

VU Faculty of Mathematics and Informatics

Institute of Data Science and Digital Technologies – Annual Report 2019



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

STAFF

61 research fellows (incl. 59 holding research degree),

21 teachers (all of them holding research degree),

42 doctoral students.

GROUPS OF THE INSTITUTE

[Blockchain Technologies Group](#)

[Cognitive Computing Group](#)

[Cyber-Social Systems Engineering Group](#)

[Education Systems Group](#)

[Global Optimization Group](#)

[Image and Signal Analysis Group](#)

[Intelligent Technologies Research Group](#)

[Statistics and Probability Group](#)

RESEARCH AREAS

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

DOCTORAL DISSERTATIONS MAINTAINED IN 2019

Audrius Šaikūnas – in *Informatics Engineering (T 007)* defended on 19th December

Scientific Supervisor: prof. dr. Albertas Čaplinskas

„[Extensible parsing with Earley virtual machines](#)“ (abstract[in Lithuanian])

Kristina Bingelė – in *Mathematics (N 001)* defended on 13th December

Scientific Supervisor: prof. dr. Artūras Štikonas

„[Investigation of Spectrum for a Sturm–Liouville problem with Two-Point Nonlocal Boundary Conditions](#)“ (abstract[in Lithuanian])

Andrius Valatavičius – in *Informatics (N 009)* defended on 27th September

Scientific Supervisor: prof. dr. Saulius Gudas

„[Enterprise Application Interoperability Evaluation Using Autonomic Computing](#)“ [in Lithuanian] ([abstract](#))

Rokas Jurevičius – in *Informatics Engineering (T 007)* defended on 24th September
Scientific Supervisor: dr. Virginijus Marcinkevičius

„[Investigation of Particle Filter Based Visual Localization for Unmanned Aerial Vehicle Flights at Low-Altitude](#)“ ([abstract](#)[in Lithuanian])

Natalija Pozniak – in *Informatics (N 009)* defended on 17th September
Scientific Supervisor: prof. habil. dr. Leonidas Sakalauskas

„[Study and Application of Euclidean Matrices to Surrogate Modelling](#)“ [in Lithuanian] ([abstract](#))

Dovilė Stumbrienė – in *Informatics (N 009)* defended on 3th July
Scientific Supervisor: prof. dr. Audronė Jakaitienė

„[Data Envelopment Analysis for Effectiveness Analysis of Education Systems](#)“ [in Lithuanian] ([abstract](#))

Gabrielė Stupurienė – in *Informatics Engineering (T 007)* defended on 2th July
Scientific Supervisor: prof. dr. Valentina Dagienė

„[Concept-Driven Informatics Education: Extension of Computational Thinking Tasks and Educational Platform for Primary School](#)“ ([abstract](#) [in Lithuanian])

Daina Gudonienė – in *Informatics Engineering (T 007)* defended on 2th July
Scientific Supervisor: prof. dr. Valentina Dagienė

„[Integrated E-Learning Objects Design Model and Implementation into Educational Platform](#)“ [in Lithuanian] ([abstract](#))

Giedrius Stabingis – in *Informatics (N 009)* defended on 27th of June
Scientific Supervisor: prof. habil. dr. Gintautas Dzemyda

Scientific Consultant: prof. dr. Kęstutis Dučinskas

„[Statistical decisions for spatial information in digital images](#)“ [in Lithuanian] ([abstract](#))

Lina Dreiziėnė – in *Mathematics (N 001)* defended on 1th of March

Scientific Supervisors: Prof. Dr. Marijus Radavičius (2014–2017), Prof. Dr. Kęstutis Dučinskas (2017–2018); Scientific Consultant: Prof. Dr. Marijus Radavičius (2017–2018)

„[Classification Risk of Gaussian Spatial Data Using Linear Discriminant Functions](#)“ ([abstract](#) [in Lithuanian])

MAIN CONFERENCES ORGANIZED IN 2019

- 10th International Doctoral Consortium "[Informatics Engineering Education Research](#)", December 2–6, 2019, Druskininkai, Lithuania
- 11th International Workshop "[Data Analysis Methods for Software Systems](#)", November 28 – 30, 2019, Druskininkai, Lithuania
- EURO Mini Conference "[Modelling and Simulation of Social-Behavioural Phenomena in Creative Societies \(MSBC-2019\)](#)", September 18-20, 2019, Vilnius, Lithuania

BLOCKCHAIN TECHNOLOGIES GROUP

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Head – Dr. Remigijus Paulavičius

STAFF

Senior researchers: dr. Remigijus Paulavičius, dr. Ernestas Filatovas, dr. Viktor Medvedev, dr. Algirdas Lančinskas

Lector: dr. Aleksandr Igumenov

Junior researcher: Linas Stripinis

Doctoral students: Linas Stripinis, Vaidas Jusevičius, Andrius Adamonis, Saulius Grigaitis, Jaroslava Arsenjeva, Rytis Bieliauskas

RESEARCH INTERESTS

Blockchain technologies

Global optimization

Optimization Software

Multi-objective optimization

High-Performance Computing

Artificial Intelligence

Image Processing

Big Data

RESEARCH PROJECTS CARRIED OUT IN 2019

Projects Supported by University Budget

National Research Projects

Research Council of Lithuania. *Development and applications of bilevel optimization algorithms* (No. P-MIP-17-60). Dr. R. Paulavičius, 2017-2020. *Description:* Bilevel optimization is important from the practical viewpoint, but efficient bilevel optimization methods still exist only in specific cases. As a result, development of general bilevel optimization methods is particularly relevant and timely. Many practical problems in the economy, engineering, and other fields can be described as bilevel optimization models. However, a plethora of these applications still cannot be solved with existing optimization tools. More importantly, only in the last decade, the first methods to solve general bilevel optimization problems were proposed. Unfortunately, the application of these methods has been mainly demonstrated only on small test instances. In this project, we seek an ambitious goal to develop new and improve existing bilevel optimization algorithms, enabling to solve real practical problems. It is equally important to implement efficient and publicly accessible bilevel optimization software, which would allow solving such problems for a broad range of practitioners. This would have a significant and internationally recognizable contribution to the field of bilevel optimization.

Main results:

- New efficient DIRECT-type derivative-free algorithm for general global optimization problems was developed.
- A review of the blockchain technology has been carried out, the areas most frequently using blockchain technology have been identified, the main existing technological challenges emphasized, and possible future directions of the technology have been highlighted.

Main publications:

1. **L. Stripinis, R. Paulavičius, J. Žilinskas** (2019) Penalty functions and two-step selection procedure based DIRECT-type algorithm for constrained global optimization. *Structural and Multidisciplinary Optimization* 59 (6), p. 2155-2175, [DOI: 10.1007/s00158-018-2181-2](https://doi.org/10.1007/s00158-018-2181-2).
2. **R. Paulavičius, S. Grigaitis, A. Igumenov, E. Filatovas** (2019) A Decade of Blockchain: Review of the Current Status, Challenges, and Future Directions. *Informatika*, 30 (4), p. 729-748, [DOI: 10.15388/Informatika.2019.227](https://doi.org/10.15388/Informatika.2019.227)

International Research Projects

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

Description: The Big Data era poses a critically difficult challenge and striking development opportunities in High-Performance Computing (HPC): how to efficiently turn massively large data into valuable information and meaningful knowledge. Computationally effective HPC is required in a rapidly-increasing number of data-intensive domains, such as Life and Physical Sciences, and Socioeconomic Systems. Modelling and Simulation (MS) offer suitable abstractions to manage the complexity of analysing Big Data in various scientific and engineering domains. Unfortunately, Big Data problems are not always easily amenable to efficient MS over HPC. Also, MS communities may lack the detailed expertise required to exploit the full potential of HPC solutions, and HPC architects may not be fully aware of specific MS requirements. Therefore, there is an urgent need for European co-ordination to facilitate interactions among data-intensive MS and HPC experts, ensuring that the field, which is strategic and of long-standing interest in Europe, develops efficiently – from academic research to industrial practice. This Action will provide the integration to foster a novel, coordinated Big Data endeavour supported by HPC. It will strongly support information exchange, synergy and coordination of activities among leading European research groups and top global partner institutions, and will promote European software industry competitiveness.

Main results:

- Data batching strategies for the SOM neural network retraining to detect anomalies in streaming maritime traffic data were proposed and investigated; the effectiveness of strategies in terms of modeling precision and the data processing time were estimated on real sensor data.

Main publications:

1. J. Venskus, P. Treigys, J. Bernatavičienė, G. Tamulevičius, **V. Medvedev**. Real-time maritime traffic anomaly detection based on sensors and history data embedding // *Sensors*. Basel: MDPI. ISSN 1424-8220. 2019, 19 (17), art. no. 3782, p. 1-10. [DOI: 0.3390/s19173782](https://doi.org/10.3390/s19173782).

Contractual Research

1. Contract (No. GLG-2018-0658) with UAB Girteka logistics - “*Creation of the conceptual model for the pickup and delivery problem with time windows (PDPTW)*”
2. Contract (No. GLG-2019-0115) with UAB Girteka logistics - “*Experimental comparative analysis of algebraic modeling languages, investigation of the potential of combining several modeling languages*”
3. Contract (No. GLG-2019-0306) with UAB Girteka logistics - “*Development of an efficient algorithm for large-scale transportation planning problem*”

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

1. Imperial College London (UK)
2. Universidad de Almería (Spain)
3. Systems Research Institute, Polish Academy of Sciences (Poland)
4. UAB Girteka Logistics (Lithuania)
5. Bank of Lithuania (Lithuania)

OTHER SCIENTIFIC ACTIVITIES

dr. R. Paulavičius –

- Member of the Young Academy of the Lithuanian Academy of Sciences.
- Affiliate member of European Network of Excellence on High Performance and Embedded Architecture and Compilation (HiPEAC), www.hipeac.net.
- Member of the American Institute of Chemical Engineers (AIChE), www.aiche.org
- Member of the Mathematical Optimization Society (MOS), <http://www.mathopt.org/>
- Member of Program/Scientific Committees:
 - [LOD2020: The Sixth International Conference on Machine Learning, Optimization, and Data Science](#), Sienna, Italy, 2020.
 - [NUMTA-2019: The 3rd International Conference and Summer School](#), Crotona, Italy, 2019.
 - [1st Workshop on Blockchain and Smart Contract Technologies \(BSCT 2018\)](#), Poznan, Poland, 2018.
 - [LION12: Learning and Intelligent Optimization Conference](#), Kalamata, Greece, 2018.
- 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*
 - *Informatika*
 - *Baltic Journal of Modern Computing*

dr. E. Filatovas –

- Member of International Society on Multiple Criteria Decision Making (MCDM).
- Member of the Lithuanian Computer Society (LIKS).
- Member of Program/Scientific Committees:

- 1st Workshop on Blockchain and Smart Contract Technologies (BSCT 2018)
- Reviewer of international journals:
 - *Engineering Optimization*
 - *Complexity*
 - *Journal of Global Optimization*
 - *Information Technology and Control*
 - *Informatica*
 - *Baltic Journal of Modern Computing*

dr. V. Medvedev –

- Member of Lithuanian Computer Society, <http://www.liko.lt/>
- Member of Lithuanian Mathematical Society, <http://www.mif.vu.lt/lmd/>
- Member of SERVICE COMPUTATION 2014-2017 Technical Program Committee
- Member of Program/Scientific Committees:
 - International Workshop on Secure Mobile Cloud Computing (IWSeMC-20), <http://iwosemc.eu/>. Melbourne (Australia), 2020 gegužės 11–14 d.
- 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*;
 - *Applied Computing and Informatics (Elsevier)*.

A. Lančinskas –

- Reviewer of international journals: Applied Mathematical Modelling, Baltic Journal of Modern Computing, Central European Journal of Computer Science, Computers and Industrial Engineering, Computers and Operation Research, Informatica, Journal of Global Optimization, Nonlinear Analysis: Modelling and Control, Open Engineering, Optimization Letters, Research in Transportation Economics.
- Affiliate member of European Network of Excellence on High Performance and Embedded Architecture and Compilation (HiPEAC), www.hipeac.net.
- Member of Program/Scientific Committees:
 - 16th International Conference on Parallel Problem Solving from Nature (PPSN 2020)
 - Black Box Discrete Optimization Benchmarking (BB-DOB) Workshop at the Genetic and Evolutionary Computation Conference (GECCO 2019)
 - 3rd International Workshop on Theoretical Approaches to Performance Evaluation, Modeling and Simulation (TAPEMS 2019).

COGNITIVE COMPUTING GROUP

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

STAFF

Principal researchers: Prof. Habil. Dr. Gintautas Dzemyda, Prof. Dr. Olga Kurasova, Prof. Dr. Kęstutis Dučinskas, Prof. Dr. Audronė Jakaitienė, Dr. Rita Dukynaitė. Dr. Saulė Raižienė, Prof. Habil. Dr. Rimantas Želvys

Affiliated researchers: Prof. Habil. Dr. Jonas Mockus

Researchers: Dr. Rasa Karbauskaitė

Junior Researchers: Dr. Martynas Sabaliauskas, Dr. Dovilė Stumbrienė, Jogaila Vaitiekaitis

Specialists and engineering staff: Vytautas Tiešis, Dr. Laura Ringienė, Laimutė Mikalauskienė, Raimundas Savukynas, Aušra Šubonienė

Postdoctoral researchers: Gerda Ana Melnik

Doctoral students: Andrius Daranda, Povilas Gudžius, Rokas Jurevičius, Marta Karaliutė, Roma Puronaitė, Mantas Stankevičius, Dovilė Stumbrienė, Ričardas Toliušis, Viktoras Bulavas, Nikolaj Kondrat, Žydrūnas Vaišnoras

RESEARCH INTERESTS

Artificial neural networks;

Big data;

Bioinformatics;

Data mining;

Deep learning;

Global optimization methods;

Multi-objective optimization;

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

Internet data mining;

Fractal dimensionality;

Local optimization methods;

Machine learning;

Medical data analysis and decision support;

Multiple criteria decision support;

Operations research;

Optimal control applications;

Parallel computing;

Simulation models in epidemiology, education, economics, and energy with uncertainty;

Statistical simulation;

Stochastic programming;

Swarm intelligence;

Visualization of multidimensional data;

Web service development.

RESEARCH PROJECTS CARRIED OUT IN 2019

Projects Supported by University Budget

Project title: Optimal decisions in the problems of data mining, visualization, and image processing. Prof. Habil. Dr. Gintautas Dzemyda, Prof. Dr. Olga Kurasova. 2017–2019

Description: The aim of the project is to develop the integrated data mining, visualization, and image processing methods and tools and to apply them for solving the problems in economics, education, health care, medicine and chemical engineering.

Main results:

1. Application of fractal dimension-based speech signal features to evaluate the speech emotions.
2. Extending the Data Envelopment Analysis (DEA) model for Composite Indicators computation, allowing for a gradual transition from fixed to flexible weights when aggregating selected variables in a study.
3. Improvement of the accuracy of Isomap algorithm in the analysis of hyperspectral images. To achieve this, Isomap has been based on SMACOF, which is the most accurate MDS method, instead of classical scaling such as eigen-decomposition process.

Publications:

1. Tamulevičius, G., Karbauskaitė, R., Dzemyda, G. (2019). Speech emotion classification using fractal dimension-based features. *Nonlinear Analysis: Modelling and Control*, 24 (5), 679–695.
2. Stumbriene, D., Camanho, A. S., & Jakaitiene, A. (2019). The performance of education systems in the light of Europe 2020 strategy. *Annals of Operations Research*, 1-32.
3. Orts Gomez, F. J., Ortega Lopez, G., Filatovas E., Kurasova, O., Martin Garzon, G. E. (2019). Hyperspectral image classification using Isomap with SMACOF. *Informatika* 2019, 30(2), 349–365.

Project title: Geometric method for solving the problem of multidimensional scaling, No. MSF-LMT-4. Prof. Habil. Dr. G. Dzemyda. 2019-2021.

Description: The main goal of the project is to consider the stress function and multidimensional scaling, in general, the geometric point of view, and to develop the so-called Geometric MDS that creates a basis for a new class of algorithms to minimize the MDS stress.

Main result: The new interpretation of the stress allows finding the proper step size, and the descent direction forwards the minimum of the stress function analytically if we consider and move a separate point of the projected space.

Publications:

1. Dzemyda, G, Sabaliauskas M. (2019). New method to minimize the stress in multidimensional scaling. In: Filzmoser P., Kharin Yu. (Eds.), *Computer Data Analysis and Modeling: Stochastics and Data Science: Proc. of the Twelfth Intern. Conf. BSU, Minsk*. pp. 29–31.
2. Dzemyda, G, Sabaliauskas M. (2020). A novel geometric approach to the problem of multidimensional scaling. In: Sergeyev Y. D., Kvasov D. E. (Eds.), *Numerical Computations: Theory and Algorithms. Lecture Notes in Computer Science*. Springer. 8 p. (accepted).

National Research Projects

Research Council of Lithuania. **Effectiveness and Efficiency Analysis of Education Systems in EU Countries Employing Secondary Big Data (EFFECTAS)** (No. DOTSUT-39 (09.3.3-LMT-K-712-01-0018) / LSS-250000-57) Dr. A. Jakaitienė. 2018-2022.

Description: The main idea of the project is to assess the factors influencing the effectiveness and efficiency of the EU education systems, to develop effectiveness and efficiency measuring instruments in order to implement sound evidence-based educational policy.

Main result: School leadership and educational effectiveness in Lithuania were analysed in 2019 as well as teaching practices and students' performance in science across EU countries using PISA 2015 data. In addition, Lithuanian population database for maturity examinations and 10th grade national assessments for mathematics and Lithuanian language were developed.

Publications:

1. Želvys, Rimantas; Dukynaitė, Rita; Vaitekaitis, Jogaila; Jakaitienė, Audronė. School leadership and educational effectiveness: Lithuanian case in comparative perspective // Management: journal of contemporary management issues. Croatia: 2019, 24(Special Issue), p. 17-36. DOI: 10.30924/mjcmi.24.si.2
2. Raižienė, Saulė; Stumbrienė, Dovilė; Ringienė, Laura; Dukynaitė, Rita; Jakaitienė, Audronė. Students' Performance and Teaching Practices in Science Across EU Countries: Evidence from PISA 2015 // The European Proceedings of Social & Behavioural Sciences (EpSBS), ICEEPSY 2018. UK. ISSN: 2357-1330. 2019, vol. LIII, p. 241-254. DOI: 10.15405/epsbs.2019.01.24

International Research Projects

1. COST action **Open Multiscale Systems Medicine CA15120** Member of Managing Committee dr. Jolita Bernatavičienė 2016-2020, http://www.cost.eu/COST_Actions/ca/CA15120

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

1. University of Almeria, Spain
2. University College London, UK
3. Bar-Ilan University, Israel
4. University of Ferrara, Italy
5. Southwestern University of Finance and Economics, China
6. Belarus State University
7. University of Calabria, Italy
8. National Cancer Institute of Lithuania
9. Hospital of Lithuanian University of Health Sciences Kauno klinikos
10. Maribor University, Slovenia

OTHER SCIENTIFIC ACTIVITIES

Prof. Habil. Dr. G. Dzemyda –

- Member of Lithuanian Academy of Science, <http://lma.lt>
- Member of programme committees of the following International conferences:
 - International Conference on Operations Research and Enterprise Systems (ICORES 2019);
 - International Conference on Sensor Networks (SENSORNET 2019)

- NUMTA-2019, Numerical Computations: Theory And Algorithms, The 3rd International Conference And Summer School, 2019, Italy
- CDAM-2019, Computer Data Analysis & Modeling, 2019, Belarus
- Chairman of the 11th International Workshop „Data Analysis Methods for Software Systems“, Druskininkai, Lithuania, 2019, <http://www.mii.lt/DatAMSS/>
- Editor-in-Chief of *Baltic Journal of Modern Computing* <http://www.lu.lv/baltic-journal-of-modern-computing/> and the International Journal *Informatica* (IOSPress/VU) <https://www.mii.lt/Informatica/>.
- Editorial board member of 9 international journals: *Financial Innovation; International Journal of Computers; Communications and Control; Applied Computer Systems; Informatics in Education; Journal of Civil Engineering and Management; Nonlinear Analysis: Modelling and Control; Mathematics and Informatics. Journal of the Belarusian State University; Scientific Proceedings of Riga Technical University. Computer Science, Information Technology and Management Science.*
- Member of IFIP Technical Committee 12 Artificial Intelligence, <http://www.ifiptc12.org.uk/ifiptc12/members.php>
- 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/>

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
- 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>

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>
 - *Informatica*, <http://www.mdpi.com/journal/informatica>
- 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)
- Member of Council of Lithuanian Computer Society, <https://www.liks.lt/en/>
- Member of Lithuanian Mathematical Society, <http://www.mif.vu.lt/lmd/>

- Member of Lithuanian Operational Research Society, <http://www.mii.lt/LitORS/>
- Chairman of the Committee of Doctoral Studies in Informatics at Vilnius University

Prof. Dr. A. Jakaitienė –

- member of Lithuanian Mathematical Society, <http://www.mif.vu.lt/lmd/index.html>;
- board member of Lithuanian Statistics Society, <http://www.statistikusajunga.lt/>;
- member of International Biometric Association, <https://www.biometricsociety.org>;
- country representative of International Biometric Association in Nord Baltic Region, <http://ibsnbr.org>;
- member of International Epidemiological Association,
- country representative at European Statistical Advisory Committee, <https://ec.europa.eu/eurostat/web/european-statistical-advisory-committee-esac>
- chairman of the committee of Master study programme Systems Biology at Vilnius University.

Dr. R. Karbauskaitė –

- Managing editor of *Informatica* (IOSPress/VU) <http://www.mii.lt/informatica/editors.htm>
- Reviewer of international journal *Informatica* (IOSPress/VU)

V. Tiešis –

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

CYBER-SOCIAL SYSTEMS ENGINEERING GROUP

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Head – Prof. Dr. *Saulius Gudas*

STAFF

Principal researcher: Prof. Dr. Saulius Gudas.

Senior researcher: Prof. Dr. Dalė Dzemydienė.

Researchers: Dr. Romas Alonderis, Assoc. Prof. Dr. Audronė Lupeikienė, Dr. Saulius Maskeliūnas.

Junior researchers: Dr. Jolanta Miliauskaitė, Dr. Haroldas Giedra.

Affiliated researchers: Prof. Dr. Albertas Čaplinskas, Prof. Habil. Dr. Stasys Jukna, Assoc. Prof. Habil. Dr. Regimantas Ričardas Pliuškevičius, Assoc. Prof. Dr. Aida Pliuškevičienė.

Other Staff: Prof. Dr. Olegas Vasilecas, Laima Paliulionienė.

Doctoral students: Audrius Šaikūnas, Andrius Valatavičius, Mindaugas Juis, Edgaras Arbataitis, Vytautas Radzevičius, Aleksandr Širaliiov, Karolis Noreika.

RESEARCH INTERESTS

Software engineering for cyber-physical-social systems:

- Theoretical foundations of information systems;

- Domain causal dependencies modeling for software engineering;
- Model based applications development (MBD) for different types of domains (enterprises, Internet of Things, smart systems, etc.);
- Knowledge-based development of cyber-physical-social systems;
- Process mining.

Mathematical logic:

- Automated deduction;
- Knowledge analysis methods;
- Deductive systems.

RESEARCH PROJECTS CARRIED OUT IN 2019

Projects Supported by University Budget

Research in the area of cyber-social systems engineering. Development of methods and technologies at the intersection of cyber-physical and cyber-social systems.

Prof. Dr. S. Gudas (leader), Dr. R. Alonderis, Prof. Dr. D. Dzemydienė, Affil. Assoc. Prof. Dr. A. Lupeikienė, Dr. S. Maskeliūnas, Dr. J. Miliauskaitė, L. Paliulionienė, Prof. Dr. O. Vasilecas, Affil. Prof. Dr. A. Čaplinskas, Affil. Assoc. Prof. Habil. Dr. R. Pliuškevičius, Affil. Assoc. Prof. Dr. A. Pliuškevičienė, Affil. Habil. Dr. S. Jukna, doctoral students A. Šaikūnas, A. Valatavičius, M. Jusis, E. Arbataitis, V. Radzevičius, A. Širaliov, K. Noreika. 2018–2020.

Main results obtained in 2019:

1. Domain causation modeling is applied a) for the analysis of a curriculum content; b) to create causal model frameworks – MODAF (UPDM) frameworks additions; c) for the analysis of the efficiency of shipping containers handling/loading control methods and procedures; d) to evaluate interoperability of applications. Domain causation modeling methodology included in a scientific project application: 4.1. Horizon2020 Project Application (Project Acronym DISC, Application No. 951700).
2. A general methodological framework of membership function development was designed for solving the fuzzification problem in the enterprise business service quality planning in service-oriented enterprise systems.
3. A cyclic sequent calculus for linear discrete temporal logic was constructed. It was proved that the rule of cut is admissible in this calculus.
4. An approach for provision of e-services based on multilayer system architecture was developed by using artificial intelligence methods such as knowledge-based production process management for control of fabric manufacturing processes.

Main publications:

1. **Gudas, Saulius**; Tekutov, Jurij; Butleris, Rimantas; Denisovas, Vitalijus. Modelling subject domain causality for learning content renewal // Informatica. Vilnius : Vilniaus universitetas. ISSN 0868-4952. eISSN 1822-8844. 2019, vol. 30, no. 3, p. 455-480. DOI: 10.15388/Informatica.2019.214.
2. Eglynas, Tomas; **Jusis, Mindaugas**; Jakovlev, Sergej; Senulis, Audrius; Andziulis, Arūnas; **Gudas, Saulius**. Analysis of the efficiency of shipping containers handling/loading control methods and procedures // Advances in mechanical

- engineering. London : SAGE publications Ltd. ISSN 1687-8132. eISSN 1687-8140. 2019, vol. 11, iss. 1, p. 1-12. DOI: 10.1177/1687814018821229.
3. **Miliauskaitė, Jolanta**; Kalibatiene, Diana. On General Framework of Type-1 Membership Function Construction: Case Study in QoS Planning // International Journal of Fuzzy Systems, Springer, 2019. doi:10.1007/s40815-019-00753-4. <https://doi.org/10.1007/s40815-019-00753-4>.
 4. **Alonderis, Romas; Giedra, Haroldas**. A proof-search system for the logic of likelihood // Logic journal of the IGPL. Oxford : Oxford University Press. ISSN 1367-0751. 2019, first on line, p. [1-21]. DOI: 10.1093/jigpal/jzz022.
 5. **Dzemydienė, Dalė; Arbataitis, Edgaras**; Dzemyda, Ignas. The design approach of knowledge-based management system for control of manufacturing processes of woven fabrics. Baltic Journal of Modern Computing. Riga : Latvijas Universitate. ISSN 2255-8942. eISSN 2255-8950. 2019, vol. 7, no. 2, p. 211-223. DOI: 10.22364/bjmc.2019.7.2.03. https://www.bjmc.lu.lv/fileadmin/user_upload/lu_portal/projekti/bjmc/Contents/7_2_03_Dzemydiene.pdf

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

Riga Technical University (Latvia)
University of Tartu (Estonia)
Warsaw University of Technology (Poland)
University of Geneva (Switzerland)
University of Frankfurt (Germany)
Hasselt University (Belgium)

OTHER SCIENTIFIC ACTIVITIES

Prof. Dr. Saulius Gudas

- reviewer for the *Baltic Journal of Modern Computing*, <http://www.bjmc.lu.lv/>;
- reviewer for the *Informatica* journal, <https://www.mii.lt/informatica/>;
- program committee member of the 15th International Conference „Beyond Databases, Architectures and Structures“ (BDAS 2019) during IFIP World Computer Congress (IFIP WCC), Ustron, Poland, May 28-31, 2019, <http://bdas.polsl.pl/>
- program committee member of the 14th International Baltic Conference on Databases and Information Systems (Baltic DB&IS 2020), <https://dbis.ttu.ee/>
- program committee member of the 25th International Conference on Information and Software Technologies (ICIST 2019), <https://icist.ktu.edu/#Programme-Committee-members>;

Prof. Dr. Dalė Dzemydienė

- editorial board member of the *Scientific Journal of Riga Technical University: Applied Computer Systems*, <https://ortus.rtu.lv/science/en/series/16>;
- editorial board member of the journal *Technological and Economic Development of Economy*, <https://journals.vgtu.lt/index.php/TEDE/editorialboard>;

- editorial board member of the *International Journal of Electronic Security and Digital Forensics*, <https://www.inderscience.com/jhome.php?jcode=ijesdf>;
- editorial board member of the *International Journal of Strategic Property Management*, <https://journals.vgtu.lt/index.php/IJSPM/editorialboard>;
- program committee member of the 14th International Baltic Conference on Databases and Information Systems (Baltic DB&IS 2020), <https://dbis.ttu.ee/>;
- program committee member of the Conference of the Lithuanian Computer Society LIKS, 2019, October, 3-4, Kaunas, Lithuania. <https://www.liko.lt/en/computer-days-2019/>;
- reviewer for the *Informatica* journal, <https://www.mii.lt/informatica/>;
- reviewer for the International EURO Mini Conference “Modelling and Simulation of Social-Behavioural Phenomena in Creative Societies (MSBC-2019), September 18-20, 2019, Vilnius, Lithuania, <https://www.msbc2019.mii.vu.lt/>;
- member of the Council of the Lithuanian Computer Society, <http://www.liko.lt/en/modules/tinycontent/index.php?id=3>;
- member of the Council of the Lithuanian Operation Research Society, <https://www.mii.lt/litors/index.php?page,council.en>;
- member of the Council of the National Digital Coalition, <http://www.skaitmeninekoalicija.lt/en/about/>.

Dr. Haroldas Giedra

- reviewer for the *Informatica* journal, <https://www.mii.lt/informatica/>.

Assoc. Prof. Dr. Audronė Lupeikienė

- editorial board member of the *Scientific Journal of Riga Technical University: Applied Computer Systems*, <https://ortus.rtu.lv/science/en/series/16>;
- program committee member of the 14th International Baltic Conference on Databases and Information Systems (Baltic DB&IS 2020), <https://dbis.ttu.ee/>;
- program committee member of the 23rd European Conference on Advances in Databases and Information Systems (ADBIS 2019), <https://adbis2019.um.si/>;
- program committee member of the 12th International Conference on Agents and Artificial Intelligence (ICAART 2020), <http://www.icaart.org/>;
- reviewer for the *Baltic Journal of Modern Computing*, <http://www.bjmc.lu.lv/>;
- reviewer for the *Informatica* journal, <https://www.mii.lt/informatica/>;
- reviewer for the *Applied Computer Systems* journal, <https://acs-journals.rtu.lv/index.php/ACS/>;
- reviewer for the *Complex Systems Informatics and Modeling Quarterly* journal, <https://csimq-journals.rtu.lv/>.

Dr. Saulius Maskeliūnas

- chairman of the Council of the Lithuanian Computer Society, <https://www.liko.lt/en/contacts/>;

- member of the Rules of Participation (RoP) working group of the European Open Science Cloud (EOSC), <https://www.eoscsecretariat.eu/working-groups/rules-participation-working-group>;
- program committee member of the 14th International Baltic Conference on Databases and Information Systems (Baltic DB&IS 2020), <https://dbis.ttu.ee/>;
- co-chair of the 11th International Workshop on Data Analysis Methods for Software Systems (DAMSS), Druskininkai, Lithuania, November 28-30, 2019, <https://www.mii.lt/damss/index.php/organizers>;
- program committee member of the 15th International Conference „Beyond Databases, Architectures and Structures“ (BDAS 2019) during IFIP World Computer Congress (IFIP WCC), Ustron, Poland, May 28-31, 2019, <http://bdas.polsl.pl/>.

Dr. Jolanta Miliauskaitė

- reviewer for the *Informatica* journal, <https://www.mii.lt/informatica/>;
- reviewer for the *International Journal of Computers Communications & Control*, <http://univagora.ro/jour/index.php/ijccc/>.

Laima Paliulionienė

- organizing committee member of the 11th International Workshop on Data Analysis Methods for Software Systems (DAMSS), Druskininkai, Lithuania, November 28 - 30, 2019, <https://www.mii.lt/damss/index.php/organizers>.

Prof. Dr. Albertas 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 and program committee member of the 14th International Baltic Conference on Databases and Information Systems (BalticDB&IS 2020), <https://dbis.ttu.ee/index.php?page=65>
- program committee member of the 18th International Conference on Perspectives in Business Informatics Research (BIR 2019), Katowice, Poland, September 23-25, 2019, <https://bir2019.ue.katowice.pl/chairs>;
- program committee member of the 9th International Conference on Business Intelligence and Technology (BUSTECH 2019), Venice, Italy, May 5-9, 2019, <https://www.iaia.org/conferences2019/ComBUSTECH19.html>;
- program committee member of the 11th International Conference on Advanced Cognitive Technologies and Applications (COGNITIVE 2019), Venice, Italy, May 5-9, 2019, <https://www.iaia.org/conferences2019/ComCOGNITIVE19.html>;

- program committee member of the 31th International Conference on Advanced Information Systems Engineering (CAiSE 2019), Rome, Italy, June 3-7, 2019, <https://www.caise19.it/caise-program-committee/>;
- program committee member of the 11th International Workshop on Data Analysis Methods for Software Systems (DAMSS 2019), Druskininkai, Lithuania, November 28-30, 2019, <https://www.mii.lt/damss/index.php/organizers>.

Prof. Habil. Dr. Stasys Jukna

- scientific board member of the *Electronic Colloquium on Computational Complexity* (ECCC), http://eccc.hpi-web.de/colloquium/scientific_board/;
- editorial board member of the *Lithuanian Mathematical Journal*, <https://www.mii.lt/lmj/>.

Assoc. Prof. Habil. Dr. Remigijus Pliuškevičius

- editorial board member of the *Lithuanian Mathematical Journal*, <https://www.mii.lt/lmj/>.

EDUCATION SYSTEM GROUP

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<https://www.mii.lt/struktura/moksliniai-padaliniai/educaciniu-sistemu-grupe>

Head – Prof. Dr. Valentina Dagiėnė

STAFF

Chief research fellow: Prof. Dr. V. Dagiėnė.

Senior research fellow: Dr. J. Kurilov.

Research fellows: Dr. T. Jevsikova, Dr. A. Juškevičienė, Dr. V. Dolgopolovas

Junior research fellows: Dr. G. Stupurienė,

Doctoral students: V. Dvareckienė, I. Krikun, O. Mirzianov, T. Šiaulyš, A. Urbaitytė, L. Vinikienė

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

RESEARCH INTERESTS

- Application of intelligent technologies in education
- Computer science (Informatics) education research
- Computing engineering education research
- Software localisation

- Technology enhanced learning

RESEARCH PROJECTS CARRIED OUT IN 2019

Projects Supported by University Budget

Research on Intelligent Technologies Application for Teaching, Learning and Cultural Environment. Prof. Dr. V. Dagienė, 2015–2019.

Developing of engineering solutions for improving teaching and learning by implementing intelligent technologies. Solutions for mobile learning; creating of e-learning recommendations based on semantic web. 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 the Bebras contest.

1. **Dolgopolovas, Vladimiras; Dagienė, Valentina; Jasutė, Eglė; Jevsikova, Tatjana.** Design science research for computational thinking in constructionist education: a pragmatist perspective = Informatinio mąstymo ugdymo konstrukcionistinėje aplinkoje projektavimo moksliniai tyrimai: pragmatistinė perspektyva // Problemos. Vilnius : Vilniaus universiteto leidykla. ISSN 1392-1126. eISSN 2424-6158. 2019, t. 95, p. 144-159. DOI: 10.15388/Problemos.95.12.
2. **Juškevičienė, Anita; Passey, Don.** Computing education, outcomes of // Encyclopedia of education and information technologies / Tatnall A. (eds). Cham : Springer Nature, 2019. ISBN 9783319600130. p. 4-14. DOI: 10.1007/978-3-319-60013-0_89-1.
3. **Dagienė, Valentina; Jevsikova, Tatjana; Stupurienė, Gabrielė.** Introducing informatics in primary education: curriculum and teachers' perspectives // Informatics in schools. New ideas in school informatics : 12th international conference on informatics in schools: situation, evolution, and perspectives, ISSEP 2019, Larnaca, Cyprus, November 18–20, 2019 : proceedings. Cham : Springer, 2019. ISBN 9783030337582. eISBN 9783030337599. p. 83-94. (Lecture notes in computer science, ISSN 0302-9743, eISSN 1611-3349 ; vol. 11913). DOI: 10.1007/978-3-030-33759-9_7.

International Research Projects

Pateikiamas vykdomų tarptautinių projektų (pvz., Horizontas 2020, kitos dvišalio bendradarbiavimo programos, CERN, Public Health, NIH) sąrašas ir trumpas kiekvieno projekto 2019 m. mokslinės veiklos rezultatus aprašymas (ne daugiau 500 spaudos ženklų) ir svarbiausios publikacijos (ne daugiau 3).

Intercultural Learning in Mathematics and Science: Initial Teacher Education (IncluSMe), 2016-1-DE01-KA203-002910

Structuring Cooperation in Doctoral Research, Transferrable Skills Training, and Academic Writing instruction in Ukraine's regions (DocHub). 574064-EPP- 1-2016- 1- LT-EPPKA2-CBHE-SP

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

Nurodomi pagrindiniai padalinio 2019 m. mokslinės ir inovacinės veiklos partneriai Lietuvoje ir užsienyje (ne daugiau 5).

Ankara University (Turkey)
 ETH Zurich (Switzerland)
 Lancaster University (UK)
 Radboud University Nijmegen (The Netherlands)
 Turku University (Finland)

OTHER SCIENTIFIC ACTIVITIES

Prof. Dr. V. Dagienė –

Editor-in-Chief of the journal “Informatics in Education”,
http://www.mii.lt/informatics_in_education (Clarivate Analytics Web of Science Core Collection; Scopus; etc.);

Editor of the journal “Olympiads in Informatics” (Scopus, etc):
<https://ioinformatics.org/page/ioi-journal-editorial-board/2>

Area Editor (Computing Didactics) of the „Baltic Journal of Modern Computing“,
<https://www.bjmc.lu.lv> (Clarivate Analytics Web of Science Core Collection; Scopus; etc.);

Editorial board member of the Journals: „International Journal of Digital Literacy and Digital Competence“, „International Journal of Instruction“, „Acta Paedagogica Vilnensia“;

Guest Co-Editor of the “Computer Applications in Engineering Education” (Wiley), Special Issue on Computational Thinking for STEAM and Engineering Education,
<https://onlinelibrary.wiley.com/journal/10990542> (Clarivate Web of Science Core Collection);

Coordinator of the Nordplus Network on Innovative Computing Engineering Education Research;

Representative of Lithuania in Education Committee TC3 under the International Federation for Information Processing (IFIP);

Member of Steering Committee of International Olympiads in Informatics:
<https://ioinformatics.org/page/committees/6>

Member of Joint Doctoral Committee of Education (Vytautas Magnus University; Vilnius University; Klaipėda University; Riomeris University; and Aveiro University), 2015–2019

Chair of the Bebras Board (International Challenge on Informatics and Computational Thinking): <https://www.bebbras.org/?q=community>

Assoc. Prof. Dr. J. Kurilov –

Executive Editor of the journal 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, <http://www.ijee.ie/> (Thomson Reuters Web of Science);

Co-editor Europe of the journal International Journal of Knowledge Society Research (IGI Global, USA), <http://www.igi-global.com/journal/international-journal-knowledge-society-research/1180>;

Associate Editor of the Journal of Engineering and Computer Innovations (Academic Journals), <http://www.academicjournals.org/JECI/index.htm>;

Editorial board member of the journal International Journal On Advances in Software (IARIA journal, USA), <http://www.ariajournals.org/software/index.html>;

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

Dr. V. Dolgopolovas –

Member of the local editorial board of “Informatics in Education” journal.
http://www.mii.lt/informatics_in_education/ (Clarivate Web of Science Core Collection);

Guest Co-Editor of the Computer Applications in Engineering Education (Wiley), Special Issue on Computational Thinking for STEAM and Engineering Education,
<https://onlinelibrary.wiley.com/journal/10990542> (Clarivate Web of Science Core Collection);

Project researcher, EU co-funded project No. 01.1.1-CPVA-V-701-15-0001 „Development of Vilnius STEAM Center” activity „Preparation of the Methodological Part of STEAM Center activities: Development of Laboratory Descriptors and Integrated Methodologies for Mobile Technology and Robotics Laboratory and Visual Programming Laboratory”

Dr. T. Jevsikova –

Member of International Federation for Information Processing (IFIP) TC3 WG 3.1 (Informatics for Secondary Education);

Dr. A. Juškevičienė –

PostDoc: “Algorithmic thinking enhancement by modern technologies in basic education”, Lithuanian Research Council, 2017-2019

Dr. G. Stupurienė –

Managing Editor of the of the journal “Informatics in Education”,
https://www.mii.lt/informatics_in_education/editors.htm (Clarivate Analytics Web of Science Core Collection; Scopus; etc.);

**THE LIST OF THE MOST IMPORTANT RESULTS OF SCIENCE
POPULARISATION ACTIVITIES**

Book: V. Dagienė. Mąstau ir kuriu. Integruotos informatikos užduotys 6-8 metų vaikams [I think and create. Integrated Informatics tasks for 6-8 year olds; in Lithuanian]. Baltos lankos. 2019 (An electronic supplement to this textbook has been published as well as detailed methodological guidelines for teachers).

Valentina Dagienė, Gabrielė Stupurienė, Tatjana Jevsikova, Vaidotas Kinčius organises International Challenge on Informatics and Computational Thinking “Bebras”, they create, translate, test tasks and develop methodological materials for teachers.

GLOBAL OPTIMIZATION GROUP

Akademijos 4, LT-08663 Vilnius
Tel. +370 210 9304

E-mail: julius.zilinskas@mii.vu.lt

Head – Prof. Dr. (HP) Julius Žilinskas

STAFF

Principal researchers: Prof. Dr. (HP) Julius Žilinskas, Prof. Habil. Dr. Antanas Žilinskas

Senior researchers: Doc. Dr. Algirdas Lančinskas, Doc. Dr. Rimantas Pupeikis

Researchers:

Doctoral students: Rima Kriauzienė, Eglė Zikarienė, Saulius Tautvaišas, Karolis Noreika

RESEARCH INTERESTS

Optimization and high-performance computing.

RESEARCH PROJECTS CARRIED OUT IN 2019

Projects Supported by University Budget

Project title: Global optimization. Prof. dr. Julius Žilinskas

Aim: Development of global optimization algorithms and application of them to optimization problems.

Main results:

1. Global optimization algorithms with constraints;
2. Heuristic algorithms for competitive facility location problems;
3. Bi-objective decision making in Bayesian global optimization;
4. Linear convolution computations online optimization algorithm.

Publication:

- Stripinis L., Paulavičius R., Žilinskas J., Penalty functions and two-step selection procedure based DIRECT-type algorithm for constrained global optimization // *Structural and Multidisciplinary Optimization*, **59**(6), 2019, p. 2155 – 2175.
- Žilinskas A., Calvin J., Bi-objective decision making in global optimization based on statistical models // *Journal of Global Optimization*, **74**, 2019, p. 599–609.
- Žilinskas A., Gimbutienė G., A hybrid of Bayesian approach based global search with clustering aided local refinement // *Communications in Nonlinear Science and Numerical Simulation*, **78**, 2019, p. 104857.
- Pupeikis R., Revised linear convolution // *Lietuvos matematikos rinkinys*. **60**, Ser. A, Proc. LMS, 2019, p. 33–38.

National Research Projects

Research Council of Lithuania. **Development and parallelization of ranking-based optimization algorithms** (No. 09.3.3-LMT-K-712-02-0087) Dr. A. Lančinskas, 2017-2019.

Description: The project will deal with combinatorial optimization algorithms and their application to high-performance computing systems.

The objective of the project is to develop a ranking-based algorithm for solving combinatorial optimization problems using high-performance computing systems.

The project is based on two activities: development of the ranking-based algorithm and its application to high-performance computing systems.

The goal of the first activity is to develop the ranking-based algorithm suitable to solve combinatorial optimization problems. Beside well-known combinatorial optimization test problems, various instances of competitive facility location problems will be used in an experimental investigation. It is planned to organize a research visit at University of Murcia, where researchers have experience in modelling and solving facility location problems.

The goal of the second activity is to develop parallel versions of the algorithm ensuring effective communication between processors. For this purpose, it is necessary to search for novel solution in high-performance computing in order to create an optimal communication strategy. Computational experiments will be performed using high-performance computing system at Vilnius University. It is also planned to collaborate with Edinburgh Parallel Computing Centre in developing the parallel algorithm for large-scale high-performance computing systems.

In the case of success, a ranking-based algorithm for solving combinatorial optimization problems using high-performance computing systems will be proposed and experimentally investigated. The proposed algorithm will allow to solve complex combinatorial optimization problems encountered in various research and industry areas. The proposed principal solutions to create and parallelize the algorithm will contribute to further researches in development and parallelization of similar algorithms.

Research Council of Lithuania. (No. S-MIP-17-97/LSS-580000-1328) Prof. Habil. Dr. Antanas Žilinskas, 2017-2019.

Description: The goal of the project is the creation of a unified stochastic global optimization (GO) theory. It is aimed at the breakthrough in the development of GO algorithms which will be based on fundamental postulates of the theory of rational decision making under uncertainty supplemented by the statistical models which represent considered classes of problems. The research is aimed at the reduction of complexity of auxiliary computations, and increase of dimensionality of practically solvable problems. The research is focused on single objective algorithms but some theoretical results are also generalized for multi-objective case. In the field of random search, the rate of convergence of general algorithms in the case of large dimension is investigated. In particular, we study precision of statistical estimates of the global minimum in the case of large dimensions, and show the degree in which these estimates suffer the so-called curse of dimensionality. Additionally, we study advantages and disadvantages of the use of quasi-random points in place of the random ones in large dimensions. Special versions of the algorithms are developed for the perspective computer patented as “the infinity computer” and their theoretical efficiency is assessed. The results of application of the developed algorithm to a real world problem are provided.

International Research Projects

1. COST action **Improving Applicability of Nature-Inspired Optimisation by Joining Theory and Practice** (ImAppNIO) CA15140. Member of Managing Committee Dr. A. Lančinskas. 2016–2020.

Description: Nature-inspired search and optimisation heuristics are easy to implement and apply to new problems. However, in order to achieve good performance it is

usually necessary to adjust them to the problem at hand. Theoretical foundations for the understanding of such approaches have been built very successfully in the past 20 years but there is a huge disconnect between the theoretical basis and practical applications. The development of powerful analytical tools, significant insights in general limitations of different types of nature-inspired optimisation methods and the development of more practically relevant perspectives for theoretical analysis have brought impressive advances to the theory-side of the field. However, so far impact on the application-side has been limited and few people in the diverse potential application areas have benefitted from these advances.

The main objective of the COST Action is to bridge this gap and improve the applicability of all kinds of nature-inspired optimisation methods. It aims at making theoretical insights more accessible and practical by creating a platform where theoreticians and practitioners can meet and exchange insights, ideas and needs; by developing robust guidelines and practical support for application development based on theoretical insights; by developing theoretical frameworks driven by actual needs arising from practical applications; by training Early Career Investigators in a theory of nature-inspired optimisation methods that clearly aims at practical applications; by broadening participation in the ongoing research of how to develop and apply robust nature-inspired optimisation methods in different application areas.

MAIN SCIENTIFIC ACHIEVEMENTS IN 2019

Pateikiami svarbiausieji 2019 m. mokslinės veiklos pasiekimai (jeigu buvo) – max 3

1. Global optimization algorithms with constraints;
2. Heuristic algorithms for competitive facility location problems;
3. Bi-objective decision making in Bayesian global optimization;
4. Linear convolution computations real time optimization algorithm.

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

1. Universidad de Almería (Spain)
2. Universidad de Murcia (Spain)
3. Universidad de La Laguna (Spain)
4. University of Edinburgh (United Kingdom)
5. Università della Calabria (Italy)
6. Cardiff University (UK)
7. New Jersey Institute of Technology (USA)

OTHER SCIENTIFIC ACTIVITIES

Prof. Dr. (HP) J. Žilinskas –

- Member of editorial boards of international journals:
 - *Computer Science* (AGH), <https://journals.agh.edu.pl/csci/about/editorialTeam>
 - *Informatica* (IOSPress/VU), <http://www.mii.lt/informatica/editors.htm>
 - *Information Technology and Control* (KTU), <http://itc.ktu.lt/index.php/ITC/about/editorialTeam>
 - *Journal of Global Optimization* (Springer), <http://www.springer.com/business+%26+management/operations+research/journal/10898?detailsPage=editorialBoard>

- *Mathematical Methods of Operations Research* (Springer)
<http://www.springer.com/mathematics/journal/186/PSE?detailsPage=editorialBoard>
- *Mathematical Modelling and Analysis* (VGTU),
<https://journals.vgtu.lt/index.php/MMA/editorialboard>
- *Open Computer Science* (De Gruyter), <https://www.degruyter.com/view/j/comp>
- *Open Engineering* (De Gruyter), <https://www.degruyter.com/view/j/eng>
- *Optimization Letters* (Springer),
<http://www.springer.com/mathematics/journal/11590?detailsPage=editorialBoard>
- *SN Operations Research Forum* (Springer Nature),
<https://www.springer.com/journal/43069/editors>
- 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>
- Member of Program/Scientific Committees
 - WCGO2019: 6th World Congress on Global Optimization, Metz, France, 8-10 July, 2019.
 - EUROPT2019: 17th Workshop on Advances in Continuous Optimization, Glasgow, UK, 28-29 June, 2019.
 - EURO2019: 30th European Conference on Operational Research, Dublin, Ireland, 23-26 June, 2019.
 - NUMTA2019: Numerical Computations: Theory and Algorithms, Le Castella, Italy, 15-21 June, 2019.

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 5 following International conferences.
- 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>
 - Control and Cybernetics, control.ibspan.waw.pl:3000/mainpage
 - *Statistics, Optimization and Information Computing*, www.iapress.org/index.php/soic
 - *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

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 CA15140 Improving Applicability of Nature-Inspired Optimisation by Joining Theory and Practice (ImAppNIO).
- Member of conference program committees:
 - *Black Box Discrete Optimization Benchmarking (BB-DOB) Workshop at the Genetic and Evolutionary Computation Conference (GECCO 2019)*
 - *3rd International Workshop on Theoretical Approaches to Performance Evaluation, Modeling and Simulation (TAPEMS 2019)*
 - *19th International Conference on Algorithms and Architectures for Parallel Processing (ICA3PP 2019)*
- Reviewer of international journals:
 - *Applied Mathematical Modelling*
 - *Baltic Journal of Modern Computing*
 - *Central European Journal of Computer Science*
 - *Computers and Industrial Engineering*
 - *Computers and Operation Research*
 - *Informatica*
 - *Journal of Global Optimization*
 - *Nonlinear Analysis: Modelling and Control*
 - *Open Engineering (Central European Journal of Engineering)*
 - *Optimization Letters*
 - *Research in Transportation Economics*

IMAGE AND SIGNAL ANALYSIS GROUP

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Head – Assoc. Prof. Dr. Povilas Treigys

STAFF

Senior research fellows: Assoc. Prof., Dr. Povilas Treigys, Dr. G. Korvel, Assoc. Prof., Dr. G. Tamulevičius, Dr. Jolita Bernatavičienė

Affiliated research fellows: Prof. Habil. Dr. K. Kazlauskas, Prof. Habil. Dr. Adolfas Laimutis Telksnys.

Senior specialist: G. Navickas

Doctoral students: B. Čiapas, M. Morkūnas, J. Venskus.

RESEARCH INTERESTS

Audio and image signal processing; random processes analysis and recognition.

RESEARCH PROJECTS CARRIED OUT IN 2019

Project Supported by University Budget

Project title: Digital signal analysis and modelling.

Tasks in 2019:

- To develop machine learning algorithms for lymphocyte nuclei in WSI image detections and classification.
- To develop autoecoder based collagen network extraction deep learning model in WSI images.
- To develop LSTM model for unusual maritime traffic detection.

- To explore white and colour noise impact on speech signal analysis and modelling.

Main results:

- Developed model for histological image cell segmentation and classification.
- Explored audio signal feature spaces and built classifier. Developed test set for Lithuanian speech phoneme automated segmentation.

International Research Projects

COST action „A new Network of European BioImage Analysts to advance life science imaging (NEUBIAS)“ Member of Managing Committee Assoc. Prof. Dr. P.Treigys 2016-2020:

- This Action is a programme for establishing a network of BioImage Analysts (BIAlysts), to maximize the impact of advances in imaging technology on the Life-Sciences (LSc), and to boost the productivity of bioimaging-based research projects in Europe. BIAlysts have recently emerged in various research institutions, but these experts are still not well recognised in the LSc community. The Action aims to provide a stronger identity to BIAlysts by organising a new type of meeting fostering interactions between all stakeholders including Life scientists, BIAlysts, microscopists, developers and the private sector.

COST action “Open Multiscale Systems Medicine (OpenMultiMed)” Member of Managing Committee Dr. J.Bernatavičienė 2016-2020:

- Human health and disease are characterized by a complex interplay of multiple factors from the genome to the exposome. For many complex diseases, a sufficiently detailed understanding of the underlying mechanisms has remained elusive, and therefore the development of effective cures continues to be major challenge. As a result, the socioeconomic burden (morbidity, mortality, financial cost) of complex diseases remains high and is likely to grow within Europe’s aging population. Systems medicine is an emerging interdisciplinary framework that aims to improve our understanding, prevention and treatment of complex diseases by integrating knowledge and data across multiple levels of biomedical organization.

COST action CA18231 "Multi3Generation: Multi-task, Multilingual, Multi-modal Language Generation", Member of Managing Committee Dr. G. Korvel 2019-2023

- Language generation (LG) is a crucial technology if machines are to communicate with humans seamlessly using human natural language. A great number of different tasks within Natural Language Processing (NLP) are language generation tasks, and being able to effectively perform these tasks implies (1) that machines are equipped with world knowledge that can require multi-modal processing and reasoning (e.g. textual, visual and auditory inputs, or sensory data streams), and (2) the study of strong, novel Machine Learning (ML) methods (e.g. structured prediction, generative models), since virtually all state-of-the-art NLP models are learned from data. Moreover, human languages can differ wildly in their surface realisation (i.e. scripts) as well as their internal structure (i.e. grammar), which suggests that multilinguality is a central goal if machines are to perform seamless language generation. Language generation technologies would greatly benefit both public and private services offered to EU citizens in a multilingual Europe and have strong economic and societal impacts.

COST action CA15225 "Fractional-order systems - analysis, synthesis and their importance for future design" Member of Managing Committee Assoc. Prof. Dr. G.Tamulevičius 2016-2020:

- Fractional-order systems have lately been attracting significant attention and gaining more acceptance as generalization to classical integer-order systems. Mathematical basics of fractional-order calculus were laid nearly 300 years ago and since that it has gained deeply rooted mathematical concepts. Today, it is known that many real dynamic systems cannot be described by a system of simple differential equation or of integer-order system. In practice we can encounter such systems in electronics, signal processing, thermodynamics, biology, medicine, control theory, etc. The Action will favour scientific advancement in above

mentioned areas by coordinating activities of academic research groups towards an efficient deployment of fractal theory to industry applications. The cooperation of researchers from different institutions will guarantee wide visibility of Action results.

Main results:

- Machine learning algorithms for tumour classification.
- Feature space analysis for machine based recognition.
- Machine learning algorithms for multiscale data analysis.
- Machine learning methods for language generation.
- Efficient deployment of fractal theory to industry applications.

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

- Hospital Kauno klinikos of Lithuanian University of Health Sciences (Lithuania)
- Vilnius University Hospital Santaros klinikos (Lithuania)
- National Cancer Institute (Lithuania)
- JSC NetCode (Lithuania)
- Brno University of Technology (Czech Republic)
- Gdansk University of Technology, Faculty of Electronics, Telecommunications and Informatics, Audio Acoustics Laboratory

OTHER SCIENTIFIC ACTIVITIES

Assoc. Prof. Dr. P. Treigys –

- reviewer of the journals:
 - *Informatica*, <http://www.mii.lt/informatica>;
 - *Modelling and Control Journal*, <http://www.mii.lt/NA>;

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 the 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 journals: *Informatica*, <http://www.mii.lt/Informatica/editors.htm>; *Information Technology and Control*, <http://www.itc.ktu.lt/index.php/ITC/about/editorialTeam>; *Tamkang Journal of Science and Engineering*, http://www2.tku.edu.tw/~tkjse/editorial_board-en.htm;
- 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/>;
- 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. G. Tamulevičius –

- reviewer for the international journals:
 - *Informatica*, <http://www.mii.lt/Informatica/>;
 - *Baltic Journal of Modern Computing*, www.lu.lv/baltic-journal-of-modern-computing;
 - *Nonlinear Analysis: Modelling and Control Journal*, <http://www.mii.lt/NA>;
 - *IEEE Access*, [IEEE Access](http://www.ieee.org).
- member of IEEE Computer society and Signal processing society sections.

Dr. G. Korvel –

- member of Lithuanian Computer Society, <http://www.liks.lt>;
- member of Lithuanian Society of Young Researchers. <http://www.ljms.lt>;
- member of Lithuanian Mathematical Society, <http://www.mif.vu.lt/lmd/>
- member of INSTICC (the Institute for Systems and Technologies of Information), <http://www.insticc.org/Portal/>;
- reviewer of international journals:
 - *Journal of the Audio Engineering Society* www.aes.org/journal;
 - *Archives of Acoustics* acoustics.ippt.gov.pl;
 - *Metrology and Measurement Systems* <http://www.metrology.pg.gda.pl>;
 - *Journal of Intelligent Information Systems* <https://link.springer.com/journal/10844>;
 - *Information Technology and Control* <http://itc.ktu.lt>;
 - *Informatica* www.mii.lt/informatica;
 - *Pattern Recognition Letters* www.journals.elsevier.com/speech-communication;
 - *Speech Communication* www.journals.elsevier.com/speech-communication;

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.liks.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*

G. Navickas –

- member of Lithuanian Computer Society, <http://www.liks.lt>;
- member of IEEE <http://www.ieee.org>.

INTELLIGENT TECHNOLOGIES RESEARCH GROUP

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STAFF

Principal researchers: Prof. Habil. Dr. Leonidas Sakalauskas, Prof. Dr. Rimvydas Laužikas

Senior researchers: Dr. Virginijus Marcinkevičius, Prof. Dr. Saulius Minkevičius, Prof. Dr. Darius Plikynas, Assoc. Prof. Dr. Igoris Belovas.

Affiliated researcher: Assoc. Prof. Dr. Stasys Steišūnas,

Junior researcher: Arūnas Miliuskas

Specialists and engineering staff: Dr. Gintautas Jakimauskas, Dr. Vilma Zubaitienė, Vytautas Dulskis, Snieguolė Meškauskienė, Laimutė Mikalauskienė, Martynas Sabaliauskas, Žygimantas Sideravičius.

Doctoral students: Donatas Kavaliauskas, Julija Kurilova, Jūratė Vaičiulytė, Liudas Ališauskas, Albertas Jurgelevičius, Raimundas Savukynas, Mantas Stankevičius, Vytautas Dulskis, Paulius Vaitkevičius, Neringa Urbonaitė.

RESEARCH INTERESTS

Machine learning and its application.

Artificial intelligence and its application.

Natural language processing.

Cyber security.

Mathematical modeling.

Image analysis.

Visual odometry and localization.

Data mining and visualization.

Application of modeling, classification and clustering methods in medicine (e.g. in genetics) and economics.

Optimization. Application of stochastic optimization methods in engineering.

Multi-agent systems: simulation and application in social research.

RESEARCH PROJECTS CARRIED OUT IN 2019

National Research Projects

Project title: Social Impact of Cultural Processes: Development of Metrics, Conceptual and Simulation Model. Dr. Darius Plikynas 2017– 2019.

Main goal is development of the measuring metrics, conceptual and agent-based simulation model aimed at investigation of the social impact of cultural processes.

Main results:

1. Conceptual modelling of social impact to the cultural processes (events, agents and objects) using CIDOC-CRM methodic.
2. Development of a novel metrics for the quantitative measuring of social capital and social cohesion.
3. Standardized ODD protocol (used for the development of the agent-based simulation tools) employment for the detailed (technical) description of the conceptual model.
4. Algorithmization and mathematical modelling using the detailed (technical) ODD description.
5. Selection and adaptation of an agent-based simulation platform [NetLogo](#), that is used for the programming implementation of the mathematical model.
6. Successful passing of the interim report reviewed by Lithuania science council experts.

Publications:

Accepted:

1. A. Laukaitis, D. Plikynas, E. Ostasius (2018) Sentence Level Alignment of Digitized Books Parallel Corpora. *Informatica*. Vol. 29, No. 4, 1–18.
2. D. Plikynas, L. Sakalauskas, R. Laužikas, A. Miliauskas, V. Dulskis. Agent-Based Simulation of Cultural Events Impact on Social Capital Dynamics. *IntelliSys2019* conference proceedings in the Springer series "Advances in Intelligent Systems and Computing".

In review:

1. R. Laužikas, D. Plikynas, L. Sakalauskas, A. Miliauskas, V. Dulskis. A Conceptual Model for Social Impact of Cultural Processes. *Social Indicators Research*. (WoS, IF=1,65)
2. D. Plikynas, L. Sakalauskas, A. Raudys. Conceptual Modelling of Brain State Dynamics as Free Energy and Entropy-based Processes. *Journal of Biological physics* (WoS, IF=1,0).

Conference announcements:

R. Laužikas, D. Plikynas, L. Sakalauskas. A Conceptual Model for Social Impact of Cultural Processes. *Conference CAA-2018*, Tubingen, 2018.

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

SAP (Germany)

Neurotechnology (Lithuania)

University of Tartu (Estonia)

Vilnius Gediminas Technical University (Lithuania)

Ghent University (Belgium)

Warsaw University of Technology (Poland)

Lithuanian Culture Research Institute (Lithuania)

OTHER SCIENTIFIC ACTIVITIES

Prof. 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 *European Working Group on Stochastic Optimisation* <http://www.mii.lt/EWGSO>
- Member of *European Working Group on Civil Engineering and Sustainable Development* <http://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-2016>.
- 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. D. Plikynas -

- Reviewer in
 - Computational and Mathematical Organization Theory (Springer)
 - Entropy (MDPI)
 - PeerJ
 - Economics (VU)
 - Information Technology and Control (KTU)
- Member of
 - Artificial Intelligence section of Lithuanian Computer Society (LIKS-AIS)
 - ESSA (European Social Simulation Association)
 - ECCAI (European Coordinating Committee for Artificial Intelligence)

Assoc. Prof. Dr. I. Belovas –

- Member of Lithuanian Mathematical Society, <http://www.mif.vu.lt/lmd/>
- Editorial board member of „Jaunuju mokslininku darbai”
http://www.su.lt/index.php?option=com_content&view=article&id=1226&Itemid=17349&lang=lt
- Reviewer of international journal “Nonlinear Analysis: Modelling and Control”

Assoc. Prof. Dr. S. Minkevičius –

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

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/>
- Member of European Working Group on Stochastic Optimisation
<http://www.mii.lt/EWGSO>
- Reviewer of international journal Informatica (IOSPress/VU)
- Member of editorial board of journal Applied Computer Systems
- Member of IST-141-RTG on Exploratory Visual Analytics group
- Substitute in COST action Statistical and machine learning techniques in human microbiome studies.

STATISTICS AND PROBABILITY GROUP

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Head – Prof. Habil. Dr. Kęstutis Kubilius

STAFF

Principal researchers: Prof. Habil. Dr. Kęstutis Kubilius
Dr. Saulius Norvidas

Senior researchers: Dr. Otera Daniele Ettore
Dr. Marijus Radavičius
Prof. Habil. Dr. Rimantas Rudzkis
Dr. Marijus Vaičiulis

Researchers: Dr. Arvydas Astrauskas
Dr. Andrius Čiginas
Dr. Dainius Dzindzalieta
Dr. Tomas Juškevičius
Dr. Valentas Kurauskas
Dr. Aleksej Bakšaev

Junior Researches: Dr. Juriy Novickij

Affiliated researchers:
Dr. Juozas Juvencijus Mačys
Prof. Dr. Remigijus Mikulevičius
Prof. Habil. Dr. Jonas Kazys Sunklodas

Emerite: Professor Emeritus Mifodijus Sapagovas

Doctoral students: Aidas Medžiūnas
Rūta Užupytė

RESEARCH INTERESTS: statistical inference for long memory processes, statistical hypothesis testing, heavy tails, self-similar processes, rough paths, econometrics, biostatistics, finite population statistics and statistical analysis of data, extremal problems in harmonic analysis, random graphs, combinatorics, discrete mathematics, algebraic geometry.

RESEARCH PROJECTS CARRIED OUT IN 2018

Projects Supported by University Budget

Analysis and application of of probabilistic models and the study of asymptotic properties. Prof. Habil. Dr. K. Kubilius. 2017–2019.

Optimal Littlewood – Offord type inequality for arbitrary multidimensional distributions is obtained.

Strong consistency and asymptotic normal estimator of solutions of SDE with non-Lipschitz diffusion coefficient driven by a fractional Brownian motion is obtained. It is proved that the Hurst estimator preserves its properties, if we replace the solution with its backward Euler approximation.

A method for estimating the approximation error using the maximum norm for the convergence of a finite-difference scheme of a two-dimensional nonlinear elliptic equation in a rectangular region with an integral boundary condition is proposed.

Main publications:

1. **Juškevičius, Tomas**; Šemetulskis, Gražvydas. Optimal Littlewood-Offord inequalities in groups // *Combinatorica*. Heidelberg : Springer Heidelberg. ISSN 0209-9683. eISSN 1439-6912. 2019, vol. 39, iss. 4, p. 911-921. DOI: 10.1007/s00493-018-3845-7.
2. **Sapagovas, Mifodijus**; Štikonienė, Olga; Jakubėlienė, Kristina; Čiupaila, Regimantas. Finite difference method for boundary value problem for nonlinear elliptic equation with nonlocal conditions // *Boundary value problems*. London : Springer Open. ISSN 1687-2762. eISSN 1687-2770. 2019, vol. 2019, iss. 1, art. no. 94, p. 39-62. DOI: 10.1186/s13661-019-1202-4

National Research Projects

Research Council of Lithuania. **A visit to the Lithuanian Institute of Science and Studies to raise the competence of scientists** (No. 09.3.3-LMT-K-712-12-0007) Prof. Habil. Dr. K. Kubilius. 2019-10-3 – 2019-10-26

The aim of the project is to improve the competence of VU Mathematics and Informatics scientists together with Ukrainian scientist prof. habil. dr. Yuliya Mishura in the study "Fractional stochastic processes with short and long memory and their applications.

Research Council of Lithuania. **Optimal inequalities for concentration function, entropy, and number of random polynomial roots** (No. 09.3.3-LMT-K-712-02-0151) dr. Tomas Juškevičius. 2017-12-04 – 2019-12-03

The aim of the project was to evaluate the Levy concentration function for the measure of the coupling coefficients, the Shannon and differential entropy estimators for random variables, and the estimation of the number of roots of random trigonometric polynomials.

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](http://www.springer.com/mathematics/journal/10986?detailsPage=editorialBoard;);
- editorial board member of the *Mathematical Modelling and Analysis*, <http://inga.vgtu.lt/~mma/> .

Prof. S. Norvidas –

- editorial board member of the *Lithuanian Mathematical Journal*, [http://www.springer.com/mathematics/journal/10986?detailsPage=editorialBoard](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](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/>;
- editorial board member of the journal *Lietuvos statistikos darbai* (Lithuanian Journal of Statistics), <https://www.journals.vu.lt/statisticsjournal>.

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* (Lithuanian Journal of Statistics), <https://www.journals.vu.lt/statisticsjournal>;
- editorial board member of the journal *Pinigu studijos* (*Monetary Studies*), http://www.lb.lt/pinigu_studijos_redkolegija.

Prof. Emeritus M. Sapagovas –

- editorial board member of the *Lithuanian Mathematical Journal*, <http://www.springer.com/mathematics/journal/10986?detailsPage=editorialBoard>;
 - editorial board member of the journal *Nonlinear Analysis: Modelling and Control*, <https://www.mii.lt/NA/>;
 - editorial board member of the journal *Informatica*, <https://www.mii.lt/Informatica/>;
- editorial board member of the *Mathematical Modelling and Analysis*, <http://inga.vgtu.lt/~mma/>.