
Preface

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Biographical notes: Fabiano Dalpiaz is an Assistant Professor in the Department of Information and Computing Sciences, Utrecht University, The Netherlands. His research is in requirements engineering, and his work spans across multiple facets of this discipline like security, adaptation, modelling and automated reasoning. He received his PhD in Computer Science from the University of Trento, Italy on self-adaptive socio-technical systems. He published over 80 papers, and he is co-author of the book *Security Requirements Engineering* published by MIT Press. He coorganised several scientific events in the fields of (agent-oriented) requirements engineering, and he serves on numerous program committees.

Jürgen Dix received his PhD from Karlsruhe, Habilitation from TU Vienna. He is a Professor for Artificial Intelligence and Dean of the Faculty at Clausthal University of Technology. He spent some years in the USA and UK. He worked on basic research in knowledge representation and reasoning, deductive databases and multiagent systems. He co-authored or co-edited more than 20 books, over 70 journal publications and organised/chaired more than 40 conferences and workshops. He is on the editorial boards of seven journals and several steering committees as well as an Associate Editor of *the Annals of Math and AI*. His Hirsch index is 35 and his Erdős number is 3.

M. Birna van Riemsdijk is an Assistant Professor in the Interactive Intelligence Section at TU Delft, The Netherlands. Her research mission is to develop theory and technology for creating software that understands and adapts to norms and values of people. For this research she was awarded a Vidi Personal Grant and the Dutch Prize for Research in ICT 2014. She is elected member of the board of the International Foundation for Autonomous Agents and Multiagent Systems (IFAAMAS), and has coorganised several workshops and conferences in this area.

This special issue of the *International Journal of Agent-Oriented Software Engineering* is guest edited by the organisers of EMAS 2014, which took place as a workshop at AAMAS 2014 in Paris (<https://emas14.wordpress.com>).

After the presentation of all accepted papers at the workshop, the authors submitted a revised version that was carefully re-reviewed for inclusion in the post-proceedings (Springer LNAI 8758). All authors were then invited to submit a significantly extended version of their papers for this special issue of *IJAOSE on designing, developing and verifying multi-agent systems*. Eleven papers were submitted and after a careful and extensive double blind reviewing phase, six papers were finally selected for inclusion in this special issue.

The engineering of multi-agent systems (MAS) is a complex activity: such systems consist of multiple autonomous and heterogeneous agents, and their proper functioning depends on the effective interaction between these agents. While MAS have been used to some extent in industry, wider adoption is hindered because the underlying engineering techniques are not as mature as those in mainstream software and systems engineering. Numerous challenges have to be addressed, including:

- *Design and software engineering*: how to effectively *design* agents and their interactions?
- *Implementation*: how to *implement* multi-agent coordination or organisations efficiently?
- *Verification*: how to *formally verify* (un-)desired properties of individual agents and MAS?

We believe that these challenges can be tackled more effectively when considered within the discipline of MAS engineering.

The International Workshop on Engineering Multi-Agent Systems (EMAS) is an ideal venue for papers that relate to all aspects of agent and MAS engineering. EMAS was created in 2013 as a merger of three separate workshops (with overlapping communities) that focused on software engineering aspects (AOSE), programming aspects (ProMAS), and the application of declarative techniques to design, programming and verification (DALT).

The EMAS workshop series (<http://emas.in.tu-clausthal.de>) explicitly pursues three goals:

- To progress and further develop the understanding of how to engineer MAS.
- To bring together the communities that are concerned with different aspects of engineering MAS, and by doing so, allow for better interchange of ideas between the communities, thus exploiting the synergies discussed above.

- To provide a venue for workshop papers that report on experiences and lessons learned from innovative applications of MAS, and have these lessons influence further research in the field.

The papers selected for this special issue tackle some of the challenges above. We list the accepted papers *from conceptual to practical* order.

- 1 In ‘Process-oriented modelling, creation, and interpretation of multi-agent systems’ by Küster, Heßler and Albayrak, the relationship between business processes and MAS is investigated. The result is a mapping from process diagrams to executable agent components that has also been implemented and thus relates process modelling notation with agent systems.
- 2 In ‘A stepwise refinement-based development of self-organising multi-agent systems: application to the foraging ants’ by Graja, Migeon, Maurel, Gleizes and Kacem, the authors propose a formal modelling approach for developing self-organising MAS in a structured manner through the stepwise refinement of a specification both at the micro level (individual agent) and at the macro level (global behaviour of the system).
- 3 In ‘Design patterns for multi-agent programming’ by Dastani, and Testerink, the authors tackle the problem of limited industrial adoption of agent programming languages. They propose a methodology that, by defining a library of object-oriented design patterns, maps agent concepts and abstractions to standard object-oriented technology.
- 4 In ‘Modelling and implementing modularised BDI agents with capability relationships’ by Nunes and Faccin, the authors address the issue of modularisation of intra-agent software components. The BDI modularity concept of capability is extended by adding association, composition and generalisation relations. A modelling tool is developed and a case study is used to evaluate the approach.
- 5 In ‘An architecture for scalable simulation of systems of cognitive agents’ by Ahlbrecht, Dix, Fiekas, Köster, Kraus, and Müller, the authors develop a distributed scalable runtime simulation platform for multiagent simulation. Emphasis is put on clean modelling (e.g., like Jason) and on integrating both a micro as well as a macro view (to allow for dedicated plug-ins).
- 6 In ‘Integrating interaction with agents, environment, and organisation in JaCaMo’ by Zатели, Ricci and Hübner, the interaction in a MAS is conceived as a first-class abstraction in MAS development. The authors present a conceptual model, a language to define the interaction, the integration of the interaction component into the JaCaMo platform, and an evaluation of its benefits and drawbacks.

We would like to thank all authors for their contribution to this special issue, and also the referees for their work in carefully reviewing the articles. Furthermore, we would like to thank the editor-in-chief Professor Michael Winikoff for his invaluable support throughout the special issue production process.