### GROUP OF GLOBAL OPTIMIZATION

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

***STAFF***

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

**Senior researchers:**

**Researchers:** Dr. Algirdas Lančinskas

**Doctoral students:** Rima Kriauzienė, Eglė Zikarienė

***RESEARCH INTERESTS***

Optimization and high-performance computing.

***RESEARCH PROJECTS CARRIED OUT IN 2017***

**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. Created global optimization algorithms with rectangular subregions;
2. Created heuristic algorithms for competitive facility location problems.

*Publication:*

* Paulavičius, Remigijus; Chiter, Lakhdar; **Žilinskas, Julius**. Global optimization based on bisection of rectangles, function values at diagonals, and a set of Lipschitz constants // Journal of global optimization. New York, NY : Springer New York LLC. ISSN 0925-5001. eISSN 1573-2916. 2018, Vol. 71, iss. 1, spec. iss. SI, p. 5-20. DOI: 10.1007/s10898-016-0485-6.
* Calvin, James; Gimbutienė, Gražina; Phillips, William O.; **Žilinskas, Antanas**. On convergence rate of a rectangular partition based global optimization algorithm // Journal of global optimization. Dordrecht : Springer. ISSN 0925-5001. eISSN 1573-2916. 2018, vol. 71, iss. 1, spec. iss. SI, p. 165-191. DOI: [10.1007/s10898-018-0636-z](https://doi.org/10.1007/s10898-018-0636-z).
* Fernandez, Pascual; Pelegrin, Blas; **Lančinskas, Algirdas**; **Žilinskas, Julius**. The Huff versus the Pareto-Huff customer choice rules in a discrete competitive location model // Computational science and its applications – ICCSA 2018: 18th international conference, Melbourne, VIC, Australia, July 2–5, 2018: proceedings / Osvaldo Gervasi, Beniamino Murgante, Sanjay Misra, ... [et al.] (Eds.). Cham : Springer, 2018. ISBN 9783319951645. eISBN 9783319951652. p. 583-592. (Lecture notes in computer science, ISSN 0302-9743, eISSN 1611-3349 ; vol. 10961). DOI: [10.1007/978-3-319-95165-2\_41](https://doi.org/10.1007/978-3-319-95165-2_41).

**National Research Projects**

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

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

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

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

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

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

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

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

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

**International Research Projects**

1. COST action **Network for Sustainable Ultrascale Computing (NESUS) IC1305** Member of Managing Committee Dr. A. Lančinskas. 2014-2018, <http://www.cost.eu/COST_Actions/ict/Actions/IC1305>

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

2. 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 R&D&I (RESEARCH, DEVELOPMENT AND INNOVATION) PARTNERS***

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

***OTHER SCIENTIFIC ACTIVITIES***

**Prof. Dr. (HP) J. Žilinskas –**

* Member of editorial boards of international journals:
  + *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* (Taylor&Francis/VGTU), http://www.tandfonline.com/action/journalInformation?show=editorialBoard&journalCode=tmma20
  + *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
* Chair of managing board of Continuous Optimization Working Group of The Association of European Operational Research Societies (EURO), https://www.euro-online.org/websites/continuous-optimization/managing-board/
* Member of board of Lithuanian Operational Research Society (member society of EURO and IFORS), head of working group Optimization Methods and Applications, http://www.mii.lt/LitORS/
* Member of European Network of Excellence on High Performance and Embedded Architecture and Compilation (HiPEAC), <http://www.hipeac.net>
* Member of Program/Scientific Committees
  + 9th International Workshop Data Analysis Methods for Software Systems, Druskininkai, Lithuania, November 30 - December 2, 2017.
  + PPAM 2017: 12th International Conference on Parallel Processing and Applied Mathematics Lublin, Poland, September 10-13, 2017.
  + Euro-Par 2017: International European Conference on Parallel and Distributed Computing, Santiago de Compostela, Spain, August 28 - September 1, 2017.
  + EUROPT 2017: 15th EUROPT Workshop on Advances in Continuous Optimization, Montreal, Canada, July 12-14, 2017.
  + LION11: 11th Learning and Intelligent OptimizatioN Conference, Nizhny Novgorod, Russia, June 19-21, 2017.
  + GOC 2017: Global Optimization Conference, College Station, TX, USA, March 30 - April 1, 2017.

**Prof. Habil. Dr. A. Žilinskas –**

* Member of IFIP working group WG 7.6 Optimization-Based Computer Aided Modeling and Design, <http://www.ifip.org/bulletin/bulltcs/memtc07.htm>
* Member of American Mathematical Society <http://www.ams.org/cml>
* Member of programme committees of the following International conferences:
* CompSysTech 2015, Dublin, Ireland, 25-26 June 2015
* World Congress on Global Optimization, 2015, Gainesvile, Florida, Fed 22-25, 2015
* 8th Workshop on Computational Optimization, Lodz, Ploland, 13-16 September, 2015
* Member of editorial boards of international journals:
* *Journal of Global Optimization* (Springer), <http://www.springer.com/business+%26+management/operations+research/journal/10898?detailsPage=editorialBoard>
* *Informatica* (IOSPress/VU), <http://www.mii.lt/Informatica/editors.htm>
* Control and Cybernetics, control.ibspan.waw.pl:3000/mainpage
* *Statistics, Optimization and Information Computing, www.iapress.org/index.php/soic*
* *Journal of Intelligent Learning Systems and Applications*, <http://www.scirp.org/journal/jilsa/>
* *International Journal of Grid and High Performance Computing*, <http://www.igi-global.com/Bookstore/TitleDetails.aspx?TitleId=1105&DetailsType=ReviewBoard>
* *The Open Cybernetics and Systemics Journal*, <http://www.bentham.org/open/tocsj/EBM.htm>
* *Baltic Journal of Modern Computing* <http://www.bjmc.lu.lv/editorial-board/>
* Member of the Lithuanian Academy of Sciences, <http://lma.lt> <http://lma.lt/index.php?option=com_k2&view=item&layout=item&id=235&Itemid=243&lang=lt>

**Dr. A. 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 IC1305 Network for Sustainable Ultrascale Computing (NESUS).
* Member of management committee of COST action CA15140 Improving Applicability of Nature-Inspired Optimisation by Joining Theory and Practice (ImAppNIO).
* Reviewer of international journals:
  + *Journal of Global Optimization*
  + *Central European Journal of Computer Science*
  + *Central European Journal of Engineering*
  + *Informatica*
  + *Optimization Letters*
  + *Computers & Operations Research*
  + *Baltic Journal of Modern Computing*