Applied Computer Systems*, <https://ortus.rtu.lv/science/en/series/16>;
- steering committee member of the annual East European Conference on Advances in Databases and Information Systems (ADBIS), <http://adbis2015.ensma.fr/>;
- steering committee member of the International Baltic Conference on Databases and Information Systems (BalticDB&IS), <http://www.dbis.lu.lv/conference-organisation/>;
- program committee member of the 19th East European Conference on Advances in Databases and Information Systems (ADBIS), Poitiers, France, September 8-11, 2015, <http://adbis2015.ensma.fr/>;
- program committee member of the Central and Eastern European Conference on Software Engineering Conference in Russia (CEE-SECR 2015), Moscow, Russia, October 22-24, 2015, <http://2015.secr.ru/lang/ru/about/program-committee>;

- program committee member of the 5th International Conference on Business Intelligence and Technology (BUSTECH 2015), Nice, France, May 22-27, 2015, <http://www.iaia.org/conferences2015/ComBUSTECH15.html> ;
- program committee member of the 7th International Conference on Advanced Cognitive Technologies and Applications COGNITIVE 2015, Nice, France, May 22-27, 2015, <http://www.iaia.org/conferences2015/ComCOGNITIVE15.html>;
- program committee member of the 21th International Conference on Information and Software Technologies (ICIST 2015), Druskininkai, Lithuania, October 15-16, 2015, <http://icist.if.ktu.lt/index.php/ICIST/pages/view/Chairs&Commitee>;
- program committee member of the 8th Workshop on Information Logistics and Knowledge Supply (ILOG 2015), Tartu, Estonia, August 26-28, 2015, <http://www.informatik.uni-rostock.de/ilog2015.html>;
- program committee member of the 9th International Conference on Intelligent Systems and Agents (ISA 2015), Las Palmas de Gran Canaria, Spain, July 22-24, 2015, <http://isa-conf.org/commitees/>;
- program committee member of the 27th International Conference on Advanced Information Systems Engineering (CAiSE'15), Stockholm, Sweden, June 8-12, 2015, <http://caise2015.dsv.su.se/organization/program-committee>;
- program committee member of 7th International Workshop on Data Analysis Methods for Software Systems (DatAMSS), Druskininkai, Lithuania, December 3-5, 2015, <http://www.mii.lt/datamss/index.php?page=organizers&lang=en>;
- program committee member of the 17th Computer Science Scientific Conference of “Computer Days – 2015”, Panevėžys, Lithuania, September 17-19, 2015, <http://www.liks.lt/en/modules/tinycontent/index.php?id=13>.

#### **Prof. Dr. D. Dzemydienė**

- editorial board member of the *Scientific Journal of Riga Technical University: Applied Computer Systems*, <https://ortus.rtu.lv/science/en/series/16>;

#### **Doc. Dr. A. Lupeikienė**

- editorial board member of the journal *Informatica*, <http://www.mii.lt/informatica/editors.htm>;
- editorial board member of the *Scientific Journal of Riga Technical University: Applied Computer Systems*, <https://ortus.rtu.lv/science/en/series/16>;
- steering committee member of the International Baltic Conference on Databases and Information Systems (BalticDB&IS), <http://ati.ttu.ee/dbis2014/index.php?page=8>;

#### **Dr. S. Maskeliūnas**

- program committee chair and organizing committee chair of the 17th Computer Science Scientific Conference of “Computer Days – 2015”, Panevėžys, Lithuania, September 17-19, 2015, <http://www.liks.lt/en/modules/tinycontent/index.php?id=13>.
- chairman of 7th International Workshop on Data Analysis Methods for Software Systems (DatAMSS), Druskininkai, Lithuania, December 3-5, 2015, <http://www.mii.lt/datamss/index.php?page=organizers&lang=en>;
- chairman of the Council of the Lithuanian Computer Society, <http://www.liks.lt/en/modules/tinycontent/index.php?id=3>.

#### **Prof. Habil. Dr. S. Jukna**

- scientific board member of ECCC, Electronic Colloquium on Computational Complexity, [http://eccc.hpi-web.de/colloquium/scientific\\_board/](http://eccc.hpi-web.de/colloquium/scientific_board/);

- editorial board member of the *Lithuanian Mathematical Journal*,  
[http://www.mii.lt/index.php?siteaction=pages.browse&page=lmj\\_an&lang=en](http://www.mii.lt/index.php?siteaction=pages.browse&page=lmj_an&lang=en).

**Assoc. Prof. Habil. Dr. R. Pliuškevičius**

- editorial board member of the *Lithuanian Mathematical Journal*,  
[http://www.mii.lt/index.php?siteaction=pages.browse&page=lmj\\_an&lang=en](http://www.mii.lt/index.php?siteaction=pages.browse&page=lmj_an&lang=en);

## 4.6 DEPARTMENT OF STOCHASTIC PROCESSES

Akademijos str. 4, LT-08663 Vilnius

Tel. (+370 5) 210 9317

E-mail: donatas.surgailis@mii.vu.lt

**Head** – Prof. Habil. Dr. *Donatas Surgailis*

**Chief research fellows:** Prof. Habil. Dr. D. Surgailis, Prof. Habil. Dr. A. Dubickas, Prof. Habil. Dr. R. Leipus, Habil. Dr. R. Norvaiša.

**Affiliated chief research fellows:** Prof. Habil. Dr. L. Giraitis, Prof. Habil. Dr. R. Mikulevičius.

**Senior research fellow:** Assoc. Prof. Dr. A. Astrauskas, Dr. M. Vaičiulis, Prof. Dr. J. Šiaulyš.

**Specialists and engineering staff:** Š. Dirmeikis, I. Grublytė, V. Pilipauskaitė, Dr. A. Zinevičius, J. Zinkevičienė.

**Doctoral students:** Š. Dirmeikis, I. Grublytė, V. Pilipauskaitė, A. Škarnulis.

### **RESEARCH INTERESTS.**

Statistical inference for long memory processes

Modeling financial data

Long range dependence

Heavy tails

Aggregation

Random fields

Self-similar processes

Levy processes

Rough paths

Concrete functional calculus

Random Hamiltonians

Insurance mathematics

### **RESEARCH PROJECTS CARRIED OUT IN 2015**

#### **Projects Supported by University Budget**

**Investigation of Fractal Properties of Random Processes and Random Fields.** Prof. R. Norvaiša, Prof. D. Surgailis. 2012–2015.

#### **Main publications:**

Norvaiša, R. 2015. Weighted power variation of integrals with respect to a Gaussian process. *Bernoulli*, vol. 21, no. 2, 1260-1288.

Puplinskaitė, D., Surgailis, D. 2015. Scaling transition for long-range dependent Gaussian random fields. *Stochastic processes and their applications*, vol. 125, 2256-2271.

#### **National Research Projects**

**Research Council of Lithuania. Nonlinear long memory, heavy tails and aggregation** (No. MIP-063/2013). D. Surgailis. 2013–2015.

The notion of scaling transition and distributional long-range dependence for stationary random fields on the plane were introduced in terms of scaling limits over rectangles whose sides grow at arbitrary rate. The existence of scaling transition was established for several classes of long-range dependent random fields, including a natural class of Gaussian random fields with singular spectral density.

**Main publications:**

Puplinskaitė D., Surgailis D. 2015. Scaling transition for long-range dependent Gaussian random fields. *Stochastic processes and their applications*, vol. 125, 2256-2271.

Puplinskaitė D., Surgailis D. Aggregation of autoregressive random fields and anisotropic long-range dependence. *Bernoulli* (in press).

**OTHER SCIENTIFIC ACTIVITIES**

**Prof. Habil. Dr. A. Dubickas –**

- Associate editor of *Uniform Distribution Theory*
- Associate editor of *European Journal of Mathematics*
- Associate editor of *Conference Papers in Mathematics*
- Associate editor of *Lithuanian Mathematical Journal*
- Associate editor of *Šiauliai Mathematical Seminar*

**Dr. R. Norvaiša –**

- Managing editor of *Lithuanian Mathematical Journal*
- Associate editor of *North-Western European Journal of Mathematics*

**Prof. Habil. Dr. R. Leipus –**

- Associate editor of *Lithuanian Mathematical Journal*.
- Associate editor of *Pinigų studijos (Monetary Studies)*

**Prof. Habil. Dr. D. Surgailis –**

- Associate editor of *Lithuanian Mathematical Journal*

**Prof. Dr. J. Šiaulys –**

- Associate editor of *Lithuanian Mathematical Journal*
- Associate editor of *Modern Stochastics: Theory and Methods*
- Reviewer for *Mathematical Reviews*.
- Reviewer for *Zentralblatt MATH*

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**4.7 DEPARTMENT OF SYSTEMS ANALYSIS**

Akademijos 4, LT-08663 Vilnius

Tel. (+370 5) 210 9300

E-mail: [gintautas.dzemyda@mii.vu.lt](mailto:gintautas.dzemyda@mii.vu.lt)

**Head** – Prof. Habil. Dr. *Gintautas Dzemyda*

**STAFF**

**Principal researchers:** Prof. Habil. Dr. G. Dzemyda, Prof. Habil. Dr. L. Sakalauskas, Prof. Habil. Dr. A. Žilinskas, Prof. Habil. Dr. R. Želvys.

**Senior researchers:** Assoc. Prof. Dr. O. Kurasova, Prof. Dr. S. Minkevičius, Dr. V. Marcinkevičius, Dr. D.E. Otera, Dr. A. Jakaitienė.

**Affiliated researchers:** Prof. Habil. Dr. A. Garliauskas, Dr. A. Mockus, Dr. S. Steišūnas, Prof. Habil. Dr. J. Mockus.

**Researchers:** Assoc. Prof. Dr. I. Belov, Dr. J. Bernatavičienė, Dr. J. Gordevičius, Dr. R. Karbauskaitė, Dr. V. Medvedev, Assoc. Prof. Dr. P. Treigys, Prof. Dr. A. Pakštas, Dr. E. Filatovas.

**Junior Researchers:** Dr. A. Rapečka, T. Grigalis, K. Koncevičius.

**Specialists and engineering staff:** V. Tiešis, Dr. L. Ringienė, Dr. G. Jakimauskas, K. Minkevičius, A. Ušpurienė, P. Gibas.

**Affairs manager:** J. Katina.

**Doctoral students:** E. Artemčiukas, G. Bazilevičius, M.J. Bilinskas, D. Bykovas, A. Daranda, A. Gimbutas, G. Gimbutienė, A.A. Haidari, V. Jakštys, V. Jančauskas, J. Jucevičius, R. Jurevičius, D. Kavaliauskas, J. Kurilova, K. Paulauskienė, N. Pozniak, T. Pranckevičius, R. Rybnikovė, M. Sabaliauskas, G. Stabingis, D. Stumbrienė, D. Tamašauskas, J. Tichonov, J. Vaičiulytė, J. Zubova.

### ***RESEARCH INTERESTS***

Analysis of large data sets

Artificial neural networks

Creation and computational realization of complex simulation models in epidemiology, education, economics, and energy supply systems and of various other origin with uncertainty

Data mining

Development of decision support systems

Bioinformatics

Geometric group theory and geometric topology

Global optimization methods

Multi-objective optimization

Image analysis, feature detection, image reconstruction, medical image processing

Internet data mining

Local optimization methods

Medical data analysis and decision support

Multiple criteria decision support

Operations research

Optimal control applications

Parallel computing

Queueing theory

Statistical simulation

Stochastic programming

Visualization of multidimensional data

Swarm intelligence

Web service development

### ***RESEARCH PROJECTS CARRIED OUT IN 2015***

#### **Projects Supported by University Budget**

**Optimal solutions in data mining tasks.** Prof. Habil. Dr. G. Dzemyda. 2014–2016.

The volumes and diversity of data are rapidly increasing in our days. Optimization, visualization and simulation methods for specific data (biomedical, financial, visual etc.) help us to analyze and take decisions. However there is a need to get new knowledge from existing data. Therefore it is necessary to develop new hybrid data mining and optimization methods that can help you to find and reveal an important new knowledge. Parallel computing is also an important tool for these challenges.

**Main results:**

A visualization technique for accessing solution pool in interactive methods of multiobjective optimization has been developed and investigated.

An multiobjective optimization algorithm based on statistical rational decision theory and visualization of the Pareto set is developed and applied to the optimal design of technological processes.

Optimization of the maximum likelihood estimator for determining the intrinsic dimensionality of high-dimensional data.

The visual method which can be used in the analysis of streaming data of various nature for finding the best subsequences matching to the sample in the multivariate time series has been developed and investigated.

**Main publications:**

Filatovas, E., Podkopaev. D., Kurasova, O. 2015. A Visualization Technique for Accessing Solution Pool in Interactive Methods of Multiobjective Optimization. *International Journal of Computers Communications & Control*, vol. 10, no. 4, 508–519.

Žilinskas, A., Fraga, E.S., Beck, J., Varoneckas, A. 2015. Visualization of multi-objective decisions for the optimal design of a pressure swing adsorption system. *Chemometrics and Intelligent Laboratory Systems*, vol. 142, 151-158.

Karbauskaite, R., Dzemyda, G. 2015. Optimization of the maximum likelihood estimator for determining the intrinsic dimensionality of high-dimensional data. *International Journal of Applied Mathematics and Computer Science (AMCS)*, vol. 25, no. 4, 895-913.

Bernatavičienė, J., Dzemyda, G., Bazilevičius, G., Medvedev, V., Marcinkevičius, V., Treigys, P. 2015. Method for visual detection of similarities in medical streaming data. *International Journal of Computers Communications & Control*, vol. 10, no. 1, 8-21.

**Study and application of statistical simulation and stochastic programming to computer network design.** Prof. Habil. Dr. L. Sakalauskas. 2013–2015.

Big data are generated and stored in computer networks that are saving a lot of information which extraction and application is very important for gain of concurrent ability in modern dynamic environment of research and business. Problems of computer network analysis, modelling and control are usually solved by methods of data mining and queueing theory.

**Main results:**

Stochastic algorithm has been created to solve the two-stage Activity-Based-Costing problem;

Law of the iterated logarithm is proved for the open multichannel network in a heavy traffic.

**Main publications:**

Belovas I., Starikovičius V. 2015. Parallel computing for mixed-stable modelling of large data sets. *Information technology and control*, vol. 44, no. 2, 148-154.

Dumskis V., Sakalauskas L. 2015. Nonlinear Stochastic Programming Involving *CVaR* in the Objective and Constraints. *Informatica*, vol. 26, no. 4, 1–23.

### **National Research Projects**

**Research Council of Lithuania. Lithuanian education system status and its influencing factors modeling** (No. MIP-024/2015) Dr. A. Jakaitienė. 2015-2017.

**Research Council of Lithuania. Geometry and topology of groups** (No. MIP-046/2014) Dr. D. Otera. 2014-2016.

Asymptotic topology of manifolds and quasi-isometry invariants of discrete groups. Main topics: simple connectivity at infinity, geometric simple connectivity, quasi-simple filtration (QSF), Tucker property, and the easy inverse representations. The main goal is to show that all groups are easily representable.

**Research Council of Lithuania. Identification of epigenetic markers for early diagnosis of colorectal cancer** (No. MIP-043/2014) Dr. J. Gordevičius. 2014-2016.

In this project we propose to perform data analysis of epigenetic profiles in blood circulating DNA to detect epigenetic biomarkers for early CRC diagnosis. Our goal is to apply novel algorithmic methods that will reveal epigenetic aberrations in extended regions when comparing cancer patients to controls. The detected regions will be used to train machine learning algorithms and to build and evaluate an early diagnostic CRC classifier. The bioinformatics analysis conducted in this project may provide novel, non-invasive markers, with the potential for translation into clinical practice.

**Research Council of Lithuania. European Union Structural Funds project "Postdoctoral Fellowship Implementation in Lithuania" within the framework of the Measure for Enhancing Mobility of Scholars and Other Researchers and the Promotion of Student Research (VP1-3.1-ŠMM-01) of the Program of Human Resources Development Action Plan. Post doctoral researcher E. Filatovas** (No. 004/56/ MTS-580000-318) Prof. Habil. Dr. G. Dzemyda. 2013-2015.

Creation of the new hybrid methods combining interactive methods and evolutionary multiobjective optimization algorithms. Development of the techniques for visualizing Pareto front when solving multiobjective optimization problems.

**Research Council of Lithuania. European Union Structural Funds project "Postdoctoral Fellowship Implementation in Lithuania" within the framework of the Measure for Enhancing Mobility of Scholars and Other Researchers and the Promotion of Student Research (VP1-3.1-ŠMM-01) of the Program of Human Resources Development Action Plan. Post doctoral researcher A. Varoneckas** (No. 004/61/ MTS-580000-323) Prof. Habil. Dr. A. Žilinskas. 2013-2015.

European social fund agency **Theoretical and Engineering Aspects of e-Service Technology Development and Application in High-performance Computing Platforms** (No. VP1-3.1-ŠMM-08-K-01-010). Prof. Habil. Dr. G. Dzemyda. 2012-2015.

### **Main publications:**

Lupeikienė, A.; Medvedev, V.; Kurasova, O.; Čaplinskas, A.; Dzemyda, G. 2015. Decision support via big multidimensional data visualization. *Joint Proceedings of the BIR 2015 Workshops and Doctoral Consortium co-located with 14th International Conference on Perspectives in Business Informatics Research (BIR 2015), Tartu, Estonia, August 26-28, 2015. Ser.: CEUR Workshop Proceedings, Vol. 1420.*

Medvedev, V.; Kurasova, O.; Dzemyda, G.; Lupeikienė, A.; Čaplinskas A. 2015. Neural networks-based big multidimensional data visualization. *ASMDA 2015: 16th Applied Stochastic Models and Data Analysis International Conference with 4th Demographics 2015 Workshop, 30 June - 4 July 2015: book of abstracts / eds.: Yiannis Dimotikalis, Sotiris Bersimis.*

**Research according Innovation voucher. A model for new book demand prediction for short time** (No. MTS-580000-2707) (Joint-stock company UAB „Barzda“, Agency for Science, Innovation and Technology (MITA)). Dr. V. Marcinkevičius 2014-11-25 – 2015-02-27.

**Research according Innovation voucher. An investigation of genetic risk factors assertion methods** (No. MTS-580000-x) (Joint-stock company „Algoritmų sistemos“, Agency for Science, Innovation and Technology (MITA)). Dr. V. Marcinkevičius. 2014-11-31 – 2015-04-20.

Project of EU Structural funds economic growth action program's priority "Information Society for All" implementation tool "Lithuanian language in the information society"  
**Creation of the website providing integral resources, products and services of the Lithuanian language and its writing** (No. VP2-3.1-IVPK-12-K-01-003). Dr. V. Marcinkevičius. 2012-2015.

In the project there will be developed the information system designated to store resources of Lithuanian language and to provide these resources to users through web browsers, web services and mobile applications.

### **International Research Projects**

COST action **Big Data Era in Sky and Earth Observation TD1403** Member of Managing Committee Assoc. Prof. Dr. Olga Kurasova. 2014-2018, [http://www.cost.eu/COST\\_Actions/TDP/Actions/TD1403](http://www.cost.eu/COST_Actions/TDP/Actions/TD1403)

COST action **High-Performance Modelling and Simulation for Big Data Applications (cHiPSet) IC1406** Member of Managing Committee Dr. Viktor Medvedev 2014-2018, [http://www.cost.eu/COST\\_Actions/ict/IC1406](http://www.cost.eu/COST_Actions/ict/IC1406)

### ***MAIN R&D&I (RESEARCH, DEVELOPMENT AND INOVATION) PARTNERS***

University College London, UK

Poznan Supercomputing and Networking Center, Poland

Middle East Technical University, Ankara, Turkey

National Cancer Institute

Hospital of Lithuanian University of Health Sciences Kauno klinikos

Maribor University (Brumen)

### ***OTHER SCIENTIFIC ACTIVITIES***

#### **Prof. Habil. Dr. G. Dzemyda –**

- Member of programme committees of the following International conferences:
  - International Conference on Operations Research and Enterprise Systems (ICORES 2015), <http://www.icores.org/>
  - International conference on Psychological Computing Systems (PhyCS 2015), [www.phycs.org](http://www.phycs.org)
  - 4th International Conference on Sensor Networks (SENSORNET 2015), <http://www.sensornets.org/?y=2015>



- Chairman of the 7th International Workshop „Data Analysis Methods for Software Systems“, Druskininkai, Lithuania, December 3-5, 2015, <http://www.mii.lt/DatAMSS/>
- Editorial board member of *Baltic Journal of Modern Computing* <http://www.lu.lv/baltic-journal-of-modern-computing/>
- Editorial board member of the International Journal *Informatica* (IOSPress/VU), executive Editor, <http://www.mii.lt/Informatica/editors.htm>
- Editorial board member of Eastern and Central Europe Journal *Informatics in Education*, [http://www.mii.lt/informatics\\_in\\_education/editors.htm](http://www.mii.lt/informatics_in_education/editors.htm)
- Editorial board member of the *Journal of Civil Engineering and Management*, [http://www.jcem.vgtu.lt/en/?page=2&sub=RED\\_KOLEGIJA](http://www.jcem.vgtu.lt/en/?page=2&sub=RED_KOLEGIJA)
- Editorial board member of the *Nonlinear Analysis; Modelling and Control*, deputy-editor-in-chief, <http://www.mii.lt/NA/>
- International editorial board member of the *Vestnik BSU. Series 1. Physics. Mathematics. Informatics* <http://www.bsu.by/en/main.aspx?guid=208151>
- Editorial board member of the journal *Mokslas ir technika*, <http://www.mokslasirtechnika.lt/>
- Member of the Lithuanian Academy of Sciences [http://lma.lt/index.php?option=com\\_k2&view=item&layout=item&id=235&Itemid=243&lang=lt](http://lma.lt/index.php?option=com_k2&view=item&layout=item&id=235&Itemid=243&lang=lt)
- Member of IFIP Technical Committee 12 Artificial Intelligence, <http://www.ifiptc12.org.uk/ifiptc12/members.php>
- Board member of Transportation Science and Information Technologies in Ministry of Transport and Communications of the Republic of Lithuania
- Board member of Military Science and Technologies in Ministry of National Defence of the Republic of Lithuania
- Member of Lithuanian Academy of Science, <http://lma.lt>
- Member of Lithuanian Computer Society, <http://www.liks.lt/>
- Member of Lithuanian Mathematical Society, <http://www.mif.vu.lt/lmd/>
- Member of Lithuanian Operational Research Society, <http://www.mii.lt/LitORS/>
- Leader of the projects in Vilnius University:
  - NKP – Project of the National Integrated Program of Information Technologies “Theoretical and Engineering Aspects of e-Service Technology Development and Application in High-performance Computing Platforms” (No. VP1-3.1-ŠMM-08-K-01-010),
  - MIDAS – National Open Access Research Data Archive (NO. VP2-3.1-IVPK-13-V-01-001)

**Prof. Habil. Dr. L. Sakalauskas –**

- Editorial board member of Journal *Technological and Economic Development of Economy* <http://www.tandf.co.uk/journals/journal.asp?issn=2029-4913&linktype=145>
- Elected member of International Statistical Institute (2001) <http://isi-web.org/>
- Member of European Working Group on Continuous Optimization <http://www.iam.metu.edu.tr/EUROPT/>
- Member of Board of European Working Group on Stochastic Programming <http://www.mii.lt/EWGSP;>
- Member of European Working Group on Civil Engineering and Sustainable Development <http://www.orsdce.vgtu.lt/>
- President of Lithuanian Operational Research Society, <http://www.mii.lt/LitORS/>

- Chair of Lithuanian Conference on Operations Research and Application in Business and Technics <http://www.mii.lt/OT-2015>.
- Reviewer of international journals:
  - *Annals of Operation Research* (Springer)
  - *European Journal of Operational Research* (Elsevier)
  - *Informatica* (IOSPress/VU)
  - *Central European Journal of Operational Research* (Springer),
  - *Information Technology and Control* (KTU),
  - *International Transactions on Operational Research* (Wiley&Sons)
  - *Methodology and Computing in Applied Probability* (Springer)
  - *Technological and Economic Development of Economy* (Francis&Taylor).

**Prof. Habil. Dr. A. Žilinskas –**

- Member of IFIP working group WG 7.6 Optimization-Based Computer Aided Modeling and Design, <http://www.ifip.org/bulletin/bulltcs/memtc07.htm>
- Member of American Mathematical Society <http://www.ams.org/cml>
- Member of programme committees of the following International conferences:
  - CompSysTech 2015, Dublin, Ireland, 25-26 June 2015
  - World Congress on Global Optimization, 2015, Gainesville, Florida, Fed 22-25, 2015
  - 8<sup>th</sup> Workshop on Computational Optimization, Lodz, Poland, 13-16 September, 2015
- Member of editorial boards of international journals:
  - *Journal of Global Optimization* (Springer), <http://www.springer.com/business+%26+management/operations+research/journal/10898?detailsPage=editorialBoard>
  - *Informatica* (IOSPress/VU), <http://www.mii.lt/Informatica/editors.htm>
  - *Statistics, Optimization and Information Computing*,
  - *Journal of Intelligent Learning Systems and Applications*, <http://www.scirp.org/journal/jilsa/>
  - *International Journal of Grid and High Performance Computing*, <http://www.igi-global.com/Bookstore/TitleDetails.aspx?TitleId=1105&DetailsType=ReviewBoard>
  - *The Open Cybernetics and Systemics Journal*, <http://www.bentham.org/open/tocsj/EBM.htm>
  - *Baltic Journal of Modern Computing* <http://www.bjmc.lu.lv/editorial-board/>
- Member of the Lithuanian Academy of Sciences, <http://lma.lt>  
[http://lma.lt/index.php?option=com\\_k2&view=item&layout=item&id=235&Itemid=243&lang=lt](http://lma.lt/index.php?option=com_k2&view=item&layout=item&id=235&Itemid=243&lang=lt)

**Prof. Habil. Dr. J. Mockus –**

- Member of the Lithuanian Academy of Sciences  
[http://lma.lt/index.php?option=com\\_k2&view=item&layout=item&id=235&Itemid=243&lang=lt](http://lma.lt/index.php?option=com_k2&view=item&layout=item&id=235&Itemid=243&lang=lt)
- Member of American Mathematical Society <http://www.ams.org/cml>
- Member of IFIP Technical Committee WG 7.7 Stochastic Optimization,  
<http://www.ifip.org/bulletin/bulltcs/memtc07.htm>

**Assoc. Prof. Dr. I. Belovas –**

- Member of *Lithuanian Mathematical Society*, <http://www.mif.vu.lt/lmd/>
- reviewer of international journal *Mathematical Modelling and Analysis* (Taylor & Francis)

**Assoc. Prof. Dr. O. Kurasova –**

- Member of editorial boards of international journals:
  - *Nonlinear Analysis: Modelling and Control*, <http://www.mii.lt/NA/>
  - *Baltic Journal of Modern Computing*, <http://www.lu.lv/baltic-journal-of-modern-computing/editorial-board/>
  - *Computational Science and Techniques*  
<http://journals.ku.lt/index.php/CST/about/editorialTeam>
  - Informatics, <http://www.mdpi.com/journal/informatics>
- Member of Council of Lithuanian Computer Society,  
<http://www.liko.lt/en/modules/tinycontent/index.php?id=3>
- Member of Lithuanian Mathematical Society, <http://www.mif.vu.lt/lmd/>
- Member of Lithuanian Operational Research Society, <http://www.mii.lt/LitORS/>
- Reviewer of international journals:
  - *Informatica* (IOSPress/VU)
  - *Mathematical Modelling and Analysis* (Taylor & Francis)
  - *Journal of Visualization* (Springer)
  - *Mechanical Systems and Signal Processing* (Elsevier)
  - *Informatics in Education* (VU)
  - *Central European Journal of Computer Science* (Springer),
  - *Neural Processing Letters* (Springer),
  - *Optimization Letters* (Springer),
  - *Information Technology and Control* (KTU),
  - *Neurocomputing* (Elsevier)

**Assoc. Prof. Dr. S. Minkevičius –**

- reviewer of international journal *Informatica* (IOSPress/VU)
- reviewer of international journal *Nonlinear Analysis; Modelling and Control*  
<http://www.mii.lt/NA/>

**Dr. J. Bernatavičienė –**

- Managing Co-editor of *Baltic Journal of Modern Computing*,  
<http://www.bjmc.lu.lv/editorial-board/>
- Member of Lithuanian Computer Society (Artificial Intelligence Section),  
<http://www.liko.lt/>
- Member of Lithuanian Mathematical Society, <http://www.mif.vu.lt/lmd/>
- Member of Lithuanian Operational Research Society, <http://www.mii.lt/LitORS/>
- reviewer of international journals:
  - *Informatica* (IOSPress/VU)
  - *Baltic Journal of Modern Computing*

**Dr. E. Filatovas –**

- Member of International Society on Multiple Criteria Decision Making (MCDM)  
<http://mcdmsociety.org/members/country.php?country=LITHUANIA>
- Member of Council of Lithuanian Computer Society,  
<http://www.liko.lt/en/modules/tinycontent/index.php?id=3>
- Reviewer of international journals:
  - *Baltic Journal of Modern Computing*
  - *Central European Journal of Operations Research*

**Dr. R. Karbauskaitė –**

- Managing editor of *Informatica* (IOSPress/VU) <http://www.mii.lt/informatica/instruct.htm>
- Reviewer of international journals:
  - *Informatica* (IOSPress/VU)
  - *Computer Vision and Image Understanding*

**Dr. V. Marcinkevičius –**

- Member of Council of Lithuanian Computer Society, <http://www.liks.lt/en/modules/tinycontent/index.php?id=3>
- Member of Lithuanian Mathematical Society, <http://www.mif.vu.lt/lmd/>
- Member of Lithuanian Operational Research Society, <http://www.mii.lt/LitORS/>
- Reviewer of international journal *Informatica* (IOSPress/VU)

**Dr. V. Medvedev –**

- Member of Council of Lithuanian Computer Society, <http://www.liks.lt/en/modules/tinycontent/index.php?id=3>
- Member of Lithuanian Mathematical Society, <http://www.mif.vu.lt/lmd/>
- Member SERVICE COMPUTATION 2013–2015 Technical Program Committee, <http://www.iaria.org/conferences2014/ComSERVICECOMPUTATION14.html>
- reviewer of international journals:
  - *Informatica* (IOSPress/VU)
  - *Mathematical Modelling and Analysis* (Taylor & Francis)
  - *Journal of Global Optimization* (Springer)
  - *Pattern Recognition Letters* (Elsevier)
  - *The Baltic Journal of Road and Bridge Engineering* (Technika/VGTU, Lithuania)
  - *Baltic Journal of Modern Computing*

**Dr. D. Otera –**

- Member of the Italian geometers group G.N.S.A.G.A., <http://www.altamatematica.it/gnsaga/>
- Member of the Lithuanian Mathematical Society, <http://www.mif.vu.lt/lmd/>
- Referee for international journals:
  - *Quaestiones Mathematicae* (Taylor & Francis)
  - *Indagationes Mathematicae* (Elsevier)
- Reviewer for Zentralblatt MATH
- Reviewer for a research project funded by South Africa's National Research Foundation (NRF)

**Assoc. Prof. Dr. P. Treigys –**

- Reviewer of the international journal *Informatica* (IOSPress/VU)

**V. Tiešis –**

- Member of Lithuanian Mathematical Society, <http://www.mif.vu.lt/lmd/>
- Reviewer of international journal *Informatica* (IOSPress/VU)