### 

### GROUP OF COGNITIVE COMPUTING

Akademijos 4, LT-08663 Vilnius

Tel. (+370 5) 210 9300, fax (+370 5) 272 9209

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

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

***STAFF***

**Principal researchers**: Prof. Habil. Dr. 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. Algis Garliauskas, Prof. Habil. Dr. Jonas Mockus

**Researchers:** Dr. Jolita Bernatavičienė, Dr. Rasa Karbauskaitė

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

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

**Doctoral students:** Liudas Ališauskas, Andrius Daranda, Povilas Gudžius, Rokas Jurevičius, Marta Karaliutė, Roma Puronaitė, Rimantė Rybnikovė, Giedrius Stabingis, Mantas Stankevičius, Dovilė Stumbrienė, Ričardas Toliušis, Viktoras Bulavas

***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 2018***

**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 to solve the problems in economics, health care, medicine and chemical engineering.

*Main results:*

1. Approximation of the ribs-bounded contour in a tomography scan slice has been developed and applied for feature-based registration of thorax CT scan slices.
2. The novel closed-form expression for the actual risk and the approximation of the expected risk associated with the linear classification of the Gaussian Markov Random Field observations are derived. Accuracy of the derived approximation is tested by using the simulated data.
3. Self-organizing map was applied for data mining in the artificial neural network-based decision support system for development of an energy-efficient built environment.
4. A heuristic approach to select the optimal configuration of the parallel MDS-type algorithm SMACOF on the available platforms in terms of energy efficiency has been proposed and investigated.
5. An automatic blood vessel classification algorithm, which is used for artery and vein width ratio measurements, is developed. Method is compared with other similar algorithms. The advantage of the developed algorithm among others is its ability to automatically adapt to image size, it is not dependent on eye fundus camera type and it reduces the influence of unevenly lighting of the image.

*Publication:*

1. **Bilinskas, Mykolas Jurgis**; **Dzemyda, Gintautas**; Trakymas, Mantas. Approximation of the ribs-bounded contour in a tomography scan slice // International journal of information technology & decision making. Singapore : World Scientific Publishing Company. ISSN 0219-6220. eISSN 1793-6845. 2018, Vol. 17, no 1, p. 83-102. DOI: 10.1142/S0219622017500298. [DB: Science Citation Index Expanded (Web of Science); Scopus; Applied Science & Technology Source; Business Source Premier; INSPEC; Zentralblatt MATH (zbMATH)]
2. **Dučinskas, Kęstutis**; Dreižienė, Lina. Risks of classification of the Gaussian Markov random field observations // Journal of classification. New York : Springer. ISSN 0176-4268. eISSN 1432-1343. 2018, vol. 35, iss. 3, p. 422-436. DOI: 10.1007/s00357-018-9269-7. [DB: SpringerLink; Academic Search Complete; Scopus; Science Citation Index Expanded (Web of Science)]
3. Kaklauskas, Artūras; **Dzemyda, Gintautas**; Tupėnaitė, Laura; Voitau, Ihar; **Kurasova, Olga**; Naimavičienė, Jurga; Rassokha, Yauheni; Kanapeckienė, Loreta. Artificial neural network-based decision support system for development of an energy-efficient built environment // Energies. Basel : MDPI. eISSN 1996-1073. 2018, vol. 11, iss. 8, p. 1-20. DOI: 10.3390/en11081994. [DB: Chemical abstracts; RePec; DOAJ; INSPEC; CAB Abstracts; EI Compendex Plus; Scopus; Current Contents / Engineering, Computing & Technology; Science Citation Index Expanded (Web of Science)]
4. Orts, Francisco; Filatovas, Ernestas; Ortega, Gloria; **Kurasova, Olga**; Garzon, Ester M. Improving the energy efficiency of SMACOF for multidimensional scaling on modern architectures // Journal of supercomputing. Dordrecht : Springer. ISSN 0920-8542. eISSN 1573-0484. 2018, First published online, [13 p.]. DOI: 10.1007/s11227-018-2285-x. [DB: Current Contents; Academic OneFile; Zentralblatt MATH (zbMATH); INSPEC; SpringerLink; Scopus; Science Citation Index Expanded (Web of Science)]
5. **Stabingis, Giedrius**; **Bernatavičienė, Jolita**; **Dzemyda, Gintautas**; Paunksnis, Alvydas; Stabingienė, Lijana; Treigys, Povilas; Vaičaitienė, Ramutė. Adaptive eye fundus vessel classification for automatic artery and vein diameter ratio evaluation // Informatica. Vilnius : Vilniaus universitetas Matematikos ir informatikos institutas. ISSN 0868-4952. eISSN 1822-8844. 2018, vol. 29, no 4, p. 757-771. DOI: 10.15388/Informatica.2018.191. [DB: Zentralblatt MATH (zbMATH); MatSciNet; Scopus; Science Citation Index Expanded (Web of Science)].

**National Research Projects**

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, Research Council of Lithuania) 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.

*Publications:*

Želvys, Rimantas; Dukynaitė, Rita; Vaitekaitis, Jogaila. Švietimo sistemų efektyvumas ir našumas kintančių švietimo paradigmų kontekste = Effectiveness and eficiency of educational systems in a context of shifting educational paradigms // Pedagogika : mokslo darbai. Vilnius : Lietuvos edukologijos universiteto leidykla. ISSN 1392-0340. eISSN 2029-0551. 2018, T. 130, Nr. 2, p. 32-45. DOI: 10.15823/p.2018.20

Jakaitienė, Audronė; Žilinskas, Antanas; Stumbrienė, Dovilė. Analysis of education systems performance in European countries by means of PCA-DEA // Informatics in education. Vilnius : Vilniaus universiteto Matematikos ir informatikos institutas. ISSN 1648-5831. eISSN 2335-8971. 2018, vol. 17, no 2, p. 245-263. DOI: 10.15388/infedu.2018.13

**International Research Projects**

1. COST action **Big Data Era in Sky and Earth Observation TD1403** Member of Managing Committee Prof. Dr. Olga Kurasova. 2014-2018, <http://www.cost.eu/COST_Actions/TDP/Actions/TD1403>
2. 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>
3. COST action **A new Network of European BioImage Analysts to advance life science imaging (NEUBIAS) CA15124** Member of Managing Committee Dr. Povilas Treigys 2016-2020, <http://www.cost.eu/COST_Actions/ca/CA15124>
4. 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 Psychological Computing Systems (PhyCS 2018),
  + 4th International Conference on Sensor Networks (SENSORNET 2018),
* Chairman of the 9th International Workshop „Data Analysis Methods for Software Systems“, Druskininkai, Lithuania, 2018, 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 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)
* Member of IFIP Technical Committee 12 Artificial Intelligence, <http://www.ifiptc12.org.uk/ifiptc12/members.php>
* Board member of Transportation Science and Information Technologies in Ministry of Transport and Communications of the Republic of Lithuania
* Board member of Military Science and Technologies in Ministry of National Defence of the Republic of Lithuania
* Member of Lithuanian 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
* Member 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/>
* 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)

**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*

**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 –**

* Member of Lithuanian Mathematical Society, <http://www.mif.vu.lt/lmd/>