

VU Faculty of Mathematics and Informatics

Institute of Data Science and Digital Technologies – Annual Report 2020



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

STAFF

63 research fellows (incl. 57 holding research degree),
18 teachers (all of them holding research degree),
40 doctoral students.

SUBDIVISIONS 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](#)

[Artificial Intelligence Laboratory](#)

RESEARCH AREAS

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

DOCTORAL DISSERTATIONS MAINTAINED IN 2020

Jūratė Vaičiulytė – in Informatics (N 009) defended on 23rd June

Scientific Supervisor: prof. habil. dr. Leonidas Sakalauskas

„[Study and Application of Hidden Markov Models to Online Analysis of Multivariate Sequence Data](#)“ [in Lithuanian] ([abstract](#))

Rima Kriauzienė – in Informatics (N 009) defended on 8th January

Scientific Supervisor: prof. habil. dr. Raimondas Čiegis,

Scientific Consultant: prof. dr. Julius Žilinskas

„[Parallel algorithms for non-classical problems with big computational costs](#)“
([abstract](#) [in Lithuanian])

MAIN CONFERENCES ORGANIZED IN 2020

- Working Group meeting of [COST Action CA15140 “Improving Applicability of Nature-Inspired Optimisation by Joining Theory and Practice”](#), February 17–18, 2020, Vilnius, Lithuania
- National Seminar on development and adaptation of [International Challenge on Informatics and Computational Thinking “Bebras”](#) tasks, September 4 – 6, 2020, Druskininkai, 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 (*project implementer*, until 31-03-2020);

Lector: dr. Aleksandr Igumenov;

Junior researcher: Linas Stripinis;

Doctoral students: Vaidas Jusevičius, Andrius Adamonis, Saulius Grigaitis, Jaroslava Arsenjeva, Rytis Bieliauskas, Arnoldas Budžys.

RESEARCH INTERESTS

Blockchain technologies

Global optimization

Optimization Software

Multi-objective optimization

High-Performance Computing

Artificial Intelligence

Image Processing

Big Data

Data Mining

Machine Learning

RESEARCH PROJECTS CARRIED OUT IN 2020

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, 2017-2020-03.31
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:

- The world's first deterministic solver (BASBL) for general bilevel optimization problems was developed.
- A new efficient DIRECT-type algorithm with local accelerators for general global optimization problems was developed.
- A parallel version of the evolutionary GENOCOP III algorithm to solve large-scale radiotherapy planning problems was developed.

Main publications:

1. **R. Paulavičius**, Y.D. Sergeyev, D.E. Kvasov, J. Žilinskas (2020) Globally-biased BIRECT algorithm with local accelerators for expensive global optimization. *Expert Systems With Applications*, 144,. DOI: [10.1016/j.eswa.2019.113052](https://doi.org/10.1016/j.eswa.2019.113052). 2019 Impact Factor: 5.452
2. **R. Paulavičius**, J. Gao, P.-M. Kleniati, C. S. Adjiman (2020). BASBL: Branch-And-Sandwich BiLevel solver. Implementation and computational study with the BASBLib test set. *Computers & Chemical Engineering*, 132, DOI: [10.1016/j.compchemeng.2019.106609](https://doi.org/10.1016/j.compchemeng.2019.106609). 2019 Impact Factor: 4.0
3. **E. Filatovas; O. Kurasova**, J. López Redondo, F. José. A reference point-based evolutionary algorithm for approximating regions of interest in multiobjective problems // TOP. New York : Springer. ISSN 1134-5764. eISSN 1863-8279. 2020, vol. 28, iss. 2, p. 402-423. DOI: [10.1007/s11750-019-00535-z](https://doi.org/10.1007/s11750-019-00535-z). 2019 Impact Factor: 1.452

Contractual Research

1. 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)
6. Chinese Institute of Electronics (China)

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.
- 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*
 - *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 the the InfoBalt Blockchain Workgroup
- Reviewer of international journals:
 - *IEEE Transactions on Systems, Man and Cybernetics: Systems*
 - *Engineering Optimization*
 - *Complexity*
 - *Journal of Global Optimization*
 - *Applied sciences*
 - *Information Technology and Control*
 - *Informatica*
 - *Control and Cybernetics*
 - *Baltic Journal of Modern Computing*

dr. V. Medvedev –

- Expert of FP7-ICT Committee (2013)
- Member of Lithuanian Computer Society, <http://www.lik.s.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 (IWoseMC), <http://iwosemc.eu/>. 2020, 2021 metai.
- 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)*.

L. Stripinis –

- Reviewer of international journals:
 - *Engineering Optimization*
 - *Journal of Global Optimization*
- Honor and awards:
 - *Research Council of Lithuania. Support of PhD students for academic achievements 2019-2020.*

dr. A. Igumenov –

- Member of the Lithuanian Computer Society (LIKS).
- 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 Visual Programming Laboratory”

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, Prof. Dr. Danguolė Melnikienė;

Affiliated researcher: Prof. Habil. Dr. Jonas Mockus;

Researcher: Dr. Rasa Karbauskaitė;

Junior Researchers: Dr. Martynas Sabaliauskas, Dr. Dovilė Stumbrienė, Jogaila Vaitiekaitis, Dr. Igor Katin, Žydrūnas Vaišnoras;

Specialists and engineering staff: Vytautas Tiešis, Dr. Laura Ringienė, Laimutė Mikalauskienė, Aušra Šubonienė, Jaroslava Arsenjeva;

Postdoctoral researcher: Gerda Ana Melnik-Leroy;

Doctoral students: Viktoras Bulavas, Povilas Gudžius, Rokas Gipiškis, Marta Karaliutė, Nikolaj Kondrat, Ingrida Pocė, Roma Purnaitė, Ričardas Toliušis, Žydrūnas Vaišnoras, Ramunė Vaišnorė, Eglė Zikarienė.

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 2020

Projects Supported by University Budget

Project title:

Cognitive computing development for solving the problems of data visualization, image analysis, and decision making. *Kognityvinių skaičiavimų galimybių plėtra duomenų vizualizavimo, vaizdų analizės ir sprendimų priėmimo uždaviniams spręsti* Prof. Habil. Dr. Gintautas Dzemyda, Prof. Dr. Olga Kurasova. 2020–2022

Description:

The aim of the project is to integrate cognitive computing capabilities into data visualization, image analysis, and multicriteria decision making.

Main results:

1. Development of a reference point-based evolutionary algorithm for approximating regions of interest in multiobjective problems.
2. A scientific basis has been developed for the new way of data dimensionality reduction and visualization by multidimensional scaling, new properties of the Geometric Multidimensional scaling have been disclosed.

Publications:

1. Filatovas, Ernestas; Kurasova, Olga; López Redondo, Juana; José, Fernández. A reference point-based evolutionary algorithm for approximating regions of interest in multiobjective problems. *TOP*. New York : Springer. ISSN 1134-5764. eISSN 1863-8279. 2020, vol. 28, iss. 2, p. 402-423. DOI: 10.1007/s11750-019-00535-z.
2. Dzemyda, G., Sabaliauskas, M. (2020). Geometric multidimensional scaling: A new approach for data dimensionality reduction. *Applied Mathematics and Computation*, Available online 18 September 2020, 125561. <https://doi.org/10.1016/j.amc.2020.125561>
3. Stumbrienė, Dovilė; Camanho, Ana S.; Jakaitienė, Audronė. The performance of education systems in the light of Europe 2020 strategy // *Annals of operations research*. New York : Springer Science+Business Media. ISSN 0254-5330. eISSN 1572-9338. 2020, vol. 228, no 2, special issue, p. 577-609. DOI: 10.1007/s10479-019-03329-5.

Project title: Geometric method for solving the problem of multidimensional scaling,
No. MSF-LMT-4. Prof. Habil. Dr. G. Dzemyda. 2020-2022.

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. (2020). Geometric multidimensional scaling: A new approach for data dimensionality reduction. *Applied Mathematics and Computation*, Available online 18 September 2020, 125561. <https://doi.org/10.1016/j.amc.2020.125561>
2. Sabaliauskas, M., Dzemyda, G. (2020) Visual Analysis of Multidimensional Scaling Using GeoGebra. In: Dzitac I., Dzitac S., Filip F., Kacprzyk J., Manolescu MJ., Oros H. (Eds.), *Intelligent Methods in Computing, Communications and Control. ICCCC 2020. Advances in Intelligent Systems and Computing*, Vol 1243. Springer, Cham. pp. 179-187. https://doi.org/10.1007/978-3-030-53651-0_15

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. Transformation Educational Goals into Performance Indicators in Lithuanian and International Education Policy // *Acta Paedagogica Vilnensia*. Vilnius: 2020, vol. 44, p. 18-33. DOI: 10.15388/ActPaed.44.2
2. Stumbrienė, Dovilė; Camanho, Ana S.; Jakaitienė, Audronė. The performance of education systems in the light of Europe 2020 strategy // *Annals of operations research*. New York : Springer Science+Business Media. ISSN 0254-5330. eISSN

1572-9338. 2020, vol. 228, no 2, special issue, p. 577-609. DOI: 10.1007/s10479-019-03329-5.

Research Council of Lithuania. **The influence of pandemic stress on consumer decision making - a cognitive analysis and prognosis for Lituanian economy.** (No. P-COV-20-53)
Dr. Gerda Ana Melnik-Leroy. 2020.

Description: We empirically examine how the objective changes in the financial situation of Lithuanian citizens and the experienced pandemic-induced stress affect their intentions to consume and their planned household expenses. Based on data from an online survey (N=1200) and on longitudinal consumption data, we made prognoses on the consumption of specific goods for three hypothetical Covid-19 development scenarios. Second, using k-mode clustering we provide the first typology of Covid-era consumers.

Main result: Results show that different groups of consumers adopt different strategies for the three pandemic development scenarios to cope with the economic and emotional hardship. Importantly, we found that the obtained groups are economically and socially heterogeneous, and the experienced stress and feeling of financial distress were important factors, determining their spending tendencies.

International Research Projects

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 INNOVATION) 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:
 - 8th International Conference on Computers Communications and Control (ICCCC), Agora University of Oradea, Oradea, Romania
 - International Conference on Sensor Networks (SENSORNET 2020)

- 14th International Baltic Conference on Databases and Information Systems (Baltic DB&IS 2020)
- Chairman of the Annual International Workshop „Data Analysis Methods for Software Systems“, Druskininkai, Lithuania, <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>

Prof. Dr. O. Kurasova –

- Member of editorial boards of international journals:
 - *Nonlinear Analysis: Modelling and Control*, <https://www.journals.vu.lt/nonlinear-analysis/>
 - *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>
- 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

Chief research fellow: Prof. Dr. Saulius Gudas;

Senior research fellow: Prof. Dr. Dalė Dzemydienė;

Research fellows: Dr. Romas Alonderis, Assoc. Prof. Dr. Audronė Lupeikienė, Dr. Saulius Maskeliūnas;

Junior research fellows: Dr. Jolanta Miliauskaitė, Arūnas Miliauskas;

Assistant professor: Dr. Asta Slotkeinė;

Assistant research fellow: Laima Paliulionienė;

Specialist: Prof. Dr. Olegas Vasilecas;

Affiliated professor: Prof. Dr. Albertas Čaplinskas;

Affiliated researchers: Prof. Habil. Dr. Stasys Jukna, Assoc. Prof. Habil. Dr. Regimantas Pliuškevičius, Assoc. Prof. Dr. Aida Pliuškevičienė;

Doctoral students: Mindaugas Jusis, Vytautas Radzevičius, Aleksandr Širaliyov, Karolis Noreika.

RESEARCH INTERESTS

Causality research in enterprise software engineering:

- Foundations of causality-based enterprise software engineering;
- Integration of causal models in the MDA / MDD process;
- Integration of causal models in business process and enterprise modeling;

Mathematical logic:

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

RESEARCH PROJECTS CARRIED OUT IN 2020

Projects Supported by University Budget

Engineering research in cyber-social (enterprise) systems. 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, 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 M. Jusis, V. Radzevičius, A. Širaliiov, K. Noreika. 2018–2020.

Main results obtained in 2020:

1. Domain causality modeling applied (S. Gudas, A. Valatavičius, A. Lupeikienė):
 - 1.1. Modified MDA / MDD process by adding a layer of causal models next to traditional (CIM, PIM, PSM) layers.
 - 1.2. A method and technology (prototype) for evaluating the interoperability of applications has been developed.
 - 1.3. The method of domain causal modeling is included in the research project: LMT research group project application (CAUSATEX), topic: “Integration of causal models in application engineering methods and tools” (evaluation stage) (S. Gudas, J. Miliauskaitė).
2. The study of the efficiency of the sea container loading synchronization method was performed (S. Gudas, M. Jusis).
3. An architecture of multilayer systems of e-services for monitoring of environment data has been developed (D. Dzemydienė, S. Maskeliūnas, V. Radzevičius, A. Miliauskas).
4. A general framework of membership function construction has been developed, a detailed example of the construction by modeling service quality characteristics has been provided (J. Miliauskaitė).
5. A complete and sound cyclic sequent calculus for common knowledge logic has been constructed. Based on the calculus, a decidability procedure for the mentioned logic has been presented (R. Alonderis, A. Pliuškevičienė, R. Pliuškevičius).

Main publications:

1. **Gudas, Saulius; Valatavičius, Andrius.** Extending model-driven development process with causal modeling approach // Data science: new issues, challenges and applications / Dzemyda, Gintautas, Bernatavičienė, Jolita, Kacprzyk, Janusz (Eds.). Cham : Springer, 2020. ISBN 9783030392499. eISBN 9783030392505. p. 111-143. (Studies in Computational Intelligence, ISSN 1860-949X, eISSN 1860-9503 ; vol. 869). DOI: 10.1007/978-3-030-39250-5_7.
2. **Valatavičius, Andrius; Gudas, Saulius.** A deep knowledge-based evaluation of enterprise applications interoperability // Data science: new issues, challenges and applications / Dzemyda,

- Gintautas, Bernatavičienė, Jolita, Kacprzyk, Janusz (Eds.). Cham : Springer Nature, 2020. ISBN 9783030392499. eISBN 9783030392505. p. 279-296. (Studies in Computational Intelligence, ISSN 1860-949X, eISSN 1860-9503 ; vol. 869). DOI: 10.1007/978-3-030-39250-5_15.
3. **Dzemydienė, Dalė**; Burinskienė, Aurelija; **Miliauskas, Arūnas**. An assessment of provision of heterogeneous services for sustainable cargo transportation process management by roads // Sustainability. Basel : MDPI AG. ISSN 2071-1050. eISSN 2071-1050. 2020, vol. 12, iss. 20, art. no. 8405, p. 1-20. DOI: 10.3390/su12208405. [DB: Scopus; Social Sciences Citation Index (Web of Science); Science Citation Index Expanded (Web of Science)] [Citav. rod.: 2.576 (2019, SCIE); 2.576 (2019, SSCI)]
 4. **Dzemydienė, Dalė**; Dzemydaitė, Giedrė; Gopiseti, Dinesh. Application of multicriteria decision aid for evaluation of ICT usage in business // Central European journal of operations research. New York : Springer. ISSN 1435-246X. eISSN 1613-9178. 2020, first published online, p. [1-21]. DOI: 10.1007/s10100-020-00691-9.
 5. **Dzemydienė, Dalė**; **Radzevičius, Vytautas**. An approach for networking of wireless sensors and embedded systems applied for monitoring of environment data // Data science: new issues, challenges and applications / Dzemyda, Gintautas, Bernatavičienė, Jolita, Kacprzyk, Janusz (Eds.). Cham : Springer, 2020. ISBN 9783030392499. eISBN 9783030392505. p. 61-82. (Studies in computational intelligence, ISSN 1860-949X, eISSN 1860-9503 ; vol. 869). DOI: 10.1007/978-3-030-39250-5_4. [DB: SpringerLink]
 6. Szelągowski, Marek; **Lupeikienė, Audronė**. Business process management systems: evolution and development trends // Informatica. Vilnius : Vilnius University Institute of Data Science and Digital Technologies. ISSN 0868-4952. eISSN 1822-8844. 2020, vol. 31, iss. 3, p. 579-595. DOI: 10.15388/20-INFOR429.
 7. **Miliauskaitė, Jolanta**; Kalibatienė, Diana. On general framework of type-1 membership function construction: case study in QoS planning // International journal of fuzzy systems. Heidelberg : Springer. ISSN 1562-2479. eISSN 2199-3211. 2020, vol. 22, iss. 2, p. 504-521. DOI: 10.1007/s40815-019-00753-4. [DB: Scopus; Science Citation Index Expanded (Web of Science)] [Citav. rod.: 4.406 (2019, SCIE)]
 8. **Alonderis, Romas**; **Pliuškevičius, Regimantas Ričardas**; **Pliuškevičienė, Aida**; Giedra, Haroldas. Loop-type sequent calculi for temporal logic // Journal of automated reasoning. Dordrecht : Springer. ISSN 0168-7433. eISSN 1573-0670. 2020, vol. 64, iss. 8, p. 1663-1684. DOI: 10.1007/s10817-020-09544-1.
 9. **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. 2020, vol. 28, no. 3, p. 261-280. DOI: 10.1093/jigpal/jzz022.

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

Riga Technical University (Latvia)

University of Tartu (Estonia)

Warsaw University of Technology (Poland)

Systems Research Institute Polish Academy of Sciences

University of Geneva (Switzerland)

University of Frankfurt (Germany)

OTHER SCIENTIFIC ACTIVITIES

Prof. Dr. Saulius Gudas

- reviewer of the *Baltic Journal of Modern Computing*, <http://www.bjmc.lu.lv/>;
- reviewer of the journal *Informatica*, <https://www.mii.lt/informatica/>;
- member of the Technical Committee TK8 of the Lithuanian Standardization Department;

- member of the Council of the Lithuanian Computer Society (LIKS);
- IFIP TC8 Information Systems member;
- representative of the National Digital Coalition from LIKS.

Prof. Dr. Dalė Dzemydienė

- editorial board member of the *Scientific Journal of Riga Technical University: Applied Computer Systems*, <https://acs-journals.rtu.lv/>;
- 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 International conference ALTA'20 "Advanced Learning Technologies and Applications. Short Learning Programmes", <https://ndma.lt/alta2020/en/programme-committee/>;
- member of the Council of the Lithuanian Computer Society (LIKS);
- 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/>.

Assoc. Prof. Dr. Audronė Lupeikienė

- editorial board member of the *Scientific Journal of Riga Technical University: Applied Computer Systems*, <https://acs-journals.rtu.lv/>;
- 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 13th International Conference on Agents and Artificial Intelligence (ICAART 2021), <http://www.icaart.org/>;
- reviewer for the *Informatica* journal, <https://www.mii.lt/informatica/>;

Dr. Saulius Maskeliūnas

- program committee member of the 14th International Baltic Conference on Databases and Information Systems (Baltic DB&IS 2020), <https://dbis.ttu.ee/>;
- chairman of the Council of the Lithuanian Computer Society, <https://www.liks.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>;
- board member of the Technical Committee LST TK4 "Information technology";
- member of the State Commission of the Lithuanian Language Sub-Commission of Language Technologies;

- member of the project "Development of New Generation Internet Access Infrastructure (RAIN-3)" steering committee.

Dr. Jolanta Miliauskaitė

- reviewer for the *Informacijos mokslai* journal, <https://www.zurnalai.vu.lt/informacijos-mokslai>;
- reviewer for the *International Journal of Computers Communications & Control*, <http://univagora.ro/jour/index.php/ijccc/>.

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/>;

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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Head – Prof. Dr. Valentina Dagienė

STAFF

Chief research fellow: Prof. Dr. V. Dagienė;

Senior research fellow: Dr. J. Kurilov;

Research fellows: Dr. T. Jevsikova, Dr. A. Juškevičienė, Dr. V. Dolgopolas;

Junior research fellow: Dr. G. Stupurienė;

Doctoral students: V. Dvareckienė, I. Krikun, T. Šiaulyš, L. Vinikienė;

Affiliated researchers: 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 2020

Projects Supported by University Budget

Research on Intelligent Technologies Application for Teaching, Learning and Cultural Environment.

Prof. Dr. V. Dagienė (leader), 2019–2020.

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 on informatics and computational thinking.

Main publications:

1. Dolgopolovas, Vladimiras; Dagienė, Valentina; Jevsikova, Tatjana. Methodological guidelines for the design and integration of software learning objects for scientific programming education // Scientific programming. London : Hindawi. ISSN 1058-9244. eISSN 1875-919X. 2020, vol. 2020, art. no. 6807515, p. [1-19]. DOI: 10.1155/2020/6807515. [DB: Scopus; Science Citation Index Expanded (Web of Science)] [Citav. rod.: 0.963 (2019, SCIE)]
2. Juškevičienė, Anita. Developing algorithmic thinking through computational making // Data science: new issues, challenges and applications / Dzemyda, Gintautas, Bernatavičienė, Jolita, Kacprzyk, Janusz (Eds.). Cham : Springer, 2020. ISBN 9783030392499. eISBN 9783030392505. p. 183-197. (Studies in Computational Intelligence, ISSN 1860-949X, eISSN 1860-9503 ; vol. 869). DOI: 10.1007/978-3-030-39250-5_10.
3. Kurilov, Jevgenij. On data-driven decision-making for quality education // Computers in human behavior. Amsterdam : Elsevier. ISSN 0747-5632. eISSN 1873-7692. 2020, vol. 107, art. no. 105774, p. 1-9. DOI: 10.1016/j.chb.2018.11.003. [DB: Scopus; Social Sciences Citation Index (Web of Science); Compendex] [Citav. rod.: 5.003 (2019, SSCI)]
4. Kurilov, Jevgenij; Kubilinskienė, Svetlana. Lithuanian case study on evaluating suitability, acceptance and use of IT tools by students – an example of applying technology enhanced learning research methods in higher education // Computers in human behavior. Amsterdam : Elsevier. ISSN 0747-5632. eISSN 1873-7692. 2020, vol. 107, art. no. 106274, p. 1-11. DOI: 10.1016/j.chb.2020.106274. [DB: Scopus; Social Sciences Citation Index (Web of Science); Compendex] [Citav. rod.: 5.003 (2019, SSCI)]

Research Council of Lithuania. Research internship. Using Constructivism, and Project and Challenge Driven Pedagogy for learning Computational Thinking. Dr. A. Juškevičienė, 2020-2021.

The research is aimed to propose the approach of using constructivism and challenge driven pedagogy implemented by merging design thinking and computational thinking (CT) taxonomy models through physical computing. The approach on learning CT by applying design thinking phases accomplished by CT taxonomy practices implemented by computational making activities moves the computational concepts from screen into the real world and allows learners to interact with them.

Juškevičienė, A. (2020). Developing Algorithmic Thinking Through Computational Making. In Data Science: New Issues, Challenges and Applications (pp. 183-197). Springer, Cham.

Juškevičienė, A. (2020). STEAM teacher for a day: a case study of teachers' perspectives on computational thinking. Informatics in Education, 19(1), 33-50.

Research Council of Lithuania. **EKSTRE - Nuotolinio darbo ir mokymo proceso organizavimo modelis ir rekomendacijos ekstremaliam ir pereinamajam laikotarpiui** (EKSTRE – A model of distance work and teaching process organization and recommendations for extreme and transition period), 2020. Head: KTU prof. dr. A. Venčkauskas.

The research projects investigate the educational processes, opportunities and challenges during the Covid-19 period. The research was carried out at the end of 2020 during the most challenging period for all educational organizations. The researchers from three Lithuanian universities (Kaunas University of Technology, Vilnius University and Gediminas Tech University) have provided the detailed analyses on online studies and main criteria for successful education based on administrative positions, and design makers of the educational organizations.

Butkiene, R., Dagiene, V., Gudoniene, D., Jasute, E., Navickiene, V. (2021) Organizing educational processes: qualitative research on opportunities, challenges, and sustainable quality factors during the pandemic period on higher education administration issues (submitted)

International Research Projects

COST: EUGAIN - CA19122 European Network for Gender Balance in Informatics, 2020-2024.

Action Chair: Prof. Maria Letizia JACCHERI

The main aim of this COST Action is to improve gender balance in Informatics at all levels, from undergraduate and graduate studies to participation and leadership in academia and industry, through the creation and strengthening of a truly European network of colleagues working on the forefront of the efforts for gender balance in Informatics in their countries, institutions and research communities. The Action will be building on knowledge and experience from their successes and failures, learning and sharing what has worked and how it could be transferred to different settings and practical realities across Europe. This network of excellence by fostering collaboration will be evolving and improving knowledge about measures, actions, and guidelines that have positive impact and results, working holistically towards the ultimate goal of a better gender balance in Informatics.

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, 2016-2020. Head: prof. dr. Valentina Dagiene

Seeking an essential change in education system and better opportunities for doctoral students in Ukraine, a unique project focussed around university-based hubs (Doctoral Schools / DocHubs) was established, which united 5 universities, 5 research institutes and the Ministry of Education and Science of Ukraine by coordinating Vilnius university. The project aimed to accelerate national implementation of Bologna-style 3rd cycle programs in Ukraine by building enabling structures, and to aggregate critical mass (integrating the resources of Academy of Sciences research institutes and the teaching capacities of universities) for PhD education.

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

Ankara University (Turkey)
DEL university (Indonesia)
ETH Zurich (Switzerland)
Freiburg University of Education (Germany)
KTH Stockholm (Sweden)
Lancaster University (UK)
Singapore National University (Singapore)
Taiwan Normal University (Taiwan)
Tallinn University (Estonia)
Vienna University of Technology (Austria)

OTHER RESEARCH ACTIVITIES

Prof. Dr. V. Dagiene –

- 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.); citation index DB Scopus for 2019 - 3,9.

- editor-in-Chief of the journal *Olympiads in Informatics* (Scopus, etc), <https://ioinformatics.org/page/loi-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 Council of Lithuanian Computer Society, <https://www.liks.lt/en/>;
- member of Lithuanian Mathematical Society, <http://www.mif.vu.lt/lmd/>;
- member of Steering Committee of International Olympiads in Informatics, <https://ioinformatics.org/page/committees/6>;
- chair of the Bebras Board (International Challenge on Informatics and Computational Thinking), <https://www.bebas.org/?q=community>.

Assoc. Prof. Dr. J. Kurilov –

- executive editor of the journal *Informatics in Education*, http://www.mii.lt/informatics_in_education/ (Clarivate Analytics 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/> (Clarivate Analytics Web of Science);
- co-editor Europe of the *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*, <http://www.academicjournals.org/JECI/index.htm>;
- editorial board member of the *International Journal On Advances in Software* (IARIA journal, USA), <http://www.iariajournals.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 the journal *Informatics in Education*, 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);

Dr. T. Jevsikova –

- member of International Federation for Information Processing (IFIP) TC3 WG 3.1 (Informatics for Secondary Education).

Dr. G. Stupurienė –

- executive editor of the journal *Informatics in Education*, https://www.mii.lt/informatics_in_education/editors.htm (Clarivate Analytics Web of Science Core Collection; Scopus; etc.).

MOST IMPORTANT RESEARCH DISSEMINATION ACTIVITIES

- Annual event – International Challenge on Informatics and Computational Thinking “Bebras”, organized by Valentina Dagienė, Tatjana Jevsikova, Vaidotas Kinčius, Gabrielė Stupurienė.
- Book: V. Dagienė, N. Bankauskaitė, S. Bružienė. Informatikos užduotys. 3-4 klasei [Informatics tasks, 3-4 grades; in Lithuanian]. Šviesa. 2020 (An electronic supplement to this textbook has been published as well as detailed methodological guidelines 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 researcher: Doc. Dr. Algirdas Lančinskas;

Affiliated researcher: Doc. Dr. Rimantas Pupeikis;

Doctoral students: Rima Kriauzienė, Eglė Zikarienė, Saulius Tautvaišas, Mindaugas Kepalas.

RESEARCH INTERESTS

Optimization and high-performance computing.

RESEARCH PROJECTS CARRIED OUT IN 2020

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. An algorithm for discrete competitive facility location problem with an asymmetric objective function and a binary customer choice rule has been proposed and investigated;
2. The efficiency of a multi-objective global optimization algorithm is theoretically evaluated.

Publications:

- **Lančinskas, Algirdas; Žilinskas, Julius; Fernandez, Pascual; Pelegrin, Blas.** Solution of asymmetric discrete competitive facility location problems using ranking of candidate locations // *Soft computing*. New York : Springer. ISSN 1432-7643. eISSN 1433-7479. 2020, vol. 24, iss. 23, p. 17705-17713. DOI: [10.1007/s00500-020-05106-0](https://doi.org/10.1007/s00500-020-05106-0).

- **Calvin, James; Žilinskas, Antanas.** On efficiency of a single variable bi-objective optimization algorithm // Optimization letters. Heidelberg : Springer. ISSN 1862-4472. eISSN 1862-4480. 2020, vol. 14, iss. 1, p. 259-267. DOI: [10.1007/s11590-019-01471-4](https://doi.org/10.1007/s11590-019-01471-4).

National Research Project

Research Council of Lithuania. *Development and parallelization of ranking-based optimization algorithms* (No. 09.3.3-LMT-K-712-02-0087) Dr. A. Lančinskas, 2017-2020.

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.

International Research Project

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 2020

1. An algorithm for discrete competitive facility location problem with an asymmetric objective function and a binary customer choice rule has been proposed and investigated;
2. The efficiency of a multi-objective global optimization algorithm is theoretically evaluated.

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>

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 following 4 International conferences: [22nd Int. Conference on Computer Systems and Technologies, *CompSysTech'20*](#), June 19-20, 2020, University of Ruse, Bulgaria; [13th Int. Workshop on Computational Optimization \(WCO'20\)](#), September 6-9, 2020, Sofia, Bulgaria; [6th Int. Conference on Machine Learning, Optimization, and Data Science](#), July 19-23, 2020, Certosa di Pontignano, Siena – Tuscany, Italy; [14th Learning and Intelligent Optimization Conference](#), May 24-28, 2020, Athens, Greece;
- 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/>
- Emeritus Member of the Lithuanian Academy of Sciences <http://www.lma.lt/akademijos-nariai-2019>.

Dr. A. Lančinskas –

- 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).
- 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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STAFF

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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, J. Jucevičius, S. Virbukaitė, M. Danilovaitė, R. Jurkus.

RESEARCH INTERESTS

Nurodomi katedros moksliniai interesai

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

RESEARCH PROJECTS CARRIED OUT IN 2020

Project Supported by University Budget

Project title: Digital signal analysis and modelling.

Tasks in 2020:

- To develop machine learning algorithms for lymphocyte nuclei in WSI image detections and classification.
- To develop autoencoder based collagen network extraction deep learning model in WSI images.
- To develop LSTM model for unusual maritime traffic detection.
- To explore white and color noise impact on speech signal analysis and modelling.
- To develop deep learning models for cross-linguistic speech emotion recognition.

Main results:

- Developed deep learning model for cell nuclei segmentation and lymphocyte identification in whole slide histology image.
- Developed deep learning model for cross-linguistic speech emotion recognition based on 2D feature spaces.
- Evaluation of Lombard speech models in the context of speech in noise enhancement.

1. Tamulevičius, Gintautas; Korvel, Gražina; Yayak, Anil Bora; Treigys, Povilas; Bernatavičienė, Jolita; Kostek, Bożena. A study of cross-linguistic speech emotion recognition based on 2D feature spaces // Electronics. Basel : MDPI AG. ISSN 2079-9292. eISSN 2079-9292. 2020, vol. 9, iss. 10, art. no. 1725, p. [1-13]. DOI: 10.3390/electronics9101725
2. Korvel, Gražina; Kąkol, Krzysztof; Kurasova, Olga; Kostek, Bożena. Evaluation of Lombard speech models in the context of speech in noise enhancement // IEEE access. Piscataway : IEEE. ISSN 2169-3536. 2020, vol. 8, p. 155156-155170. DOI: 10.1109/ACCESS.2020.3015421

National Research Projects

- **Creating a database of depersonalized eye fundus images.** Vilnius Region Biomedical Research Committee approval No.:158200-18/11-1057-572, 11-2018 – 10-2030, Project head: Dr. Povilas Treigys

The aim of biomedical research: to create a database of depersonalized eye fundus images to develop an artificial intelligence based system for early detection of eye fundus pathological changes that supports selected disease diagnosing, which will be used by primary care physicians and optometrists. Review and compare the topology of the deep learning networks on the basis of the collected eye fundus data, to develop models for disease recognition.

- **COVID-19 Infection in Lithuania: Modelling and Analysis of Social-economic Consequences,** project of Research Council of Lithuania, No. S-COV-20-34, 06-2020 – 12-2020, Project head: dr. Olga Štikonienė.

ARIMA and a new attention-based forecasting method were used to develop short-term forecasts of confirmed cases of COVID-19, which aim to predict trends in the spread of the virus in Lithuania using data from other countries with a longer history. The performed analysis enables to review the measures applied in the countries of the same cluster to evaluate the impact and effectiveness of the measures taken. The results obtained are published on the website <http://www.covid19.projektas.vu.lt/>.

International Research Projects

H2020 National Competence Centres in the framework of EuroHPC, Project duration 2020-9-1 – 2022-8-31, Project Reference: 951732.

- Within the EuroCC project under the European Union's Horizon 2020 (H2020), participating countries are tasked with establishing a single National Competence Centre (NCC) in the area of high-performance computing (HPC) in their respective countries. These NCCs will coordinate activities in all HPC-related fields at the national level and serve as a contact point for customers from industry, science, (future) HPC experts, and the general public alike. The EuroCC project is funded 50 percent through H2020 ([EuroHPC Joint Undertaking](#) [JU]) and 50 percent through national funding programs within the partner countries. The EuroCC activities—with 33 member and associated countries on board—is coordinated by the High-Performance Computing Center Stuttgart (HLRS). The project aims to elevate the participating countries to a common high level in the fields of **HPC, HPDA and artificial intelligence (AI)**. To this end, the EuroCC project will establish National Competence Centres (NCCs) in the participating countries, which will be responsible for surveying and documenting the core HPC, HPDA, and AI activities and competencies in their respective countries. Ultimately, the goal is to make HPC available to different users from science, industry, public administration, and society.

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 RESEARCH 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*.
 - *Neurocomputing* <https://www.journals.elsevier.com/neurocomputing>
 - *IEEE Journal of Biomedical and Health Informatics* <https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=6221020>
 - *International Journal of Applied Mathematics and Computer Sciences* <https://www.amcs.uz.zgora.pl/>
- 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;
- *Symmetry* <https://www.mdpi.com/journal/symmetry>
- *Applied Sciences* <https://www.mdpi.com/journal/applsci>
- *Electronics* <https://www.mdpi.com/journal/electronics>

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*
 - *Sensors*
 - *Applied Sciences*
 - *Journal of Marine Science and Engineering*

G. Navickas –

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

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Affiliated researchers: Prof. Habil. Dr. Leonidas Sakalauskas, Dr. Stasys Steišūnas;

Junior researcher: Neringa Urbonaitė;

Specialists and engineering staff: Dr. Gintautas Jakimauskas, Dr. Martynas Sabaliauskas, Dr. Vilma Zubaitienė, Snieguolė Meškauskienė, Laimutė Mikalauskiene, Raimundas Savukynas, Žygimantas Sideravičius;

Doctoral students: Liudas Ališauskas, Andrius Chaževskas, Vytautas Dulskis, Shubham Juneja, Vytautas Paura, Mantas Stankevičius, Neringa Urbonaitė, Paulius Vaitkevičius.

RESEARCH INTERESTS

- Machine learning and its application.
- Artificial intelligence and its application.
- Natural language processing.

- Cyber security.
- Mathematical modeling.
- Image analysis.
- 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 2020

Projects Supported by University Budget:

Theoretical and Applied Aspects of Machine Learning and Mathematical Modelling

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. New algorithms for 3D simulation and visualization of Riemann zeta function.
2. Experimental analysis of algorithms using ensembles of recurrent neural networks to detect phishing websites.
3. A model for queueing networks consisting of 100 subnets under high load conditions.
4. Completed LMT research group project No. P-MIP-17-368 “Kultūros procesų socialinio poveikio metrikos, konceptualaus bei imitacinio modelio kūrimas/ Development of metrics, conceptual and simulation models of the social impact of cultural processes.”

Main publications:

1. Belovas, I., Sabaliauskas, M. Series with binomial-like coefficients for the evaluation and 3D visualization of zeta functions. *Informatica*, 31(4) (2020), 1-22; DOI: 10.15388/20-INFOR434; Q1, Q2 (Mathematics, applied; Computer Science, Information Systems)
2. Vaitkevičius, Paulius; Marcinkevičius, Virginijus. Comparison of classification algorithms for detection of phishing websites // *Informatica*. Vilnius: Vilniaus universiteto Matematikos ir informatikos institutas. ISSN 0868-4952. eISSN 1822-8844. 2020, vol. 31, no. 1, p. 143-160. DOI: 10.15388/20-INFOR404. Q1, Q2 (Mathematics, applied; Computer Science, Information Systems)
3. Sakalauskas, L., Dulskis, V., Lauzikas, R., Miliauskas, A., & Plikynas, D. (2020). A probabilistic model of the impact of cultural participation on social capital. *The Journal of Mathematical Sociology*, 1-14. DOI: 10.1080/0022250X.2020.1725002 (Social sciences, Q1)

National Project

Title: Development of Internet portal of Integrated Lithuanian language and writing resources, products and services – Raštija 2. <http://www.raštija.lt/>

Dr. Virginijus Marcinkevičius. 2018– 2021.

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/>
- Reviewer of international journal “Nonlinear Analysis: Modelling and Control”

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 Lithuanian Computer Society, <http://www.liko.lt/en/>
- 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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Principal researchers: Prof. Habil. Dr. Kęstutis Kubilius,
Dr. Saulius Norvidas;

Senior researchers: Dr. Otera Daniele Ettore,
Dr. Marijus Radavičius,
Dr. Marijus Vaičiulis;

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

Junior Researcher: Dr. Jurij Novickij;

Affiliated researchers: Dr. Juozas Juvencijus Mačys,
Prof. Dr. Remigijus Mikulevičius,
Prof. Habil. Dr. Rimantas Rudzkis;

Affiliated professor: 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 2020

Projects Supported by University Budget

Analysis and applications of probabilistic and deterministic models. Prof. Habil. Dr. K. Kubilius (leader). 2020–2021.

In 2008, part of J. E. Littlewood's hypothesis about the number of roots of trigonometric sums with bounded coefficients was refuted. Despite considerable interest in the Littlewood problem, no progress has been made in estimating the upper bound of the minimum number of roots over the past decade. New results have been achieved.

For a class of fractional stochastic differential equations (FSDEs) with coefficients that may not satisfy the linear growth condition and non-Lipschitz diffusion coefficient, the positivity of the solutions of these equations is proved. It is shown that the trajectories of the fractional CKLS model are not necessarily positive for a certain diffusion coefficient. The almost sure convergence rate of the backward Euler approximation scheme for solutions of the considered SDEs is obtained. A strongly consistent and asymptotically normal estimator of the Hurst index $H > 1/2$ for positive solutions of FSDEs is obtained.

New iterative methods for solving systems of nonlinear differential equations with non-local conditions are investigated using the M-matrix theory.

Main publications:

10. **Juškevičius, Tomas; Kurauskas, Valentas.** On the Littlewood-Offord problem for arbitrary distributions // Random structures and algorithms, DOI: [10.1002/rsa.20977](https://doi.org/10.1002/rsa.20977)
11. **Kubilius, Kęstutis.** Estimation of the Hurst index of the solutions of fractional SDE with locally Lipschitz drift // Nonlinear analysis: modelling and control, 2020, vol. 25, no. 6, p. 1059-1078.

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*, <https://journals.vgtu.lt/index.php/MMA> .

Doc. S. Norvidas –

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

Prof. 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/>;
- editor-in-chief 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 *Pinigų 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 *Informatika*, <https://www.mii.lt/Informatika/>;

editorial board member of the *Mathematical Modelling and Analysis*, <https://journals.vgtu.lt/index.php/MMA>.

ARTIFICIAL INTELLIGENCE LABORATORY

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Head – Dr. *Virginijus Marcinkevičius*

STAFF

Senior researcher: Dr. Virginijus Marcinkevičius;

Researcher: Dr. Jūratė Vaičiulytė;

Junior researcher: Neringa Urbonaitė;

Doctoral students: Shubham Juneja, Vytautas Paura.

RESEARCH INTERESTS

Advance machine learning in process automatization.
Natural language processing.
Image processing and analysis with deep neural networks.
Visual odometry and localization.

RESEARCH PROJECTS CARRIED OUT IN 2020

National Research Projects

The main goal is to investigate machine and imitational learning usage for robot navigation and localization in real environments. Research of natural language processing applications in human-machine interface

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

SAP (Germany)
Neurotechnology (Lithuania)

OTHER SCIENTIFIC ACTIVITIES

Dr. V. Marcinkevičius –

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