### GROUP OF COGNITIVE COMPUTING

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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.

*Publication:*

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., Martın Garzon, G. E. (2019). Hyperspectral image classification using Isomap with SMACOF. *Informatica* 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.

*Publication:*

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 (EFECTAS)** (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/CA1512](http://www.cost.eu/COST_Actions/ca/CA15124)0

***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 Sience, <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>
* 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](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](https://www.biometricsociety.org/);
* country representative of International Biometric Association in Nord Baltic Region, [http://ibsnbr.org](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)