

DEPARTMENT OF INTELLIGENT SYSTEMS

E-9

The Department of Intelligent Systems develops new methods and techniques for intelligent computer systems, with applications in the areas of the information society, computer science and informatics, and network communication systems. The main research areas are ambient intelligence, computational intelligence, agent and multi-agent systems, language and speech technologies, and smart cities together with electronic and mobile health. The department collaborates closely with the Faculty of Computer and Information Science of the University of Ljubljana on the joint research program "Artificial Intelligence and Intelligent Systems", led by Prof. Dr. Ivan Bratko. The department also closely collaborates with industry and significantly contributes the introduction of intelligent systems into products and services.



Head:
Prof. Matjaž Gams

Intelligent systems simulate intelligence so that a typical user perceives them as truly intelligent. In reality, these systems use complex mechanisms and implement them on digital computers to imitate human behavior, while they also exploit raw, exponentially growing computer power. This field is somewhat broader than only artificial intelligence, both are rapidly improving worldwide and enabling the development of information society.

Ambient intelligence is a research area aiming to introduce technology into our everyday environment in a friendly way undemanding for the user. The main topic of ambient intelligence tackled by the department in 2016 was e-health. We started the H2020 project **HeartMan**, which we also coordinate. The project is developing an application that will help congestive-heart-failure patients manage their condition: it will monitor them with a sensing wristband, and provide advice on exercise, nutrition etc. So far we have developed decision models based on medical guidelines and user requirements, which will serve as the foundation for the application. Related to this project is the development of methods for the prediction of hospitalizations of heart-failure patients, and for the evaluation of their health based on stethoscope sound recordings. In the H2020 project **IN LIFE**, we are attempting to translate some solutions intended to prolong the independence of the elderly into real life. We prepared a smart-watch application that detects falls and similar events. This application is connected to a web application through which the carers can monitor their charges, send them messages and organize home visits. By the end of the year this solution was sufficiently mature to be used in pilots with 150 users, to be organized in cooperation with the Slovenian company Doktor 24 in early 2017. The AAL project **Fit4Work** is aiming to help older workers do their job more easily by providing advice on relaxation, exercise and work environment (temperature, CO₂ in the air etc.). To this end, we developed a method that recognizes mental stress using a wristband with physiological sensors. The method takes into account the context of a potentially stressful event, which makes it highly accurate. We also developed a method that can analyze physical activity with the sensors in the wristband and smartphone regardless of which device is worn and where. Finally, we use an ontology to select reasonable actions to improve the work environment, after which we simulate the outcome of each and recommend the best one. All our ambient-intelligence projects use wearable sensing devices, whose use is limited by their typically small batteries. As **doctoral research**, we are therefore developing a general method that can intelligently turn sensors on and off in such a way that the energy consumption is as small as possibly without sacrificing a lot of quality of the results obtained with these sensors.

Computational intelligence is a study of stochastic search, optimization and learning methods, inspired by biological and physical systems. Research in this area at the Department of Intelligent Systems focuses on

In the IN LIFE project we developed a smart watch for the elderly and we are running pilot tests on 150 users.



Figure 1: Within the framework of the H2020 IN LIFE project we developed a smart watch for the elderly and prepared 150 pieces for a 6-month-long pilot testing. The watch allows around 10 functions, including calls to the carer, automatic fall detection, location identification and call for help, notifications, monitoring of physical activity, etc. The system is a personal assistant and carer for the elderly. Our vision is to introduce it to the care of the elderly Europe-wide, thus increasing the quality of life.

In the AAL project Fit4Work we developed a method for stress detection using a wristband with physiological sensors. The method takes into account the context of a potentially stressful event, which makes it highly accurate.

The embedded computer system for manufacturing quality control developed by the Jožef Stefan Institute and Kolektor Group company is a key achievement of the COPCAMS project.

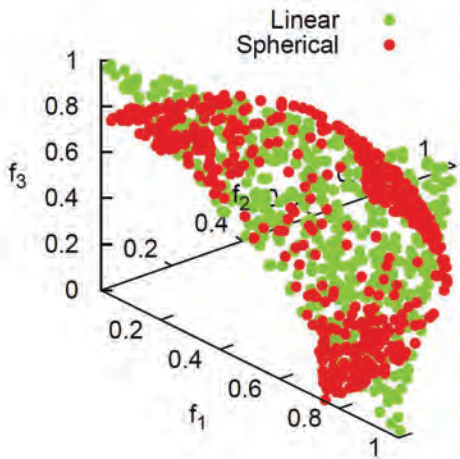


Figure 2: We design visualization methods for multiobjective optimization that assist decision-makers in selecting among trade-off solutions. A series of publications in the previous years was complemented with a tutorial given at the Genetic and Evolutionary Computation Conference (GECCO) 2016.

The ACCUS project developed a coordination platform for smart cities that enables the control of various city subsystems and provides several services for citizens.



Figure 3: A manufacturing quality control system resulting from the COPCAMS project is based on machine vision, machine learning and optimization.

In the Smart Specialisation programs we are developing several solutions for smart cities and communities, smart building and homes, and sustainable food.

the evolutionary computation methods. We study evolutionary algorithms for multiobjective optimization, their acceleration through parallel computing and surrogate models, visualization of their results, and applications in engineering design and optimization problems. These methods are being transferred to practice, especially in the area of production process optimization. In 2016, we finished the COPCAMS project approved for funding under the Artemis call. Together with the Slovene industrial partner

Kolektor Group and international partners, we developed a procedure for product quality control that is based on machine vision, machine learning and optimization, and operates on an embedded computer architecture. The procedure is now used in manufacturing of graphite commutators for automotive industry in Kolektor. It supports dimensional measurements, assessment of the cooper-graphite joints and non-contact measurements of commutator roughness. According to project reviewers, this was the most successful project achievement. We also started an H2020 Twinning project SYNERGY whose objective is to strengthen our research and innovation potential in parallelization and surrogate modelling and to explore the potential of combining the two techniques in multi-objective optimization. Three partners with complementary expertise cooperate in this endeavor: the Jožef Stefan Institute, the University of Lille, and Cologne University of Applied Sciences. The expertise and solutions gained through this cooperation will be disseminated to both academic and industrial organizations, particularly those participating in the Slovene Smart Specialisation Strategy. In addition, a bilateral Slovenian-Japanese research project was approved for funding and initiated. It is aimed at advancing the methodology of evolutionary multiobjective optimization for real-world applications. We cooperate with Shinshu University, Nagano, on developing optimization algorithms for space exploration and transportation network design.

In the field of agent and multi-agent systems the key research areas are focused on the development of smart autonomous systems for the control of smart cities, smart homes and the preservation of cultural heritage. In this year we have successfully concluded the European project ACCUS that aimed at developing an integration and coordination platform for urban systems to build applications across various domains, providing adaptive and cooperative control for urban subsystems, and optimizing the combined performance of the city. In the final presentation we presented a system for balancing the overall electricity consumption in the city by curbing the electricity spikes that occur during the day. In addition, the system optimizes the electricity consumption in smart houses and the production in thermal power plants, and manages the traffic flow and thus affects the external parameters, such as air quality. We continue the research in this area in the Smart Specialisation program EkoSMART in the field of smart cities and communities. The purpose of the program is to develop a smart city ecosystem with all the support mechanisms that are necessary for efficient, optimized and gradual integration of different smart city areas into a unified and well connected system. Within the program we are involved in activities linked to the research and development projects "Zasnova ekosistema pametnega mesta" and "Elektronsko in mobilno zdravstvo" (EMZ), where we are the lead partner. We are also involved in the Smart Specialisation program IQDOM in the field of smart buildings and homes, coordinated by Gorenje. Our focus will be on the development of smart home automation services. The aim is to apply advanced machine learning and optimization methods in order to generate real-time control strategies that increase the users' comfort and, at the same time, decrease operational costs of the smart home. We will apply similar learning algorithms also to heat pumps. The controller learns the user's behaviour and formulates a strategy for water heating during periods of cheaper electricity and, at the same time, lowers the temperature of the stored water during days of lower consumption. In the Interreg AS-IT-IC project we will develop an integrated touristic platform for cross-border tourist exchange, tour planning and effective communication between tourists and tourist offices. In the

Horizon 2020 Twinning project **eHeritage** we continue to provide support to increase the capacity and quality of the research and innovation excellence of the Romanian partner in the area of cultural heritage preservation using intelligent methods and 3D modelling, and employing augmented and virtual reality. To this end, we organized the eHeritage workshop within the Information Society 2016 multiconference. During the same event the project partners presented products and applications based on the virtual reality technology (Heritage awareness day).

In the field of **speech and language technologies** we work on speech synthesis, semantic analysis of text and question answering. Together with companies Alpineon and Amebis we developed a new, high-quality speech synthesizer eBralec (<http://ebralec.si/>). The synthesizer is improved on both understandability and natural perception of the speech. The software package already has more than a thousand subscribers and is an indispensable tool of blind and visually-impaired users (it is the »official« speech synthesizer for the Society of visually impaired of Slovenia) and people with reading impairments (society Bravo). For these users, eBralec is free of charge and can be ordered in the Library for the blind and visually impaired (<http://www.kss-ess.si/ebralec-sintetizator-govora-slovenskega-jezika/>). Since 2016, the application DarsTraffic+, which provides users traffic information, also uses the eBralec software. This application was 1st on the App Store and 3rd in Google Play. According to the media, its key functionality and advantage are the audio settings. We have also developed the free service of speech synthesis for mobile devices (<http://dis.ijs.si/dyslex/>).

In collaboration with the Computer Systems Department, we organized the **7th International Conference on Bioinspired Optimization Methods and their Applications – BIOMA 2016** that took place from 18 to 20 May 2016 in Bled, Slovenia. The conference was devoted to theoretical and practical aspects of computer optimization methods inspired by natural phenomena. Its program consisted of 19 presentations by 45 coauthors from 11 countries. The invited lecturers were Prof. Thomas Bartz-Beielstein from the Cologne University of Applied Sciences and Prof. El-Ghazali Talbi from the University of Lille. Selected papers from the conference will be published in the extended form in the Applied Soft Computing journal. Collocated events were the 28th Slovene Workshop on Nature-Inspired Algorithms and the H2020 SYNERGY project meeting and training.

From 10 to 14 October 2015, the **19th International Multiconference Information Society – IS 2015** (is.ijs.si) took place at Jožef Stefan Institute. It consisted of 13 independent conferences with 200 presented papers. Four conference awards were presented: for lifetime achievements ("Donald Michie and Alan Turing" award) to Prof. Tomaž Pisanski, for current achievements in the field of information society to Prof. Blaž Zupan, and the information strawberry and lemon for the best and worst public information-society services.

Some outstanding publications in the past year

1. Cvetković, B., Janko, V., Romero, A. E., Kafali, Ö., Stathis, K., Luštrek, M. Activity recognition for diabetic patients using a smartphone. *J. med. syst.*, 40 (2016) 256-1-256-8
2. Gjoreski, M., Gjoreski, H., Luštrek, M., Gams, M. How accurately can your wrist device recognize daily activities and detect falls?. *Sensors*, 16 (2016) 800-1-800-21
3. Tavčar, A., Kužnar, D., Gams, M. Hybrid multi-agent strategy discovering algorithm for human behavior. *Expert systems with applications*, 71 (2017) 370-382
4. Veček, N., Mernik, M., Filipič, B., Črepinšek, M. Parameter tuning with Chess Rating System (CRS-Tuning) for meta-heuristic algorithms. *Information Sciences*, 372 (2016), 446-469

Organization of conferences, congresses and meetings

1. 28th Slovene Workshop on Nature-Inspired Algorithms, AVN, Bled, 18. 5. 2016
2. 7th International Conference on Bioinspired Optimization Methods and their Applications, BIOMA 2016, Bled, 18.-20. 5. 2016
3. Conference Genetic and Evolutionary Computation Conference, GECCO 2016, Denver, USA, 20.-24. 7. 2016



Figure 4: Fit4Work application, which helps older workers relax, be physically fit and have a good work environment (left). Measurements of human energy expenditure needed to develop the application (right).

Together with companies Amebis and Alpineon, we developed a high-quality speech synthesizer eBralec (<http://ebralec.si/>).

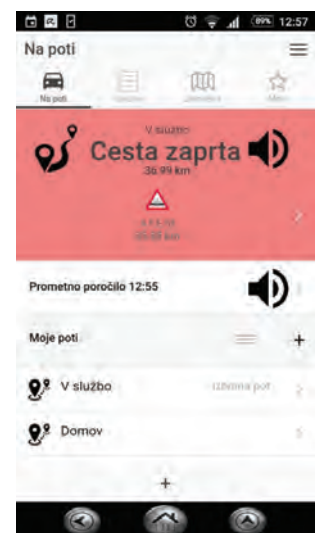


Figure 6: The application DarsTraffic+, which safely provides users traffic information, uses the eBralec software.

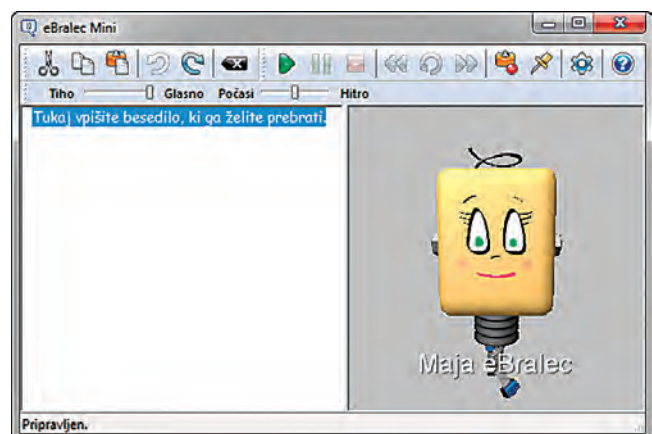


Figure 5: A new, high-quality speech synthesizer eBralec (<http://ebralec.si/>).

4. Workshop BBOB (Bi-Objective Blackbox Optimization Benchmarking) at Genetic and Evolutionary Computation Conference, GECCO 2016, Denver, USA, 20. 7. 2016
5. Workshop Women@GECCO at conference Genetic and Evolutionary Computation Conference, GECCO 2016, Denver, USA, 21. 7. 2016
6. Special Section Multiobjective Optimization with Surrogate Models, IEEE World Congress on Computational Intelligence, IEEE WCCI 2016, Vancouver, Canada, 24.-29. 7. 2016
7. Workshop Austrian-Slovenian Intelligent Tourist Information Center (AS-IT-IC), Ljubljana, Slovenia, 26. 9. 2016.
8. 19th International Multiconference Information Society, IS 2016, Ljubljana, Slovenia, 10.-14. 10. 2016; independent conferences:
 - Slovenian conference on artificial intelligence
 - Facing demographic challenges
 - Cognitive science
 - Collaboration, software and services in information society
 - Data mining and data warehouses
 - Human-computer interaction in information society (HCI-IS)
 - Workshop E-Heritage
 - Computer science and informatics: yesterday for tomorrow
 - 25th anniversary of internet in Slovenia
 - 3rd student computer science research conference
 - Ekosmart in EMZ
 - Education in information society (VIVID)
 - Middle-European conference on applied theoretical computer science (Matcos 2016)
9. eHeritage awareness day: presentation of virtual reality applications, Ljubljana, 13. 10. 2016
10. NATO Lecture series SET-235, Ljubljana, 27.-28. 10. 2016

Patent granted

1. Matjaž Gams, Hristijan Gjoreski, Mitja Luštrek, Method and system for detecting a person driving a vehicle while using a mobile computing device, SI24796 (A), Slovenian Intellectual Property Office, 29. 02. 2016.

INTERNATIONAL PROJECTS

1. Adaptive Cooperative Control in Urban (sub) Systems
Prof. Matjaž Gams
Ministrstvo za Gospodarstvo
2. COgnitive & Perceptive CAMeraS: COPCAMS
Prof. Bogdan Filipič
Ministrstvo za Gospodarstvo
3. Austrian-Slovenian Intelligent Tourist Information Center (AS-IT-IC)
Prof. Matjaž Gams
Služba Vlade Republike Slovenije za Razvoj
4. COST TD1405; ENJECT, European Network for the Joint Evaluation of Connected Health Technologies
Božidara Cvetković, B. Sc.
Cost Office
5. H2020 - IN LIFE; INdependent Living support Functions for the Elderly
Prof. Matjaž Gams
European Commission
6. H2020 - eHERITAGE; Expanding the Research and Innovation Capacity in Cultural Heritage Virtual Reality Applications
Prof. Matjaž Gams
European Commission
7. H2020 - HeartMan; Personal Decison Support System for Heart Failure Management
Dr. Mitja Luštrek
European Commission
8. H2020 - SYNERGY; Synergy for Smart Multi-Objective Optimisation
Prof. Bogdan Filipič
European Commission
9. Advanced Methodology of Evolutionary Multi- and Many-Objective Optimization for Real-World Applications
Prof. Bogdan Filipič
Slovenian Research Agency

RESEARCH PROGRAM

1. Artificial Intelligence and Intelligent Systems
Prof. Matjaž Gams

R & D GRANTS AND CONTRACTS

1. Adaptive Cooperative Control in Urban (sub) Systems
Prof. Matjaž Gams
COgnitive & Perceptive CAMeraS: COPCAMS
Prof. Bogdan Filipič
Ministry of Economic of the Republic of Slovenia
Self-management of physical and mental fitness of older workers
Dr. Mitja Luštrek
Ministry of Education, Science and Sport of the Republic of Slovenia
2. Conference BIOMA 2016; The 7th International Conference on Bioinspired Methods and their Applications, Bled, Slovenia, 18.-20.05.2016
Prof. Bogdan Filipič
3. The 19th International Multiconference Information Society 2016 (IS2016), JSI, Ljubljana, Slovenia, 10 October - 14 October 2016
Prof. Matjaž Gams
4. Intelligent home of the new generation designed on smart appliances and wood
Prof. Matjaž Gams
Ministry of Education, Science and Sport of the Republic of Slovenia
5. Smart City Ecosystem - EkoSmart
Prof. Matjaž Gams
Ministry of Education, Science and Sport of the Republic of Slovenia

NEW CONTRACT

1. The inclusion of off-line speech synthesizer into the eBralec Mobile app for the Android operating system
Dr. Tomaž Šef
Amebis, d. o. o., Kamnik

VISITORS FROM ABROAD

1. Boris Naujoks, Jörg Stork, Cologne University of Applied Sciences (TH Köln), Gummersbach, Germany, 10.-11. 2. 2016
2. El-Ghazali Talbi, prof. dr. Nouredine Melab, University Lille 1, Lille, France, 10.-11. 2. 2016
3. dr. Christian Fabre, dr. Alexandre Guerre, Julie Foucault, Commissariat à l'énergie atomique et aux énergies alternatives (CEA), Grenoble, France, 18. 4. 2016
4. Kenzi Djouhri, IUT de Cachan IUT de Cachan Génie Electrique, Paris, France, 25. 4.-15. 7. 2016
5. Thomas Justice, IUT de Cachan IUT de Cachan Génie Electrique, Paris, France, 25. 4.-15. 7. 2016
6. Hakim Kebli, IUT de Cachan IUT de Cachan Génie Electrique, Paris, France, 3. 5.-15. 7. 2016
7. Thomas Bartz-Beielstein, Jörg Stork, Martin Zaefferer, Cologne University of Applied Sciences (TH Köln), Gummersbach, Germany, 17. 5. 2016
8. Adam Benjelloun, IUT de Cachan, IUT de Cachan Génie Electrique, Paris, France, 20. 5.-12. 8. 2016
9. Timothée Foulon, IUT de Cachan, IUT de Cachan Génie Electrique, Paris, France, 20. 5.-12. 8. 2016
10. Florian Lemaître, IUT de Cachan IUT de Cachan Génie Electrique, Paris, France, 20. 5.-12. 8. 2016
11. prof. dr. Kiyoshi Tanaka, prof. dr. Hernán Aguirre, Shinshu University, Nagano, Japan, 23.-24. 5. 2016
12. Marzhan Kulbulatova, Kazakh-British Technical University, Almaty, Kazakhstan, 6. 6.-12. 8. 2016
13. Martin Bonchanoski, Faculty of Computer Science and Engineering, Ss Cyril and Methodius University, Skopje, Republic of Macedonia, 10. 9.-14. 10. 2016
14. prof. Csaba Antonya, Faculty of Mechanical Engineering, Transylvania University of Brasov, Brasov, Romania, 25. 9.-16. 10. 2016
15. dr. Eng. Eugen Valentin Butilă, Faculty of Technological Engineering, Transylvania University of Brasov, Brasov, Romania, 25. 9.-16. 10. 2016
16. Monika Simjanoska, Faculty of Computer Science and Engineering, Ss Cyril and Methodius University, Skopje, Republic of Macedonia, 24. 10.-30. 12. 2016
17. Boris Naujoks, Cologne University of Applied Sciences (TH Köln), Gummersbach, Germany, 10.-11. 11. 2016

STAFF

Researchers

1. Prof. Ivan Bratko*
2. Asst. Prof. Aleš Dobnikar*
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4. Prof. Matjaž Gams, Head
5. Dr. Anton Gradišek
6. Dr. Mitja Luštrek
7. Dr. Tomaž Šef

Postdoctoral associates

8. Dr. Erik Dovgan*
9. Dr. Hristijan Gjoreski, on leave 01.12.16
10. Dr. Matej Guid
11. Dr. Boštjan Kaluža
12. Dr. Miha Mlakar
13. Dr. Aleksander Pivk*
14. Dr. Tea Tušar
15. Dr. Vedrana Vidulin, 11.11.16, transferred to Department E8

Postgraduates

16. Jani Bizjak, B. Sc.
17. Robert Blatnik, M. Sc.
18. Božidara Cvetković, B. Sc.
19. Martin Gjoreski, B. Sc.
20. Vito Janko, B. Sc.
21. Tomaž Kompara*, B. Sc.

22. Dr. Jana Krivec*
23. Damjan Kužnar, B. Sc.
24. Martin Pečar, B. Sc., 01.12.16, transferred to Department E7
25. Dr. Rok Piltaver*
26. Aleš Tavčar, B. Sc.
27. Jernej Zupančič, B. Sc.

Technical officers

28. Martin Frešer, B. Sc., left 01.10.16
29. Gregor Grasselli, B. Sc.
30. Matej Krebelj, B. Sc., left 13.02.16
31. Jure Sorn, B. Sc.
32. Aljoša Vodopija, B. Sc.

Technical and administrative staff

33. Grigory Evseev, B. Sc.
34. Vesna Koricki, B. Sc.
35. Mitja Lasič
36. Liljana Lasič
37. Blaž Mahnič, B. Sc.
38. Pavel Maslov, B. Sc.
39. Lana Zemljak

Note:

* part-time JSI member

BIBLIOGRAPHY

ORIGINAL ARTICLE

1. Franci Bajd, Anton Gradišek, Tomaž Apih, Igor Serša, "Dry-cured ham tissue characterization by fast field cycling NMR relaxometry and quantitative magnetization transfer", *Magn. reson. chem.*, vol. 54, no. 10, pp. 827-834, 2016.
2. Božidara Cvetković, Hristijan Gjoreski, Vito Janko, Boštjan Kaluža, Anton Gradišek, Mitja Luštrek, Igor Jurinčič, Anton Gosar, Simon Kerma, Gregor Balažič, "E-turist: an intelligent personalised trip guide", *Informatica (Ljublj.)*, vol. 40, no. 4, pp. 447-455, 2016.
3. Božidara Cvetković, Vito Janko, Alfonso E. Romero, Özgür Kafali, Kostas Stathis, Mitja Luštrek, "Activity recognition for diabetic patients using a smartphone", *J. med. syst.*, vol. 40, no. 12, pp. 256-1-256-8, 2016.
4. Božidara Cvetković, Radoje Milić, Mitja Luštrek, "Estimating energy expenditure with multiple models using different wearable sensors", *IEEE j. biomed. health inform.*, vol. 20, no. 4, pp. 1081-1087, 2016.
5. Valentina Domenici, Anton Gradišek, Tomaž Apih, Věra Hamplová, Vladimíra Novotná, Pedro José Sebastião, "1H NMR relaxometry in the TGBA* and TGBC* phases", *Ferroelectrics*, vol. 495, iss. 1, pp. 17-27, 2016.
6. Matjaž Gams, Eva Černič, Angelo Montanari, "A temporal perspective on the paradox of pinocchio's nose", *Informatica (Ljublj.)*, vol. 40, no. 3, pp. 365-368, 2016.
7. Martin Gjoreski, Hristijan Gjoreski, Mitja Luštrek, Matjaž Gams, "How accurately can your wrist device recognize daily activities and detect falls?", *Sensors*, vol. 16, no. 6, pp. 800-1-800-21, 2016.
8. Anton Gradišek, Valentina Domenici, Tomaž Apih, Vladimíra Novotná, Pedro José Sebastião, "1H NMR relaxometric study of molecular dynamics in a "de vries" liquid crystal", *J. phys. chem., B Condens. mater. surf. interfaces biophys.*, vol. 120, iss. 20, pp. 4706-4714, 2016.
9. Anton Gradišek, Lars Haahr Jepsen, Torben R. Jensen, Mark S. Conradi, "Nuclear magnetic resonance study of molecular dynamics in ammine metal borohydride $\text{Sr}(\text{BH}_4)_2(\text{NH}_3)_2$ ", *The journal of physical chemistry. C, Nanomaterials and interfaces*, vol. 120, no. 43, pp. 24646-24654, 2016.
10. Vito Janko, Matej Guid, "A program for Progressive chess", *Theor. comp. sci.*, vol. 644, pp. 76-91, Sep. 2016.
11. Aljaž Kramberger, Rok Piltaver, Bojan Nemeč, Matjaž Gams, Aleš Ude, "Learning of assembly constraints by demonstration and active exploration", *Ind. rob.*, vol. 43, no. 5, pp. 524-534, 2016.
12. Jana Krivec, "How to approach a migrant: a psychosocial view", *Research in social change*, no. 8, iss. 1, pp. 79-102, Jan. 2016.
13. Damjan Kužnar, Aleš Tavčar, Jernej Zupančič, Mihai Duguleana, "Virtual assistant platform", *Informatica (Ljublj.)*, vol. 40, no. 3, pp. 285-289, 2016.
14. Rob Patro et al. (14 authors), "A computational method for designing diverse linear epitopes including citrullinated peptides with desired binding affinities to intravenous immunoglobulin", *BMC bioinformatics*, vol. 17, pp. 155-13-155-13, 2016.
15. Rok Piltaver, Mitja Luštrek, Matjaž Gams, Sanda Martinčič-Ipšič, "What makes classification trees comprehensible?", *Expert syst. appl.*, vol. 62, pp. 333-346, 2016.

16. Aleš Tavčar, Csaba Antonya, Valentin Butila, "Recommender system for virtual assistant supported museum tours", *Informatika (Ljublj.)*, vol. 40, no. 3, pp. 279-284, 2016.
17. Niki Veček, Marjan Mernik, Bogdan Filipič, Matej Črepinšek, "Parameter tuning with Chess Rating System (CRS-Tuning) for meta-heuristic algorithms", *Inf. sci.*, vol. 372, pp. 446-469, Dec. 2016.
18. Jure Žabkar, Ivan Bratko, Janez Demšar, "Extracting qualitative relations from categorical data", *Artif. intell.*, vol. 239, pp. 54-69, Oct. 2016.

PUBLISHED CONFERENCE CONTRIBUTION

1. Csaba Antonya, Silviu Butnariu, Matjaž Gams, "Haptic interface design for experiencing ancient works", In: *Delavnica e-Heritage: zbornik 19. mednarodne multikonference Informacijska družba - IS 2016, 11.-12. oktober 2016, [Ljubljana, Slovenija]: zvezek F*, pp. 16-19.
2. Anne Auger, Dimo Brockhoff, Nikolaus Hansen, Dejan Tušar, Tea Tušar, Tobias Wagner, "Benchmarking MATLAB's gamultiobj (NSGA-II) on the bi-objective BBOB-2016 test suite", In: *GECCO comp'16: proceeding of the 2016 on Genetic and Evolutionary Computation Conference Companion, July 20-24, 2016, Denver, Colorado, USA*, pp. 1233-1239.
3. Anne Auger, Dimo Brockhoff, Nikolaus Hansen, Dejan Tušar, Tea Tušar, Tobias Wagner, "Benchmarking RM-MEDA on the bi-objective BBOB-2016 test suite", In: *GECCO comp'16: proceeding of the 2016 on Genetic and Evolutionary Computation Conference Companion, July 20-24, 2016, Denver, Colorado, USA*, pp. 1241-1247.
4. Anne Auger, Dimo Brockhoff, Nikolaus Hansen, Dejan Tušar, Tea Tušar, Tobias Wagner, "Benchmarking the pure random search on the bi-objective BBOB-2016 testbed", In: *GECCO comp'16: proceeding of the 2016 on Genetic and Evolutionary Computation Conference Companion, July 20-24, 2016, Denver, Colorado, USA*, pp. 1217-1223.
5. Anne Auger, Dimo Brockhoff, Nikolaus Hansen, Dejan Tušar, Tea Tušar, Tobias Wagner, "The impact of search volume on the performance of RANDOMSEARCH on the bi-objective BBOB-2016 test suite", In: *GECCO comp'16: proceeding of the 2016 on Genetic and Evolutionary Computation Conference Companion, July 20-24, 2016, Denver, Colorado, USA*, pp. 1257-1264.
6. Anne Auger, Dimo Brockhoff, Nikolaus Hansen, Dejan Tušar, Tea Tušar, Tobias Wagner, "The impact of variation operators on the performance of SMS-EMOA on the bi-objective BBOB-2016 test suite", In: *GECCO comp'16: proceeding of the 2016 on Genetic and Evolutionary Computation Conference Companion, July 20-24, 2016, Denver, Colorado, USA*, pp. 1225-1232.
7. Jan Bizjak, Hristijan Gjoreski, Matjaž Gams, "Deep learning for diagnosing heart problems from ECG signals", In: *BOOM 2016, 1st International Workshop on Biomedical Informatics with Optimization and Machine Learning in conjunction, BOOM 2016, with 25th International joint Conference on Artificial Intelligence (IJCAI), July 9, 2016, New York, USA*, 1 pp.
8. Jani Bizjak, Hristijan Gjoreski, Matjaž Gams, "Pametna ura za starejše", In: *Delavnica Elektronsko in mobilno zdravje: zbornik 19. mednarodne multikonference Informacijska družba - IS 2016, 10.-11. oktober 2016, [Ljubljana, Slovenija]: zvezek G*, pp. 10-13.
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