

# DEPARTMENT OF INTELLIGENT SYSTEMS

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*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 modelling, and language and speech technologies. 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.*

Intelligent systems simulate intelligence so that a typical user perceives them as truly intelligent. In reality, these systems use complex mechanisms implementing them on digital computers to imitate human behaviour as well as exploiting raw, exponentially growing computer power.

Ambient intelligence is an increasingly relevant research area. It aims at introducing the technology into our everyday environment in a friendly way, undemanding for the user. Considering the rapid aging of the population, one of the area's main goals is the care for the elderly. We addressed it in the EU 7FP project Confidence, which successfully ended in 2011. Within this project an intelligent home-care system was developed, with the goal of prolonging the independence of the elderly. This was achieved by recognising the falls and other health problems from the sensor data. Last year we focused on long-term health problems. In addition, we compared radio sensors for determining the locations of the user's body parts, and accelerometers. This research was extended outside the project with a thorough study of the effects of the sensor placement and the type (location/acceleration) on the activity and fall recognition. Furthermore we also looked at the analysis of human movement for the purpose of recognising health problems, such as a leg pain and Parkinson's disease. In the European project CHIRON we worked on monitoring chronic heart-disease patients at home. Our task is the activity recognition and an estimation of the patient's energy expenditure with accelerometers. This information represents the basis for observing the patient's heartbeat using ECG. Additionally, we worked on a decision-support system for physicians. Its main task was an assessment of the risk to the patient's health. To this end we developed two methods: the first assesses the risk on the basis of the expert knowledge about the parameters monitored in the project, while the second detects deviations from a patient's normal condition. In the ELKOV22 project we cooperated with the Elgoline, Kovinoplastika and INTECH-LES razvojni center companies to develop an intelligent door system. Such a door uses sensors to detect opening, closing and violent actions. This makes it possible to react to unusual and dangerous events, and to generally increase security.

Computational intelligence is a study of stochastic search, optimization and learning methods, inspired by physical and biological systems. Research in this area at the Department of Intelligent Systems focuses on the evolutionary computation methods. We study extensions of evolutionary algorithms for a multiobjective optimization and their parallelization, and apply these algorithms in engineering design and optimization problems. Specifically, we are developing a method for visualization of multidimensional fronts of nondominated solutions in an multiobjective optimization, and an algorithm for discovering the optimal car-driving strategies with respect to the travelling time and the fuel consumption. In addition, our work is motivated by the optimization of metallurgical production processes that is a subject of two research projects carried out together with the University of Nova Gorica, the Institute of Metals and Technology, Ljubljana, and the Store Steel company. A substantial part of our applied research is devoted to energy efficiency. In collaboration with the partners from five European countries, we carry out the EU 7FP project MIRABEL (originally called MIRACLE). Its goal is to develop a computer infrastructure to efficiently balance between the generation and consumption of electrical energy using an increased amount of energy from renewable sources. This infrastructure relies on flex-



Head:  
**Prof. Matjaž Gams**



*Figure 1: Human activity recognition and energy expenditure estimation with accelerometers in the Chiron project*

**In the European project CHIRON we monitor chronic heart-disease patients at home. The recognized patient's activity and the estimated energy expenditure represent the context for the observation of the patient's heartbeat.**

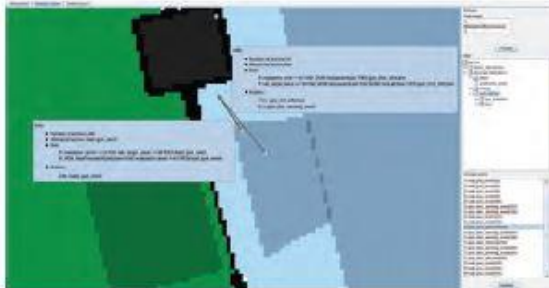


Figure 2: Discovered behaviour pattern with the corresponding symbolic description in the form of IF-THEN rules.

**In the ELKOV22 project we cooperate with industrial partners to develop an intelligent door system. The project is focused on security and the detection of unusual events during an entrance.**

knowledge. The discovered strategic action descriptions are presented to the user in the form of graph paths, agent actions, roles and corresponding rules.

The rules, constructed by machine learning, enrich the graphical strategic patterns and describe the conditions, under which individual actions present in the pattern occur. Moreover, the objective is to transfer some of the observed behaviour patterns into highly realistic and reusable models of human behaviour in riots. We also studied the behaviour of individuals, trying to detect suspicious behaviour at the airport. The goal is to detect suspicious behaviour from a sequence of events, even though no single event on its own can indicate that certain behaviour is suspicious. Individual events are recognized from multiagent interactions. Whether a sequence of such events is suspicious is established using a probabilistic Bayesian framework. We showed that an optimum evaluation of suspiciousness is not feasible in practice. Instead, we proposed a naïve and a heuristic approach and tested them on a simulated airport domain. The heuristic approach achieved high performance resulting in a high-detection rate and low false-alarm ratio.

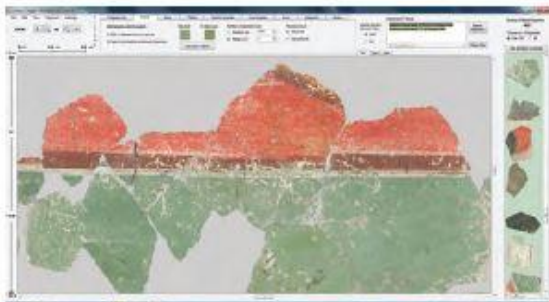


Figure 3: Computer supported restoration of wall paintings with the Pedius program

**The goal of the 7FP project MIRABEL is to develop a computer infrastructure to efficiently balance the generation and consumption of electrical energy using an increased amount of energy from renewable sources.**

Robi, the Institute's virtual assistant, received some handy new functions, for example, the ability to search the employees' contact data. We deployed the Little Dragon that answers questions of the visitors to the Municipality of Ljubljana website (<http://www.ljubljana.si/si/mol/>). We also developed an assistant to be used in an intelligent home.

The department received two major awards in 2011. At the Third Industrial Forum of Innovation, R&D and Technology, we received the **Taras Award** for a successful collaboration between a research institution and industry. It was awarded to the iLab project carried out in collaboration with the Lotrič company. In the project a system for monitoring the conditions in a laboratory was developed. At the Sixth Slovenian Innovation Forum we received the **Silver Award** for excellence in innovative industries for the Pedius system. The system provides computer support for the restoration of wall paintings from plaster fragments.

**The main goal of the EUSAS project is to develop a new approach to mission analysis and training for low-level units facing asymmetric threats in an urban environment.**

ible offers for energy generation and consumption, their aggregation and scheduling. For this project we implemented scheduling algorithms that assign time and energy amount to the relevant offers. For the Restoration Center, Ljubljana, which is part of the Institute for the Protection of Cultural Heritage of Slovenia, we continued to develop Pedius, an innovative software tool to support the restoration of wall paintings.

In the field of agent modelling we are focused on the behaviour analysis of individuals and groups. Most of the work is performed for the EUSAS project, which is funded by the European Defence Agency. The scope of this project is to develop methods for multi-agent modelling of asymmetric conflicts. The aim is to develop a new approach to mission analysis and training for low level units facing asymmetric threats in an urban environment. The developed tool can be used to discover the common agent strategy by knowing only the low-level agent behaviour and possessing basic domain knowledge. The discovered strategic action descriptions are presented to the user in the form of graph paths, agent actions, roles and corresponding rules. The rules, constructed by machine learning, enrich the graphical strategic patterns and describe the conditions, under which individual actions present in the pattern occur. Moreover, the objective is to transfer some of the observed behaviour patterns into highly realistic and reusable models of human behaviour in riots. We also studied the behaviour of individuals, trying to detect suspicious behaviour at the airport. The goal is to detect suspicious behaviour from a sequence of events, even though no single event on its own can indicate that certain behaviour is suspicious. Individual events are recognized from multiagent interactions. Whether a sequence of such events is suspicious is established using a probabilistic Bayesian framework. We showed that an optimum evaluation of suspiciousness is not feasible in practice. Instead, we proposed a naïve and a heuristic approach and tested them on a simulated airport domain. The heuristic approach achieved high performance resulting in a high-detection rate and low false-alarm ratio.

In the field of speech and language technologies we work on speech synthesis, forensic speaker recognition, semantic analysis of texts and question answering. Together with the Amebis company, we developed a new speech synthesizer for Slovene. In cooperation with the national television and radio, RTV Slovenia, we developed a phonetically rich and balanced speech database for a corpus-based speech synthesis. In speaker recognition we investigated the correlation between the speech quality in telephony and the performance of automatic-speaker verification. In question answering, a machine-learning classifier that classifies questions by expected answer type was developed. We developed a new version of the virtual assistant, which uses state-of-the-art web technology to improve the user experience.

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a laboratory was developed. At the Sixth Slovenian Innovation Forum we received the **Silver Award** for excellence in innovative industries for the Pedius system. The system provides computer support for the restoration of wall paintings from plaster fragments.

From 10 to 14 October 2011, the 14th international multiconference Information Society (IS 2011) took place at the Jožef Stefan Institute. It consisted of nine independent conferences with 193 papers, contributed by 299 (co) authors from 13 countries. Four conference awards were given. Two were traditional: for exceptional contribution to the development and promotion of the information society, and for the current achievements in the field of

information society. Two, however, were new: the information strawberry and lemon for the best and worst public information-society services, respectively.

### Outstanding publications in the last year

1. Kaluža Boštjan, Dovgan Erik, Tušar Tea, Tambe Milind, Gams Matjaž. A probabilistic risk analysis for multimodal entry control. *Expert Systems with Applications*, 2011, 38 (6), 6696–6704.
2. Scheubert Lena, Schmidt Rainer, Reipsilber Dirk, Luštrek Mitja, Fuellen Georg. Learning biomarkers of pluripotent stem cells in a mouse. *DNA Research*, 2011, 18 (4), 233–251.
3. Pogorelc Bogdan, Bosnič Zoran, Gams Matjaž. Automatic recognition of gait-related health problems in the elderly using machine learning. *Multimedia Tools and Applications*, 2011, 1–22.
4. Piltaver Rok, Luštrek Mitja, Gams Matjaž. The pathology of heuristic search in the 8-puzzle. *Journal of Experimental and Theoretical Artificial Intelligence*, 2011.
5. Vidulin Vetrana, Gams Matjaž. Impact of high-level knowledge on economic welfare through interactive data mining. *Applied Artificial Intelligence*, 2011, 25 (4), 267–291.
6. Dovgan Erik, Luštrek Mitja, Pogorelc Bogdan, Gradišek Anton, Burger Helena, Gams Matjaž. Intelligent elderly-care prototype for fall and disease detection – Inteligentni prototip za oskrbo starejših, ki zaznava padce in bolezni. *Slovenian Medical Journal*, 2011, 80 (11), 824–831.



Figure 4: At the Third Industrial Forum of Innovation, R&D and Technology we received the Taras Award for a successful collaboration between a research institution and industry. It was awarded to the iLab project.

### Patent application

1. Erik Dovgan, Matjaž Gams, Rok Piltaver, Gašper Pintarič, Andrej Planina, Bogdan Pogorelc: Intelligent surveillance system and procedure for detection of unusual behaviour, patent pending, application nr. 201100298, Ljubljana, 5. 8. 2011

**We received the Taras Award for a successful collaboration between a research institution and industry, and the Silver Award at the Slovenian Innovation Forum for the Pedius system for the computer-supported restoration of wall paintings.**

### Awards and appointments

1. Erik Dovgan: Best graduate student paper award at the Genetic and Evolutionary Computation (GECCO 2011) Conference, "A multiobjective optimization algorithm for discovering driving strategies", Dublin, Ireland, 12.–16. 7. 2011
2. Bogdan Filipič, Miha Mlakar, Erik Dovgan, Tea Tušar: Silver award for excellence of innovative industries at the 6th Slovenian Innovation Forum for Pedius, a system for computer-aided reconstruction of wall paintings, Ljubljana, 23. 11. 2011
3. Boštjan Kaluža: Best ICT paper award at the 3rd Jožef Stefan International Postgraduate School Students Conference for the paper "Identifying suspicious behaviour from multiple events", Ljubljana, 25. 5. 2011
4. Tomaž Kompara: Dean's praise for the best students in academic year 2010/2011, University of Ljubljana, Faculty of Electrical Engineering, Ljubljana, 29. 11. 2011
5. Damjan Kužnar, Matjaž Gams, Blaž Mahnič, Domen Marincič, Rok Piltaver: TARAS award at the 3rd Industrial Forum of Innovation, Portorož, R&D and Technology (IRT) for successful collaboration between research institution and industry, project "Intelligent Laboratory System for Healthcare (iLab)", 6. 6. 2011

### Organization of conferences, congress and meetings

1. 3rd Jožef Stefan International Postgraduate School Students Conference, Jožef Stefan Institute, Ljubljana, 25. 5. 2011
2. 4th International Workshop on Semantic Ambient Media Experiences, in conjunction with C&T 2011, Brisbane, Australia, 29. 6.–2. 7. 2011
3. 18th Workshop on Nature-Inspired Algorithms, AVN, Jožef Stefan Institute, Ljubljana, 13. 9. 2011



Figure 5: Little Dragon – a virtual assistant answering questions about the Municipality of Ljubljana

4. 14th International Multiconference Information Society, IS 2011, 10.–14. 10. 2011 independent conferences:
  - Intelligent Systems,
  - Facing Demographic Challenges,
  - Cognitive Sciences,
  - Collaboration, Software and Services in Information Society,
  - Data Mining and Data Warehouses,
  - Education in Information Society,
  - Cognitronics,
  - Robotics,
  - Internet and Slovenia: 1985–1995

## INTERNATIONAL PROJECTS

1. Robots Bootstrapped through Learning from Experience  
Xperience  
7. FP, 270273  
EC; Karlsruhe Institute of Technology, Karlsruhe, Germany  
Prof. Matjaž Gams, Asst. Prof. Aleš Ude
2. Micro-Request-Based Aggregation, Forecasting and Scheduling of Energy Demand, Supply and Distribution  
MIRACLE, MIRABEL  
7. FP, 248195  
EC; Sofia Martínez-Schmitt, Dr. Henrike Berthold, SAP AG, Walldorf, Germany  
Prof. Bogdan Filipić
3. Ubiquitous Care System to Support Independent Living  
CONFIDENCE  
7. FP, 214986  
EC; Centro de Estudios e Investigaciones Técnicas de Guipuzcoa, San Sebastian, Spain  
Prof. Matjaž Gams, Prof. Leon Zlajpah
4. European Urban Simulation for Asymmetric Scenarios  
EUSAS  
Contract EADS DC  
EADS N.V., Defense and Security Systems, Elancourt, France  
Prof. Matjaž Gams
5. Cyclic and Person-Centric Health Management: Integrated Approach for Home, Mobile and Clinical Environments  
CHIRON, ARTEMIS  
FIMI S.R.L., Italy  
Dr. Miha Luštrek
6. Constrained Multiobjective Optimization Based on Simulation Models  
BI-FI/11-12-018  
Dr. Erkki Laitinen, University of Oulu, Faculty of Science, Department of Mathematical

Sciences, Oulu, Finland  
Prof. Bogdan Filipić

## R & D GRANTS AND CONTRACTS

1. Advanced modelling and simulation of liquid-solid processes  
Prof. Bogdan Filipić
2. Simulation and optimization of casting, rolling and heat treatment processes for competitive production of topmost steels  
Prof. Bogdan Filipić

## RESEARCH PROGRAM

1. Artificial Intelligence and Intelligent Systems  
Prof. Matjaž Gams

## NEW CONTRACT

1. Cooperation in the introduction, use and financing of the „Intelligent doors and windows“ project  
Intech - Les, d. o. o.  
Prof. Matjaž Gams

## MENTORING

### M. Sc. Theses

1. Hristijan Gjoreski, Adaptive human activity recognition and fall detection using wearable sensors (mentor Matjaž Gams).
2. Vidojka Srebrnič, Optimization of vegetable food supply using linear programming (mentor Bogdan Filipić).

## VISITORS FROM ABROAD

1. dr. Holger Bracker, Cassidian, Unterschleissheim, Germany, 27.–28. 1. 2011
2. Mark Cornat, Cassidian SAS, Val-de-Reuil Cedex, France, 27.–28. 1. 2011
3. Štefan Dlugolinský, Institute of Informatics, Slovak Academy of Sciences, Bratislava, Slovakia, 27.–28. 1. 2011
4. Łukasz Dutka, ACK Cyfronet AGH, Kraków, Poland, 27.–28. 1. 2011
5. Ladislav Ilhuchý, Institute of Informatics, Slovak Academy of Sciences, Bratislava, Slovakia, 27.–28. 1. 2011
6. mag. Bartosz Kryza, ACK Cyfronet AGH, Kraków, Poland, 27.–28. 1. 2011
7. Marcel Kravassy, Institute of Informatics, Slovak Academy of Sciences, Bratislava, Slovakia, 27.–28. 1. 2011
8. dr. Michal Laclavík, Institute of Informatics, Slovak Academy of Sciences, Bratislava, Slovakia, 27.–28. 1. 2011
9. Mikael Lundin, Swedish Defence Research Agency FOI, Stockholm, Sweden, 27.–28. 1. 2011
10. dr. Bernhard Schneider, Cassidian, Unterschleissheim, Germany, 27.–28. 1. 2011
11. dr. Martin Soleng, Institute of Informatics, Slovak Academy of Sciences, Bratislava, Slovakia, 27.–28. 1. 2011

12. Michał Wrzeszcz, ACK Cyfronet AGH, Kraków, Poland, 27.–28. 1. 2011
13. prof. dr. Vladimir A. Kulyukin, Department of Computer Science Utah State University Logan, Utah, United States, 20.–23. 5. 2011
14. prof. dr. Norbert Koo, Hungarian Academy of Science, Budapest, Hungary, 11. 10. 2011
15. dr. Zoran Stančić, Information Society and Media Directorate-General, European Commission, Brussels, Belgium, 11. 10. 2011
16. prof. dr. Angelo Montanari, Department of Mathematics and Computer Science, University of Udine, Udine, Italy, 12.–14. 10. 2011
17. prof. dr. Christopher W. Geib, School of Informatics, University of Edinburgh, Edinburgh, United Kingdom, 14. 10. 2011
18. dr. Roberta Gazzarata, Department of Computer and System Sciences, University of Genoa, Genoa, Italy, 6.–9. 11. 2011
19. prof. dr. Mauro Giacomini, Faculty of Engineering, University of Genoa, Genoa, Italy, 6.–9. 11. 2011
20. Philip Needham, Cardionetics, LTD., Fleet Hampshire, United Kingdom, 6.–10. 11. 2011
21. Luigi Albani, FIMI S.r.l., Saronno, Italy, 7.–10. 11. 2011
22. prof. dr. Boldizsar Bencsath, Department of Telecommunications, Budapest University of Technology and Economics, Budapest, Hungary, 7.–9. 11. 2011
23. dr. Luca Becchetti, Department of Computer and System Sciences Antonio Ruberti, Sapienza University of Rome, Rome, Italy, 7.–10. 11. 2011
24. Silvio Bonfiglio, FIMI S.r.l., Saronno, Italy, 7.–10. 11. 2011
25. prof. dr. Levente Buttyan, Department of Telecommunications, Budapest University of Technology and Economics, Budapest, Hungary, 7.–9. 11. 2011
26. Angelo Caposelle, Department of Computer Science, Sapienza University of Rome, Rome, Italy, 7.–9. 11. 2011
27. Petros Chondros, Industrial Systems Institute (ISI), Athens, Greece, 7.–10. 11. 2011
28. Letizia Gabbriellini, Elisag Datamat, Genoa, Italy, 7.–10. 11. 2011
29. John Gialelis, Industrial Systems Institute (ISI), Athens, Greece, 7.–10. 11. 2011
30. dr. Miquel A. González Ballester, Alma IT Systems, Barcelona, Spain, 7.–9. 11. 2011
31. dr. Gabriele Guarnieri, Department of Industrial Engineering and Information Technology, University of Trieste, Trieste, Italy, 7.–9. 11. 2011

32. Maitena Iardja, ESI-Tecnalia, Bilbao, Spain, 7-9. 11. 2011  
 33. dr. Artur Krukowski, Intracom Telecom S. A., Athens, Greece, 7-9. 11. 2011  
 34. prof. dr. Claudio Lamberti, Department of Electronics, Computer Science and Systems, University of Bologna, Bologna, Italy, 7-9. 11. 2011  
 35. dr. Nico Lanconelli, Department of Physics, University of Bologna, Bologna, Italy, 7-9. 11. 2011  
 36. dr. Michele Magno, Department of Electronics, Computer Science and Systems, University of Bologna, Bologna, Italy, 7-9. 11. 2011  
 37. dr. Cédric Marchessoux, Barco, Kortrijk, Belgium, 7-10. 11. 2011  
 38. prof. dr. Gaia Maselli, Department of Computer Science, Sapienza University of Rome, Rome, Italy, 7-9. 11. 2011  
 39. Evangelos B. Mazomenos, School of Electronics and Computer Science, University of Southampton, Southampton, United Kingdom, 7-10. 11. 2011  
 40. prof. dr. Francesco Morandi, Faculty of Economics, University of Sassari, Sassari, Italy, 7-9. 11. 2011  
 41. Gianni Pizzetti, Elsig Datamat, Genoa, Italy, 7-10. 11. 2011  
 42. prof. Giovanni Ramponi, Department of Industrial Engineering and Information Technology, University of Trieste, Trieste, Italy, 7-9. 11. 2011  
 43. Juan María Rodríguez Anta, Atos International, Madrid, Spain, 7-10. 11. 2011  
 44. Laura Lara Rodríguez, Alma IT Systems, Barcelona, Spain, 7-9. 11. 2011  
 45. Alberto Rugnone, Healthcare & Telecomare Team Technical Lead, I\*, Bologna, Italy, 7-9. 11. 2011  
 46. imag, Aurora Summa, INAIL Prosthesis Centre, Bologna, Italy, 7-9. 11. 2011  
 47. prof. dr. Fabio Vergari, Faculty of Mechanical Engineering, University of Bologna, Bologna, Italy, 7-9. 11. 2011  
 48. Jan-Marc Verlinden, ZorgGermak BV, AK Leiden, Netherlands, 7-10. 11. 2011  
 49. Paolo Emilio Puddu, Department of Cardiovascular Pathophysiology, Anaesthesiology and Surgery, Sapienza University of Rome, Rome, Italy, 8-10. 11. 2011  
 50. dr. Héctor Solar, CEIT, San Sebastián, Spain, 8-10. 11. 2011  
 51. Luca Filippini, WLAB srl, Rome, Italy, 9-10. 11. 2011  
 52. Gennaro Tartarisco, Institute of Clinical Physiology CNR, Pisa, Italy, 9. 11. 2011  
 53. dr. Dalkhat Ediev, Vienna Institute of Demography, Austrian Academy of Sciences, Vienna, Austria, 10-11. 10. 2011  
 54. prof. dr. Vladimir A. Fomichov, Higher School of Economics, Faculty of Business Informatics, Moscow, Russia, 10-11. 11. 2011

## STAFF

### Researchers

1. Prof. Ivan Bratko\*
2. Asst. Prof. Aleš Dobnikar\*
3. Prof. Bogdan Filipič
4. **Prof. Matjaž Gams, Head**
5. Dr. Mitja Luštrek
6. Prof. Vladislav Raiković\*\*\*
7. Dr. Tomaž Šef

### Postdoctoral associates

8. Dr. Andraž Bežek\*
9. Dr. Matija Drobnič\*
10. Dr. Matej Guid\*
11. Dr. Domen Marinčič
12. Dr. Aleksander Pivk\*

### Postgraduates

13. Andrej Bratko\*, B. Sc.
14. Božidara Cvetković, B. Sc.
15. Erik Dovgan, B. Sc.
16. Boštjan Kaluža, B. Sc.
17. Tomaž Kompara, B. Sc.
18. Simon Kozina, B. Sc.
19. Jana Krivec\*, B. Sc.
20. Damjan Kužnar, B. Sc.
21. Miha Makar, B. Sc.

22. Violeta Mirchevska\*\*
23. Bogdan Pogorelc\*\*
24. Rok Pillaver, B. Sc.
25. Bogdan Pogorelc\*, B. Sc.
26. Aleš Tavčar, B. Sc.
27. Tea Tušar, M. Sc.
28. Vedrana Vidulin, B. Sc.
29. Domen Zupancič\*\*

### Technical officers

30. Robert Blatnik, B. Sc.
31. Mitja Kolbe\*, B. Sc.
32. Gašper Pintarič\*, B. Sc.

### Technical and administrative staff

33. Dr. France Dacar
34. Vesna Koricki Špetič, B. Sc.
35. Mitja Lasič
36. Liljana Lasič
37. Lana Zemljak

### Note:

- \* part-time JSI member
- \*\* postgraduate financed by industry
- \*\*\* retired researcher

## BIBLIOGRAPHY

### ORIGINAL ARTICLES

1. Robert Blatnik, Gorazd Kandus, Tomaž Šef, "Influence of the perceptual speech quality on the performance of the text-independent speaker recognition system", *Int. j. circuits syst. signal process.*, vol. 5, no. 4, pp. 346-353, 2011.
2. Ivan Bratko, "Autonomous discovery of abstract concepts by a robot", In: Adaptive and natural computing algorithms: 10th international conference, ICANNGA 2011, Ljubljana, Slovenia: proceedings, *Lect. notes comput. sci.*, vol. 6593, pp. 1-11, 2011.
3. Erik Dovgan, Mitja Luštrek, Bogdan Pogorelc, Anton Gradišek, Helena Burger, Matjaž Gams, "Intelligent elderly-care prototype for fall and disease detection", *Zdrav Vestn (Tisk. izd.)*, vol. 80, no. 11, pp. 824-831, 2011.
4. Vida Groznik, Matej Guid, Aleksander Sadikov, Martin Možina, Dejan Georgiev, Veronika Kragelj, Samo Ribarič, Zvezdan Pirtošek, Ivan Bratko, "Elicitation of neurological knowledge with ABML", In: Artificial intelligence in medicine: proceedings, *Lect. notes comput. sci.*, vol. 6747, pp. 14-23, 2011.
5. Matej Guid, Ivan Bratko, "Using heuristic-search based engines for estimating human skill at chess", *ICGA journal*, vol. 34, no. 2, pp. 71-81, 2011.
6. Boštjan Kaluža, Erik Dovgan, Tea Tušar, Milind Tambe, Matjaž Gams, "A probabilistic risk analysis for multimodal entry control", *Expert syst. appl.*, vol. 38, no. 6, pp. 6696-6704, 2011.
7. Aljaž Košmerlj, Ivan Bratko, Jure Žabkar, "Embodied concept discovery through qualitative action models", *Int. j. uncertain. fuzziness knowl.-based syst.*, vol. 19, no. 3, pp. 453-475, 2011.
8. Andrej Oblak, Ivan Bratko, "Learning from noisy data using a non-covering ILP algorithm", In: Inductive logic programming: 20th International Conference, ILP 2010, Florence, Italy: revised papers, *Lect. notes comput. sci.*, vol. 6489, pp. 190-197, 2011.
9. Dejan Petelin, Bogdan Filipič, Juš Kocijan, "Optimization of Gaussian process models with evolutionary algorithms", In: Adaptive and natural computing algorithms: 10th international conference, ICANNGA 2011, Ljubljana, Slovenia: proceedings, *Lect. notes comput. sci.*, vol. 6593, pp. 420-429, 2011.
10. Rok Pillaver, Erik Dovgan, Matjaž Gams, "An intelligent indoor surveillance system", *Informatica (Ljublj.)*, vol. 35, no. 3, pp. 383-390, 2011.
11. Bogdan Pogorelc, Zoran Bosnić, Matjaž Gams, "Automatic recognition of gait-related health problems in the elderly using machine learning", *Multimedia tools and applications*, pp. [1-22], 2011.

12. Lena Scheubert, Rainer Schmidt, Dirk Reipsilber, Mitja Luštrek, Georg Fuellen, "Learning biomarkers of pluripotent stem cells in mouse", *DNA res.*, vol. 18, no. 4, pp. 233-251, 2011.
13. Vedrana Vidulin, Matjaž Gams, "Impact of high-level knowledge on economic welfare through interactive data mining", *Appl. artif. intell.*, vol. 25, no. 4, pp. 267-291, 2011.
14. Jernej Zupanc, Bogdan Filipič, "Evolutionary synthesis of cellular automata", *CIT. J. Comput. Inf. Technol.*, vol. 19, no. 2, pp. 105-112, 2011.
15. Jure Žabkar, Martin Možina, Ivan Bratko, Janez Demšar, "Learning predictive qualitative models with Padé", *Informatica (Ljublj.)*, vol. 35, no. 4, pp. 435-444, 2011.
16. Jure Žabkar, Martin Možina, Ivan Bratko, Janez Demšar, "Learning qualitative models from numerical data", *Artif. intell.*, vol. 175, no. 9/10, pp. 1604-1619, 2011.

## REVIEW ARTICLES AND CHAPTERS IN BOOKS

1. Jana Krivec, Matjaž Gams, "Data mining techniques for explaining social events", In: *Knowledge-oriented applications in data mining*, Kimito Funatsu, ed., Kyoshi Hasegawa, ed., Rijeka, In-Tech, cop. 2011, pp. 39-52.

## PUBLISHED CONFERENCE PAPERS

### Invited Papers

1. Matjaž Gams, "Beyond AI and HAI", In: *Beyond AI: proceedings of the extended abstracts presented at the International Conference Beyond AI 2011, December 8-9, 2011, Pilsen Czech Republic*, Jan Romportl, ed., Pilsen, University of West Bohemia, 2011, pp. 4-8.

### Regular papers

1. Robert Blatnik, Gorazd Kandus, Tomaž Šef, "Influence of the speech quality in telephony on the automated speaker recognition", In: *Recent advances in circuits, systems, signal and telecommunications*, 5th WSEAS International Conference on Circuits, Systems, Signal and Telecommunications, (CISST'11), Puerto Morelos, Mexico, January 29-31, 2011, Alexander Zemliak, ed., Nikos E. Mastorakis, ed., [S. l.], WSEAS Press, cop. 2011, pp. 115-120.
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## B. SC. THESIS

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## PATENT APPLICATION

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