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, electronic and mobile health, and smart cities. The department closely collaborates 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 continuously collaborates with industry and contributes significantly to the inclusion of intelligent systems in products and services.

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 platforms to imitate human behaviour by exploiting raw, exponentially growing computer power. This field is somewhat broader than artificial intelligence, both are rapidly growing worldwide and enabling the development of the information society.

Ambient intelligence is a research area aiming to introduce technology into our everyday environment in a friendly way that is undemanding for the user. The main topic of ambient intelligence tackled by the department in 2017 was health. We coordinate the H2020 project HeartMan, which is developing an application to help congestive-heart-failure patients manage their condition: it monitors them with a sensing wristband, and provides advice on exercise, nutrition, etc. Most of the technical work is complete: we developed methods for activity monitoring and estimating blood pressure from a PPG sensor in the wristband, as well as a decision-support system that utilises expert knowledge and predictive models. In the H2020 project IN LIFE, we are translating solutions intended to prolong the independence of the elderly into real life. We developed a smart-watch application that detects falls and similar events, which is connected to a web application for carers. This solution was piloted with 150 users in cooperation with the Slovenian company Doktor 24, and we are now attempting to commercialise it. 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.). In 2017 we focused on methods for improving the work environment: we developed predictive models and a simulator to evaluate the actions that can improve the environment and recommend the best one. The project was successfully concluded with a pilot. We started the H2020 project CrowdHealth, whose objective is to mine health data to help craft better public health policies. We started developing methods that can forecast time-series data and assess health risk based on such forecasts. One of the use cases is the SloFit data describing the fitness of Slovenian primary- and high-school students, on which we cooperate with the Faculty of Sports of the University of Ljubljana. We also recently started the H2020 project WellCo, where we will develop a virtual coach advising older users on wellbeing and health. Our ambient-intelligence projects use wearable sensing devices, whose use is limited by their typically small batteries. As a doctoral research project we thus developed a general method that can intelligently turn sensors on and off in such a way that the energy consumption is as small as possible without sacrificing a lot of quality of the results obtained with these sensors. We also work on merging different sensor datasets for the purpose of machine learning.

Computational intelligence is the 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 the evolutionary computation methods. We study evolutionary algorithms for multi-objective optimization, their acceleration through parallel com-

In the H2020 project HeartMan, which we coordinate, we are finalizing an application that provides comprehensive personalized support for the self-management of congestive heart failure.

Figure 1: The Department Head, Prof. Matjaž Gams, was elected national councillor for research activities in December 2017.

We started two new H2020 projects on ambient intelligence and health, which have joined three on-going European projects on these topics. Our department is thus becoming a leading research group in this area.
The system evaluates parameter settings with a numerical simulation of the casting process and supports the visualization of results.

The system builds on the state-of-the-art open-source COCO (Comparing Continuous Optimizers) platform for optimization-algorithm benchmarking and extends it by incorporating real-world problems and their properties in order to bridge the gap between research and application in multi-objective optimization. The transfer of our knowledge and methods to industrial practice takes place in the project Upgrade of the optimization system for steel continuous casting (KN3) for the Store Steel company. We are developing a computer system to search for the optimal setting of process parameters with respect to criteria for process output variables. The system is based on the numerical simulation of steel casting and supports the visualization of results.

In the Horizon 2020 Twinning project AS-IT-IC project we will develop an integrated tourist platform for cross-border tourist exchange, tour planning and effective communications between tourists and tourist offices. The platform will support natural language communication between the users and the system and the automatic creation of personalized itineraries based on the search concepts and preferences of users. 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 are developing innovative applications that enable efficient search and richer visualisations of digital content related to cultural heritage from various internet sources and dedicated databases. As part of the project activities, the “Advanced Study Institute” event was organized in Padova, Italy, where we delivered lectures and a hands-on workshop regarding the use of systems for natural language processing and communication, information extraction from textual data, and data fusion from various sources. The goal of the bilateral Slovenian-Macedonian research project is to study
and advance wearable and non-wearable sensors for detecting the user’s physical and mental state.

In the field of speech and language technologies we work on speech synthesis, the semantic analysis of text and question answering. Together with the companies Alpineon and Amebis we developed a new, high-quality speech synthesizer eBralec (http://ebralec.si/). The synthesizer is improved in terms of both comprehensibility and natural perception of the speech. The software package has more than a thousand subscribers and is an indispensable tool for blind and visually-impaired users (it is the “official” speech synthesizer of the Slovenian Association for the Blind and Visually Impaired) and people with reading impairments (the Bravo association). For these users, eBralec is free of charge and can be ordered at the Library for the Blind and Visually Impaired (http://www.kss-ess.si/ebralec-sintetizator-govora-slovenskega-jezika/). eBralec is also an integral part of the DarsTraffic+ application, which provides traffic information, while its server version has been used by the National and University Library since 2017. We have also developed a service of speech synthesis for mobile devices (http://dis.ijs.si/dyslex/), which is free for anyone to use.

We have developed two plugins for Orange, an open-source machine-learning, data-mining and data-visualization toolkit. Audio-IJS makes it easy to build and test models for the classification of different kinds of audio recordings. The plugin is intended primarily for users without extensive prior knowledge of machine learning. By means of a graphical interface, the user determines the filtering and segmentation parameters of the sound recordings and then tests various classification models. Hybrid Trees provides users with three widgets that have a user-friendly interface for learning, validating, evaluating and using classifiers built with the MOLIC algorithm for the multi-objective learning of comprehensible and accurate hybrid trees.

The 20th International Multiconference Information Society - IS 2017 (https://is.ijs.si) took place at the Jožef Stefan Institute from 9 to 13 October 2017. It consisted of 11 independent conferences with 200 presentations. Four conference awards were presented: for lifetime achievements (“Donald Michie and Alan Turing” award) to Prof. Marjan Krisper, for current achievements in the field of information society to Prof. Andrej Brodnik, and the information strawberry and lemon for the best and worst public information-society services.

Some outstanding publications in the past year


Awards and appointments

1. Tomaž Šef: Gold recognition for product innovation, Slovenia, Chamber of Crafts Gorenjska, “Text-to-Speech Synthesizer eBralec”, 14 June, 2017

Organization of conferences, congresses and meetings

1. AS-IT-IC project meeting, Ljubljana, 28 February - 1 March 2017
2. IN LIFE project review meeting, Ljubljana, 2-3 March 2017
3. 30th Slovene Workshop on Nature-Inspired Algorithms, AVN, Šmarje gora, 9 May 2017
4. Presentation of the Internet application for tourism, Nazarje, 30 June 2017
5. Genetic and Evolutionary Computation Conference, GECCO 2017, Berlin, Germany, 15–19 July 2017 and the co-located events:
   • VizGEC (Visualisation Methods in Genetic and Evolutionary Computation) workshop
   • BBOB (Bi-Objective Blackbox Optimization Benchmarking) workshop
   • Women@GECCO workshop
   • GECCO Job Market
6. 20th International Multiconference Information Society, IS 2017, Ljubljana, Slovenia, 9–13 October 2017; independent conferences:
   • Slovenian Conference on Artificial Intelligence
   • Facing demographic challenges
   • Cognitive science
   • Collaboration, software and services in information society
   • Data mining and data warehouses – SIKDD
   • Education in Information Society
   • Cognitronics
   • 10th International technology transfer conference – 10ITTC
   • AS-IT-IC Workshop
   • Robotics
   • Workshop Electronic and Mobile Health and Smart Cities
7. Site visit and AS-IT-IC project presentation, Ljubljana, 30 November 2017
8. 31st Slovene Workshop on Nature-Inspired Algorithms, AVN, Ljubljana, 8 December 2017

INTERNATIONAL PROJECTS
1. COST TD1405; ENJECT, European Network for the Joint Evaluation of Connected Health Technologies
   Božidara Cvetković, B. Sc.
   Cost Office
2. H2020 – IN LIFE; INdependent Living support Functions for the Elderly
   Prof. Matjaž Gams
   European Commission
3. H2020 - eHERITAGE, Expanding the Research and Innovation Capacity in Cultural Heritage Virtual Reality Applications
   Prof. Matjaž Gams
   European Commission
   Dr. Mitja Luštrek
   European Commission
5. H2020 – WellEco, Wellbeing and Health Virtual Coach
   Dr. Mitja Luštrek
   European Commission
6. H2020 – HeartMan, Personal Decision Support System for Heart Failure Management
   Dr. Mitja Luštrek
   European Commission
7. H2020 – SYNERGY; Synergy for Smart Multi-Objective Optimisation
   Prof. Bogdan Filipič
   Slovenian Research Agency
8. Advanced Methodology of Evolutionary Multi- and Many-Objective Optimization for Real-World Applications
   Prof. Bogdan Filipič
   Slovenian Research Agency
9. Patient Health Prediction and Diagnostics based on Sensor Data and Machine Learning
   Prof. Matjaž Gams
   Slovenian Research Agency

RESEARCH PROGRAM
1. Artificial Intelligence and Intelligent Systems
   Prof. Matjaž Gams

R & D GRANTS AND CONTRACTS
1. Intelligent home of the new generation designed on smart appliances and wood
   Prof. Matjaž Gams
   Ministry of Education, Science and Sport
2. Smart City Ecosystem – EkoSmart

NEW CONTRACTS
1. Upgrade of the optimization system for steel continuous casting (KN3)
   Prof. Bogdan Filipič
   Štore Steel d. o. o.
2. The development of text-to-speech system for Slovenian language
   Dr. Tomaz Šef
   Alpincom d. o. o.
3. System for analysing and managing bank customers
   Dr. Miha Milakar
   Unicredit Banka Slovenija d. d.
3. 30th Slovene Workshop on Nature-Inspired Algorithms, AVN, Šmarna gora, 9 May 2017
4. Presentation of the Internet application for tourism, Nazarje, 30 June 2017
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   - Cognitive science
   - Collaboration, software and services in information society
   - Data mining and data warehouses – SKD
   - Education in Information Society
   - Cognitronics
   - 10th International technology transfer conference – 10ITTC
   - AS-IT-IC Workshop
   - Robotics
   - Workshop Electronic and Mobile Health and Smart Cities
7. Site visit and AS-IT-IC project presentation, Ljubljana, 30 November 2017
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   European Commission
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   European Commission
4. H2020 - CrowdHEALTH; Collective Wisdom Driving Public Health Policies
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   European Commission
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   European Commission
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   Slovenian Research Agency
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   Prof. Bogdan Filipič
   Slovenian Research Agency
9. Patient Health Prediction and Diagnostics based on Sensor Data and Machine Learning
   Prof. Matjaž Gams
   Slovenian Research Agency
10. eBralec Project
    Dr. Tomaž Šef
    Amebis, d. o. o.
11. Information Society IS 2017 – Multiconference
    Prof. Matjaž Gams

**RESEARCH PROGRAM**

1. Artificial Intelligence and Intelligent Systems
   Prof. Matjaž Gams

**R & D GRANTS AND CONTRACTS**

1. Intelligent home of the new generation designed on smart appliances and wood
   Prof. Matjaž Gams
   Ministry of Education, Science and Sport
2. Smart City Ecosystem – EkoSmart
   Prof. Matjaž Gams
   Slovenian Research Agency
3. Food for future - F4F
   Dr. Mitja Luštrek
   Ministry of Education, Science and Sport
4. BEPY: Application for raising awareness about viral hepatitis infections
   Prof. Matjaž Gams
   Javni stipendijski, razvojni, invalidski in preživninski sklad Republike Slovenije
5. Innovative student project to benefit society
   Prof. Matjaž Gams
   Javni stipendijski, razvojni, invalidski in preživninski sklad Republike Slovenije
6. Austrian-Slovenian Intelligent Tourist Information Center (AS-IT-IC)
   Prof. Matjaž Gams
   Government Office for Development and European Cohesion Policy
7. Strategic Research & Innovation Partnership (SRIP) Smart Cities and Communities
   Prof. Matjaž Gams
   Ministry of Education, Science and Sport
8. Self-management of physical and mental fitness of older workers
   Dr. Mitja Luštrek
   Ministry of Education, Science and Sport
   Prof. Matjaž Gams
10. Young Ph.D. - Mišar Miha
    Dr. Miha Mišar
    Andra - The French National Radioactive Waste
11. IN LIFE Smartwatch – advanced solutions for safety of elderly
    Prof. Matjaž Gams
    Slovenian Research Agency
12. eBralec Project
    Dr. Tomaz Sej
    Amehis, d. o. o.
13. Information Society IS 2017 – Multiconference
    Prof. Matjaž Gams

**NEW CONTRACTS**

1. Upgrade of the optimization system for steel continuous casting (KNS)
   Prof. Bogdan Filipič
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2. The development of text-to-speech system for Slovenian language
   Dr. Tomaz Sej
   Alpinium d. o. o.
3. System for analysing and managing bank customers
   Dr. Miha Mišar
   Unicredit Banka Slovenija d. d.
VISITORS FROM ABROAD

1. Dr. Jana Krivec*
2. Tomaž Kompara*, B. Sc.
3. Vito Janko, B. Sc.
4. Martin Gjoreski, B. Sc.
5. Božidara Cvetković, B. Sc.
6. Juri Bizjak, B. Sc., left 30.10.17
7. Dr. Tea Tušar
8. Dr. Miha Mlakar
9. Dr. Boštjan Kaluža, left 01.04.17
10. Dr. Anton Gradišek
11. Prof. Matjaž Gams, Head
14. Prof. Juan Antonio Alvarez-Garcia, University of Seville, Seville, Spain, 1 July–31 August 2017
15. Blagaj Mitrovski, Ss. Cyril and Methodius University in Skopje, Skopje, Republic of Macedonia, 3 July–3 September 2017
16. Prof. El-Ghazali Talbi, University Lille 1, Lille, France, 2–3 October 2017
17. Prof. Gerhard Widmer, Johannes Kepler University Linz and Austrian Research Institute for Artificial Intelligence Vienna, Vienna, Austria, 12–13 October 2017
18. Prof. Vladimir Trajkovikj, Ss. Cyril and Methodius University, Skopje, Republic of Macedonia, 23 November 2017
19. Prof. Saio Kocsis, Univerza Gose-Delcov, Šip, Republic of Macedonia, 23 November 2017
20. Prof. Franck Watoua, Oliver Tsai, Institute for Software Technology, Graz, Austria, 30 November 2018
21. Prof. El-Ghazali Talbi, Jan Gmys, University Lille 1, Lille, France, 11–13 December 2017
22. Prof. Boris Našković, Beate Briderhoff, Cologne University of Applied Sciences (TH Köln), Gumbersbach, Germany, 11–13 December 2017

STAFF

Researchers
1. Prof. Ivan Bratko*
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4. Prof. Matjaž Gams, Head
5. Dr. Anton Gradišek
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7. Dr. Tomaz Sef
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8. Dr. Hristijan Gjoreski, on leave 02.12.16
9. Dr. Matej Gualdi
10. Dr. Boštjan Kaluža, left 01.04.17
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13. Dr. Aleksandar Pivk*
14. Dr. Tea Tušar
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16. Robert Blatnik, M. Sc., 02.11.17, transferred to Department CTT
17. Božidar Cvetković, B. Sc.
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31. Jure Šomlaj, B. Sc., left 03.09.17
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39. Luža Stepančič, B. Sc.
40. Lana Zemljak
Note: * part-time JSI member

BIBLIOGRAPHY

ORIGINAL ARTICLE


e 2017 ACM International Symposium


1. Jožef Stefan Institute Annual Report 2017


INDEPENDENT COMPONENT PART OR A CHAPTER IN A MONOGRAPH


SCIENTIFIC MONOGRAPH


PROFESSIONAL MONOGRAPH