

Natasha Alechina
Matteo Baldoni
Brian Logan (Eds.)

LNAI 13190

Engineering Multi-Agent Systems

9th International Workshop, EMAS 2021
Virtual Event, May 3–4, 2021
Revised Selected Papers

 Springer



Lecture Notes in Artificial Intelligence

13190

Subseries of Lecture Notes in Computer Science

Series Editors

Randy Goebel

University of Alberta, Edmonton, Canada

Wolfgang Wahlster

DFKI, Berlin, Germany

Zhi-Hua Zhou

Nanjing University, Nanjing, China

Founding Editor

Jörg Siekmann

DFKI and Saarland University, Saarbrücken, Germany


More information about this subseries at <https://link.springer.com/bookseries/1244>


Natasha Alechina · Matteo Baldoni ·
Brian Logan (Eds.)

Engineering Multi-Agent Systems

9th International Workshop, EMAS 2021
Virtual Event, May 3–4, 2021
Revised Selected Papers

Editors

Natasha Alechina 
Utrecht University
Utrecht, The Netherlands

Matteo Baldoni 
University of Turin
Turin, Italy

Brian Logan 
Utrecht University
Utrecht, The Netherlands

ISSN 0302-9743 ISSN 1611-3349 (electronic)
Lecture Notes in Artificial Intelligence
ISBN 978-3-030-97456-5 ISBN 978-3-030-97457-2 (eBook)
<https://doi.org/10.1007/978-3-030-97457-2>

LNCS Sublibrary: SL7 – Artificial Intelligence

© Springer Nature Switzerland AG 2022

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

The International Workshop on Engineering Multi-Agent Systems (EMAS) was formed in 2013 as a merger of three long-running workshops: Agent-Oriented Software Engineering (AOSE), Programming Multi-Agent Systems (ProMAS), and Declarative Agent Languages and Technologies (DALT). This merger established EMAS as a reference venue for work concerned broadly with the engineering of agents and multi-agent systems.

The three parent events have a long history of association with the International Conference on Autonomous Agents and Multi-Agent Systems (AAMAS), and since its inception EMAS has been co-located at AAMAS: EMAS 2013 in St. Paul (with post-proceedings published as Springer LNCS/LNAI volume 8245), EMAS 2014 in Paris (LNCS/LNAI 8758, and a special issue in the International Journal of Agent-Oriented Software Engineering, IJAOSE Vol. 5 No. 2/3, 2016), EMAS 2015 in Istanbul (LNCS/LNAI 9318, and a special issue in IJAOSE Vol. 6 No. 2, 2018), EMAS 2016 in Singapore (LNCS/LNAI 10093, and a special issue in the IJAOSE Vol. 6 No. 3/4, 2018), EMAS 2017 in São Paulo (LNCS/LNAI 10738), EMAS 2018 in Stockholm (LNAI 11375, and a report in Software Engineering Notes), EMAS 2019 in Montreal (LNAI 12058), and EMAS 2020 in Auckland (LNAI 12589).

EMAS 2021 aimed to build on this history by gathering researchers and practitioners in the domains of agent-oriented software engineering, programming multi-agent systems, declarative agent languages and technologies, artificial intelligence, and machine learning to present and discuss their research and emerging results in MAS engineering. The overall purpose of the workshop was to facilitate the cross-fertilization of ideas and experiences in the various fields to

- enhance our knowledge of the theory and practice of engineering intelligent agents and multi-agent systems, and advance the state of the art;
- demonstrate how MAS methodologies, architectures, languages and tools can be used in the engineering of deployed large-scale and open MAS;
- define new directions for engineering MAS by drawing on results and recommendations from related research areas; and
- encourage PhD and Masters students to become involved in and contribute to the area.

As with previous editions, this edition of the EMAS workshop was intended to be co-located with AAMAS, which was planned to be held in London, UK, in May 2021. As AAMAS 2021 was a virtual event, EMAS 2021 was held as a virtual (online) event, spanning two days. EMAS 2021 received 27 submissions, each of which was reviewed (single blind) by three reviewers. In total, 25 papers were accepted (21 full papers and four doctoral and demonstration papers). In addition to these 25 papers, EMAS 2021 also had two invited talks, “Agent Programming in the Cognitive Era: A New Era for Agent Programming?” by Alessandro Ricci and “Explicitly Ethical Agent Reasoning”

by Louise Dennis. The keynotes were delivered synchronously over Zoom. Talks were pre-recorded and available from the EMAS 2021 website, together with the slides and the final workshop presentation version of the papers. Each talk also had a live Q&A session on Zoom. The Q&A sessions were intended to allow interaction between authors and participants. After a second review process, 21 papers were selected for inclusion in this volume.

We would like to thank all individuals, institutions, and sponsors that supported EMAS 2021, in particular TU Clausthal for hosting the website. We thank the authors for submitting high-quality research papers. We are indebted to our Program Committee members and additional reviewers for spending their valuable time by providing careful reviews and recommendations on the submissions, the members of the EMAS Steering Committee for their valuable suggestions and support, Alessandro Ricci and Louise Dennis for their inspiring keynotes, and finally the AAMAS workshop chairs, Francesco Belardinelli and Matthijs Spaan, for all their work and support.

January 2022

Natasha Alechina
Matteo Baldoni
Brian Logan

Organization

Workshop Organizers

Natasha Alechina	Utrecht University, The Netherlands
Matteo Baldoni	Università degli Studi di Torino, Italy
Brian Logan	Utrecht University, The Netherlands

Program Committee

Luciano Baresi	Politecnico di Milano, Italy
Cristina Baroglio	Università degli Studi di Torino, Italy
Olivier Boissier	Mines Saint-Étienne, France
Rafael H. Bordini	PUCRS, Brazil
Daniela Briola	University of Insubria, Italy
Maiquel de Brito	Federal University of Santa Catarina, Brazil
Rafael C. Cardoso	University of Manchester, UK
Moharram Challenger	University of Antwerp, Belgium
Amit Chopra	Lancaster University, UK
Andrei Ciortea	University of St. Gallen, Switzerland
Rem Collier	University College Dublin, Ireland
Stefania Costantini	Università degli Studi dell'Aquila, Italia
Mehdi Dastani	Utrecht University, The Netherlands
Davide Dell'Anna	Delft University of Technology, The Netherlands
Louise Dennis	University of Manchester, UK
Juergen Dix	Clausthal University of Technology, Germany
Angelo Ferrando	Università di Genova, Italy
Lars-Ake Fredlund	Universidad Politécnica de Madrid, Spain
Stéphane Galland	UBFC - UTBM, France
James Harland	RMIT University, Australia
Vincent Hilaire	UBFC - UTBM, France
Jorge Gomez-Sanz	Universidad Complutense de Madrid, Spain
Zahia Guessoum	Universite de Paris 6 and Université de Reims Champagne Ardenne, France
Tom Holvoet	Katholieke Universiteit Leuven, Belgium
Jomi Fred Hubner	Federal University of Santa Catarina, Brazil
Nadin Kokciyan	University of Edinburgh, UK
Yves Lespérance	York University, Canada
Viviana Mascardi	Università di Genova, Italy
Philippe Mathieu	University of Lille, France
John-Jules Meyer	Utrecht University, The Netherlands
Roberto Micalizio	Università degli Studi di Torino, Italy
Fabien Michel	Université de Montpellier, France

Jörg P. Müller	TU Clausthal, Germany
Ingrid Nunes	Universidade Federal do Rio Grande do Sul, Brazil
Enrico Pontelli	New Mexico State University, USA
Alessandro Ricci	Università di Bologna, Italy
Luca Sabatucci	ICAR-CNR, Italy
Jaime Sichman	University of São Paulo, Brazil
Viviane Silva	IBM, Brazil
Tran Cao Son	New Mexico State University, USA
Jørgen Villadsen	Technical University of Denmark, Denmark
Gerhard Weiss	Maastricht University, The Netherlands
Danny Weyns	Katholieke Universiteit Leuven, Belgium
Michael Winikoff	Victoria University of Wellington, New Zealand
Neil Yorke-Smith	Delft University of Technology, The Netherlands

Steering Committee

Matteo Baldoni	Università degli Studi di Torino, Italy
Rafael Bordini	PUCRS, Brazil
Mehdi Dastani	Utrecht University, The Netherlands
Jürgen Dix	Clausthal University of Technology, Germany
Amal El Fallah Seghrouchni	Pierre and Marie Curie University, France
Brian Logan	Utrecht University, The Netherlands
Jörg P. Müller	TU Clausthal, Germany
Ingrid Nunes	Universidade Federal do Rio Grande do Sul, Brazil
Alessandro Ricci	Università di Bologna, Italy
M. Birna Van Riemsdijk	University of Twente, The Netherlands
Danny Weyns	Katholieke Universiteit Leuven, Belgium
Michael Winikoff	Victoria University of Wellington, New Zealand
Rym Zalila-Wenkstern	University of Texas at Dallas, USA

Additional Reviewers

Chaput, Rémy
Yang, Yi

Contents

PanSim + Sim-2APL: A Framework for Large-Scale Distributed Simulation with Complex Agents	1
<i>Parantapa Bhattacharya, A. Jan de Mooij, Davide Dell’Anna, Mehdi Dastani, Brian Logan, and Samarth Swarup</i>	
Implementing Ethical Governors in BDI	22
<i>Rafael C. Cardoso, Angelo Ferrando, Louise A. Dennis, and Michael Fisher</i>	
A Unifying Framework for Agency in Hypermedia Environments.	42
<i>Victor Charpenay, Tobias Käfer, and Andreas Harth</i>	
Multiagent Foundations for Distributed Systems: A Vision.	62
<i>Amit K. Chopra, Samuel H. Christie V, and Munindar P. Singh</i>	
An Epistemic Logic for Modular Development of Multi-Agent Systems.	72
<i>Stefania Costantini, Andrea Formisano, and Valentina Pitoni</i>	
Attention Guidance Agents with Eye-Tracking: A Use-Case Based on the MATBII Cockpit Task	92
<i>Szonya Durant, Benedict Wilkins, Callum Woods, Emanuele Uliana, and Kostas Stathis</i>	
StreamB: A Declarative Language for Automatically Processing Data Streams in Abstract Environments for Agent Platforms	114
<i>Angelo Ferrando and Fabio Papacchini</i>	
BDI for Autonomous Mobile Robot Navigation	137
<i>Patrick Gavigan and Babak Esfandiari</i>	
An Appraisal Transition System for Event-Driven Emotions in Agent-Based Player Experience Testing	156
<i>Saba Gholizadeh Ansari, I. S. W. B. Prasetya, Mehdi Dastani, Frank Dignum, and Gabriele Keller</i>	
Developer Operations and Engineering Multi-agent Systems.	175
<i>Timotheus Kampik, Cleber Jorge Amaral, and Jomi Fred Hübner</i>	
Smart Cyber-Physical System-of-Systems Using Intelligent Agents and MAS.	187
<i>Burak Karaduman and Moharram Challenger</i>	

Formal Verification of a Map Merging Protocol in the Multi-agent Programming Contest	198
<i>Matt Luckcuck and Rafael C. Cardoso</i>	
Analysis of the Execution Time of the Jason BDI Reasoning Cycle	218
<i>Jason Miller and Babak Esfandiari</i>	
Autonomous Economic Agent Framework	237
<i>David Minarsch, Marco Favorito, Seyed Ali Hosseini, Yuri Turchenkov, and Jonathan Ward</i>	
Seamless Integration and Testing for MAS Engineering	254
<i>Mostafa Mohajeri Parizi, Giovanni Sileno, and Tom van Engers</i>	
Engineering Explainable Agents: An Argumentation-Based Approach	273
<i>Alison R. Panisson, Débora C. Engelmann, and Rafael H. Bordini</i>	
TPO: A Type System for the Architecture of Agent Societies	292
<i>Antônio Carlos da Rocha Costa</i>	
A Practical Framework for General Dialogue-Based Bilateral Interactions . . .	312
<i>Seyed Ali Hosseini, David Minarsch, and Marco Favorito</i>	
Implementing Durative Actions with Failure Detection in GWENDOLEN	332
<i>Peter Stringer, Rafael C. Cardoso, Clare Dixon, and Louise A. Dennis</i>	
Concept Description and Definition Extraction for the ANEMONE System	352
<i>David Toluhi, Renate Schmidt, and Bijan Parsia</i>	
GenGPT: A Systematic Way to Generate Synthetic Goal-Plan Trees	373
<i>Yuan Yao and Di Wu</i>	
Author Index	381