

# ICAAART 2010

2<sup>nd</sup> International Conference on Agents and Artificial Intelligence

## Proceedings

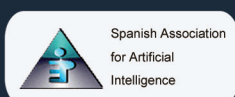
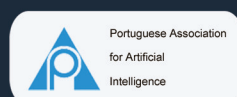
Volume 2

Valencia, Spain · 22 - 24 January, 2010

ORGANIZED BY



IN COOPERATION WITH



# ICAAART 2010

Proceedings of the  
2nd International Conference on  
Agents and Artificial Intelligence

Volume 2  
Agents

Valencia, Spain

January 22 - 24, 2010

Organized by  
**INSTICC – Institute for Systems and Technologies of Information, Control  
and Communication**

In Cooperation with  
**AAAI – Association for the Advancement of Artificial Intelligence**  
**APPIA – Portuguese Association for Artificial Intelligence**  
**AEPIA – Spanish Association of Artificial Intelligence**  
**WfMC – Workflow Management Coalition**  
**ACM SIGART – Association for Computing Machinery / Special Interest  
Group on Artificial Intelligence**

Copyright © 2010 INSTICC – Institute for Systems and Technologies of  
Information, Control and Communication  
All rights reserved

Edited by Joaquim Filipe, Ana Fred and Bernadette Sharp

Printed in Portugal  
ISBN: 978-989-674-022-1  
Depósito Legal: 303437/09

<http://www.icaart.org/>  
[icaart.secretariat@insticc.org](mailto:icaart.secretariat@insticc.org)

# BRIEF CONTENTS

---

INVITED SPEAKERS .....	IV
SPECIAL SESSION CHAIRS .....	IV
ORGANIZING AND STEERING COMMITTEES .....	V
PROGRAM COMMITTEE .....	VI
AUXILIARY REVIEWERS .....	IX
SPECIAL SESSION PROGRAM COMMITTEE .....	IX
SELECTED PAPERS BOOK .....	IX
FOREWORD .....	XI
CONTENTS .....	XIII

# INVITED SPEAKERS

---

**Yves Demazeau**

Laboratoire d'Informatique de Grenoble

France

**Tim Finin**

University of Maryland

U.S.A.

**Leonid Perlovsky**

Harvard University

U.S.A.

**Vicent J. Botti i Navarro**

Universidad Politécnica de Valencia

Spain

**Peter D. Karp**

Bioinformatics Research Group, Artificial Intelligence Center, SRI International

U.S.A.

**Amilcar Cardoso**

University of Coimbra

Portugal

# SPECIAL SESSION CHAIRS

---

## **SPECIAL SESSION ON COMPUTING LANGUAGES WITH MULTI-AGENT SYSTEMS AND BIO-INSPIRED DEVICES**

M. Dolores Jiménez-López, GRLMC - Research Group on Mathematical Linguistics,  
Rovira i Virgili University, Spain

Alfonso Ortega de la Puente, Departamento de Ingeniería Informática, Escuela Politécnica Superior,  
Universidad Autónoma de Madrid, Spain

# ORGANIZING AND STEERING COMMITTEES

---

## CONFERENCE CO-CHAIRS

Joaquim Filipe, Polytechnic Institute of Setúbal / INSTICC, Portugal

Ana Fred, Technical University of Lisbon / IT, Portugal

## PROGRAM CHAIR

Bernadette Sharp, Staffordshire University, U.K.

## PROCEEDINGS PRODUCTION

Helder Coelhas, INSTICC, Portugal

Andreia Costa, INSTICC, Portugal

Bruno Encarnação, INSTICC, Portugal

Bárbara Lima, INSTICC, Portugal

Liliana Medina, INSTICC, Portugal

Carla Mota, INSTICC, Portugal

Vitor Pedrosa, INSTICC, Portugal

José Varela, INSTICC, Portugal

## CD-ROM PRODUCTION

Elton Mendes, INSTICC, Portugal

Pedro Varela, INSTICC, Portugal

## GRAPHICS PRODUCTION AND WEBDESIGNER

Bruno Encarnação, INSTICC, Portugal

## SECRETARIAT

Patrícia Alves, INSTICC, Portugal

## WEBMASTER

Sérgio Brissos, INSTICC, Portugal

# PROGRAM COMMITTEE

---

**Stéphane Airiau**, University of Amsterdam, The Netherlands

**Natasha Alechina**, University of Nottingham, U.K.

**Sander Bohte**, CWI, The Netherlands

**Luigi Ceccaroni**, UPC - Barcelona Tech, Spain

**Berndt Farwer**, Durham University, U.K.

**Nicoletta Fornara**, Università della Svizzera Italiana, Switzerland

**Cees Witteveen**, Delft University of Technology, The Netherlands

**Thomas Ågotnes**, University of Bergen, Norway

**Rudolf Albrecht**, University of Innsbruck, Austria

**Cesar Analide**, University of Minho, Portugal

**Andreas Andreou**, University of Cyprus, Cyprus

**Ioannis N. Athanasiadis**, IDSIA, Switzerland

**Antonio Bahamonde**, Universidad de Oviedo, Spain

**Matteo Baldoni**, Università Degli Studi Di Torino, Italy

**Bikramjit Banerjee**, University of Southern Mississippi, U.S.A.

**Ana Lúcia C. Bazzan**, UFRGS, Brazil

**Orlando Belo**, University of Minho, Portugal

**Carole Bernon**, University of Toulouse III, France

**Daniel Berrar**, University of Ulster, U.K.

**Ateet Bhalla**, Technocrats Institute of Technology, India

**Olivier Boissier**, ENSM-SE, France

**Tibor Bosse**, Vrije Universiteit Amsterdam, The Netherlands

**Luis Botelho**, Superior Institute of Labour and Enterprise Sciences, Portugal

**Danielle Boulanger**, Université Jean Moulin Lyon 3, France

**Paolo Bresciani**, European Commission, Belgium

**Egon L. van den Broek**, Human-Centered Computing Consultancy, The Netherlands

**Silvia Calegari**, Università Degli Studi Di Milano Bicocca, Italy

**Valérie Camps**, IRIT - Université Paul Sabatier, France

**Jose Jesus Castro-schez**, Escuela Superior de Informatica, Spain

**Radovan Cervenka**, Whitestein Technologies, Slovak Republic

**Georgios Chalkiadakis**, University of Southampton, U.K.

**Shyi-Ming Chen**, National Taiwan University of Science and Technology, Taiwan

**Carlos Iván Chesñevar**, Universidad Nacional del Sur, Argentina

**Adam Cheyer**, SRI International, U.S.A.

**Paolo Ciancarini**, University of Bologna, Italy

**Diane Cook**, Washington State University, U.S.A.

**Paulo Cortez**, University of Minho, Portugal

**Jacob W. Crandall**, Masdar Institute of Science and Technology, U.A.E.

**Yves Demazeau**, CNRS, France

**Andreas Dengel**, German Research Center for Artificial Intelligence (DFKI GmbH), Germany

**Gaël Dias**, University of Beira Interior, Portugal

**Ian Dickinson**, HP Laboratories, Bristol, U.K.

**Edith Elkind**, Nanyang Technological University, Singapore

**Stefano Ferilli**, Università di Bari, Italy

**Antonio Fernández-caballero**, Universidad de Castilla-la Mancha, Spain

**Edilson Ferneda**, Catholic University of Brasília, Brazil

**Dariusz Frejlichowski**, West Pomeranian University of Technology, Poland

**Naoki Fukuta**, Shizuoka University, Japan

## PROGRAM COMMITTEE (CONT.)

---

**Wai-Keung Fung**, University of Manitoba, Canada

**Arnulfo Alanis Garza**, Instituto Tecnológico de Tijuana, Mexico

**Chiara Ghidini**, Fondazione Bruno Kessler - IRST, Italy

**Joseph Giampapa**, Carnegie Mellon University, U.S.A.

**Marie-Pierre Gleizes**, Université Paul Sabatier, France

**Dominic Greenwood**, Whitestein Technologies AG, Switzerland

**Sven Groppe**, University of Lübeck, Germany

**Zahia Guessoum**, UPMC, France

**Renata Guizzardi**, Universidade Federal do Espírito Santo, Brazil

**Andreas Herzig**, Université Paul Sabatier & CNRS, France

**Wladyslaw Homenda**, Warsaw University of Technology, Poland

**Wei-Chiang Hong**, Oriental Institute of Technology, Taiwan

**Mark Hoogendoorn**, Vrije Universiteit Amsterdam, The Netherlands

**Eyke Hüllermeier**, Philipps University of Marburg, Germany

**Carlos Iglesias**, Universidad Politécnica de Madrid, Spain

**François Jacquenet**, University of Saint-Étienne, France

**Yanguo Jing**, London Metropolitan University, U.K.

**W. Lewis Johnson**, Alelo Inc., U.S.A.

**Catholijn Jonker**, Delft University of Technology, The Netherlands

**Lalana Kagal**, MIT, U.S.A.

**Matthias Klusch**, Deutsches Forschungszentrum für Künstliche Intelligenz, Germany

**Joanna Kolodziej**, University of Bielsko-Biala, Poland

**Sébastien Konieczny**, CNRS - CRIL, France

**Igor Kotenko**, St. Petersburg Institute for Informatics and Automation of the Russian Academy of Science, Russian Federation

**Stan Kurkovsky**, Central Connecticut State University, U.S.A.

**Nuno Lau**, University of Aveiro, Portugal

**Ho-fung Leung**, The Chinese University of Hong Kong, Hong Kong

**Baoding Liu**, Tsinghua University, China

**Chao-Lin Liu**, National Chengchi University, Taiwan

**Stephane Loiseau**, Leria, France

**Gabriel Pereira Lopes**, FCT/UNL, Portugal

**Hongen Lu**, La Trobe University, Australia

**Bernd Ludwig**, University of Erlangen-Nürnberg, Germany

**José Machado**, University of Minho, Portugal

**Nadia Magnenat-thalmann**, University of Geneva, Switzerland

**Pierre Maret**, Université de Saint Etienne, France

**Tokuro Matsuo**, Yamagata University, Japan

**Nicola Di Mauro**, Università di Bari, Italy

**Amnon Meisels**, Ben-Gurion University, Israel

**Benito Mendoza**, ExxonMobil Research and Engineering, U.S.A.

**Daniel Merkle**, University of Southern Denmark, Denmark

**Bernd Meyer**, Monash University, Australia

**Simon Miles**, King's College London, U.K.

**Pavlos Moraitis**, Paris Descartes University, France

**Thierry Moyaux**, Université de Lyon (INSA), France

**Tracy Mullen**, The Pennsylvania State University, U.S.A.

**Radhakrishnan Nagarajan**, University of Arkansas for Medical Sciences, U.S.A.

**Tomoharu Nakashima**, Osaka Prefecture University, Japan



# PROGRAM COMMITTEE (CONT.)

---

**Paulo Novais**, Universidade do Minho, Portugal

**Charlie L. Ortiz**, SRI International, U.S.A.

**Jeng-Shyang Pan**, National Kaohsiung University of Applied Sciences, Taiwan

**Oscar Pastor**, Universidad Politécnica de Valencia, Spain

**Krzysztof Patan**, University of Zielona Gora, Poland

**Catherine Pelachaud**, CNRS - Télécom ParisTech, France

**Wojciech Penczek**, Institute of Computer Science, Poland

**Dana Petcu**, Western University of Timisoara, Romania

**Steve Phelps**, University of Essex, U.K.

**Rui Prada**, IST and INESC-ID, Portugal

**Rong Qu**, University of Nottingham, U.K.

**T. Ramayah**, Universiti Sains Malaysia, Malaysia

**Martin Reháč**, Czech Technical University in Prague, Czech Republic

**Luís Paulo Reis**, FEUP/LIACC - Faculdade de Engenharia da Universidade do Porto, Portugal

**Daniel Rodriguez**, University of Alcalá, Spain

**Pilar Rodriguez**, Universidad Autónoma de Madrid, Spain

**Rosaldo Rossetti**, Laboratório de Inteligência Artificial e Ciência de Computadores, LIACC/FEUP, Portugal

**Alessandro Saffiotti**, Orebro University, Sweden

**Manuel Filipe Santos**, University of Minho, Portugal

**Jurek Sasiadek**, Carleton University, Canada

**Camilla Schwind**, CNRS, France

**Candace L. Sidner**, BAE Systems AIT, U.S.A.

**Peer Olaf Siebers**, Nottingham University, U.K.

**Viviane Silva**, Universidade Federal Fluminense, Brazil

**Adam Slowik**, Koszalin University of Technology, Poland

**Alexander Smirnov**, SPIIRAS, Russian Academy of Sciences, Russian Federation

**Safeullah Soomro**, Yanbu University College, Saudi Arabia

**Kostas Stathis**, University of London, U.K.

**Kathleen Steinhofel**, King's College London, U.K.

**Thomas Stütze**, Université Libre de Bruxelles, Belgium

**Chun-Yi Su**, Concordia University, Canada

**Shiliang Sun**, East China Normal University, China

**Ryszard Tadeusiewicz**, AGH University of Science and Technology, Poland

**Paola Turci**, University of Parma, Italy

**Franco Turini**, KDD Lab, University of Pisa, Italy

**Paulo Urbano**, Faculdade de Ciências da Universidade de Lisboa, Portugal

**Ioannis Vlahavas**, Aristotle University of Thessaloniki, Greece

**Wutnipong Warakraisawad**, Bangkok University, Thailand

**Bozena Wozna-Szczesniak**, Jan Dlugosz University, Poland

**Seiji Yamada**, National Institute of Informatics, Japan

**Xin-She Yang**, National Physical Lab, U.K.

**Huiyu Zhou**, Queen's University Belfast, U.K.

# FOREWORD

---

This book contains the proceedings of the 2nd International Conference on Agents and Artificial Intelligence (ICAART 2010) which was organized by the Institute for Systems and Technologies of Information, Control and Communication (INSTICC). ICAART 2010 was held in cooperation with the Association for the Advancement of Artificial Intelligence (AAAI), the Portuguese Association for Artificial Intelligence (APPIA), the Spanish Association of Artificial Intelligence (AEPIA), the Workflow Management Coalition (WfMC) and the Association for Computing Machinery (ACM SIGART).

The Conference Program includes oral presentations (full papers and short papers) and posters, organized in two simultaneous tracks: “Artificial Intelligence” and “Agents”. We are proud to inform that the program includes also six plenary keynote lectures, given by internationally distinguished researchers, namely – Yves Demazeau (Laboratoire d’Informatique de Grenoble), Tim Finin (University of Maryland), Leonid Perlovsky (Harvard University), Vicent J. Botti i Navarro (Universidad Politécnic de Valencia), Peter D. Karp (AI Center at SRI International) and Amilcar Cardoso (University of Coimbra). The meeting is complemented with a Special Session on Computing Languages with Multi-Agent Systems and Bio-Inspired Devices.

ICAART received 364 paper submissions from 58 countries, in all continents. To evaluate each submission, a double blind paper review was performed by the Program Committee, whose members are highly qualified researchers in ICAART topic areas. Based on the classifications provided, only 165 papers were selected to be published in these proceedings and presented at the conference. Of these, 96 papers were selected for oral presentation (31 full papers and 65 short papers) and 69 papers were selected for poster presentation. The full paper acceptance ratio was 9%, and the oral acceptance ratio (including full papers and short papers) was 26%. This strict acceptance ratio shows the intention to preserve a high quality forum which we expect to develop further next year. A short list of presented papers will be selected so that revised and extended versions of these papers will be published by Springer-Verlag in a CCIS Series book with the best papers of ICAART 2010.

Conferences are also meeting places where collaboration projects can emerge from social contacts amongst the participants. Therefore, in order to promote the development of research and professional networks the Conference includes in its social program a Conference Social Event & Banquet in the evening of January 23 (Saturday).

We would like to express our thanks to all participants. First of all to the authors, whose quality work is the essence of this conference; secondly to all members of the Program Committee and auxiliary reviewers, who helped us with their expertise and valuable time. We would also like to deeply thank the invited speakers for their excellent contribution in sharing their knowledge and vision. Finally, a word of appreciation for the hard work of the secretariat: organizing a conference of this level is a task that can only be achieved by the collaborative effort of a dedicated and highly capable team.

The organization will distribute four paper awards at the conference closing session, two for the Agents track and two for the Artificial Intelligence track: each track will have a best paper award and the best student paper award. The decision is mainly based on the paper classifications provided by the Program Committee and the paper presentation at the conference.

We wish you all an exciting conference and an unforgettable stay in the lovely city of Valencia. We hope to meet you again next year for the 3rd ICAART, details of which will soon be available at <http://www.icaart.org>.

**Joaquim Filipe**

Polytechnic Institute of Setúbal / INSTICC, Portugal

**Ana Fred**

Technical University of Lisbon / IT, Portugal

**Bernadette Sharp**

Staffordshire University, U.K.

# CONTENTS

---

## INVITED SPEAKERS

### KEYNOTE SPEAKERS

PURPOSIVE MULTI-AGENT SYSTEMS <i>Yves Demazeau</i>	IS-5
CREATING AND EXPLOITING A WEB OF SEMANTIC DATA <i>Tim Finin</i>	IS-7
COGNITIVE EVOLUTION OF CULTURES <i>Leonid Perlovsky</i>	IS-19
AGENTS AND AGREEMENT TECHNOLOGIES - The Next Generation of Information Distributed Systems <i>Vicent J. Botti i Navarro</i>	IS-21
DEVELOPMENT OF LARGE SCIENTIFIC KNOWLEDGE BASES <i>Peter D. Karp</i>	IS-23
COMPUTATIONAL CREATIVITY - Progress and Prospects <i>Amilcar Cardoso</i>	IS-25

## AGENTS

### FULL PAPERS

MIPITS - An Agent based Intelligent Tutoring System <i>Egons Lavendelis and Janis Grundspenkis</i>	5
A 3D INDOOR PEDESTRIAN SIMULATOR USING A SPATIAL DBMS <i>Hyeyoung Kim and Chulmin Jun</i>	14
A MULTI-AGENT SYSTEM FOR INTELLIGENT BUILDING CONTROL - Norm Approach <i>Jarunee Duangsuwan and Kecheng Liu</i>	22
SELF-ADAPTIVE MULTI-AGENT SYSTEM FOR SELF-REGULATING REAL-TIME PROCESS - Preliminary Study in Bioprocess Control <i>Sylvain Videau, Carole Bernon and Pierre Glize</i>	30
A PATTERN APPROACH TO MODELING THE PROVIDER SELECTION PROBLEM <i>José Javier Durán and Carlos A. Iglesias</i>	38
SCHEDULING SOLUTION FOR GRID META-BROKERING USING THE PLIANT SYSTEM <i>József Dániel Dombi and Attila Kertész</i>	46
AGENT-BASED SYSTEMS DESIGN FOR VIRTUAL ORGANISATIONS FORMATION <i>Tiemei Irene Zhang</i>	54
MODEL-FREE LEARNING FROM DEMONSTRATION <i>Erik A. Billing, Thomas Hellström and Lars-Erik Janlert</i>	62
INTELLIGENT AGENTS FOR SEMANTIC SIMULATED REALITIES - The ISReal Platform <i>Stefan Nesbigall, Stefan Warwas, Patrick Kapahnke, René Schubotz, Matthias Klusch, Klaus Fischer and Philipp Slusallek</i>	72

AUCTION SCOPE, SCALE AND PRICING FORMAT - Agent-based Simulation of the Performance of a Water Quality Tender <i>Atakelty Hailu, John Rolfe, Jill Windle and Romy Greiner</i>	80
COORDINATION AND ORGANISATIONAL MECHANISMS APPLIED TO THE DEVELOPMENT OF A DYNAMIC, CONTEXT-AWARE INFORMATION SERVICE <i>Manel Palau, Luigi Ceccaroni, Ignasi Gómez-Sebastià, Javier Vázquez-Salceda and Juan Carlos Nieves</i>	88
AGENT-BASED INTERDISCIPLINARY FRAMEWORK FOR DECISION MAKING IN COMPLEX SYSTEMS <i>Marina V. Sokolova, Antonio Fernández-Caballero and Francisco J. Gómez</i>	96
A COGNITIVE MODEL FOR HUMAN BEHAVIOR SIMULATION IN EBDI VIRTUAL HUMANS <i>Héctor Orozco, Félix Ramos, Victor Fernández, Octavio Gutiérrez, Marco Ramos and Daniel Thalmann</i>	104
<b>SHORT PAPERS</b>	
COACH BOT - Modular e-Course with Virtual Coach Tool Support <i>Ilaria Mascitti, Mikail Feituri, Federica Funghi, Susanna Correnti and Luca Angelo Galassi</i>	115
TOWARDS A COMPREHENSIVE TEAMWORK MODEL FOR HIGHLY DYNAMIC DOMAINS <i>Hendrik Skubch, Michael Wagner, Roland Reichle, Stefan Triller and Kurt Geihs</i>	121
DISTRIBUTED PLANNING THROUGH GRAPH MERGING <i>Damien Pellier</i>	128
MANIPULATING RECOMMENDATION LISTS BY GLOBAL CONSIDERATIONS <i>Alon Grubshtein, Nurit Gal-Oz, Tal Grinshpoun, Amnon Meisels and Roie Zivan</i>	135
RISK ANALYSIS AND DEPLOYMENT SECURITY ISSUES IN A MULTI-AGENT SYSTEM <i>Ambra Molesini, Marco Prandini, Elena Nardini and Enrico Denti</i>	143
AGENT ONTOLOGY INTEROPERABILITY APPROACH FOR MAS NEGOTIATIONS IN VIRTUAL ENTERPRISES <i>X. H. Wang, T. N. Wong and G. Wang</i>	149
USING MOBILE AGENTS IN EEG SIGNAL PROCESSING <i>Roman Mouček and Petr Šolc</i>	155
A MAS-BASED NEGOTIATION MECHANISM TO DEAL WITH SATURATED CONDITIONS IN DISTRIBUTED ENVIRONMENTS <i>Mauricio Paletta and Pilar Herrero</i>	159
PROBABILISTIC AWARD STRATEGY FOR CONTRACT NET PROTOCOL IN MASSIVELY MULTI-AGENT SYSTEMS <i>Toshiharu Sugawara, Toshio Hiortsu and Kensuke Fukuda</i>	165
COOPERATIVE LEARNING OF BDI ELEVATOR AGENTS <i>Yuya Takata, Yuki Mikura, Hiroaki Ueda and Kenichi Takahashi</i>	172
EVALUATION OF TRUST POLICIES BY SIMULATION <i>Cosmin Mogoş and Ina Schieferdecker</i>	178
COORDINATION OF PLANNING AND SCHEDULING TECHNIQUES FOR A DISTRIBUTED, MULTI-LEVEL, MULTI-AGENT SYSTEM <i>John S. Kinnebrew, Daniel L. C. Mack, Gautam Biswas and Douglas C. Schmidt</i>	184

RELATED WORD EXTRACTION FROM WIKIPEDIA FOR WEB RETRIEVAL ASSISTANCE <i>Kentaro Hori, Tetsuya Oishi, Tsunenori Mine, Ryuzo Hasegawa, Hiroshi Fujita and Miyuki Koshimura</i>	192
AN AGENT-BASED MODEL FOR RECREATIONAL FISHING MANAGEMENT EVALUATION IN A CORAL REEF ENVIRONMENT <i>Lei Gao, Jeff Durkin and Atakelty Hailu</i>	200
EVALUATING JASON FOR DISTRIBUTED CROWD SIMULATIONS <i>Victor Fernández, Francisco Grimaldo, Miguel Lozano and Juan M. Orduña</i>	206
A CONTEXTUAL ENVIRONMENT APPROACH FOR MULTI-AGENT-BASED SIMULATION <i>Fabien Badeig, Flavien Balbo and Suzanne Pinson</i>	212
COORDINATING AGENTS - An Analysis of Coordination in Supply-chain Management Tasks <i>Chetan Yadati, Cees Witteveen and Yingqian Zhang</i>	218
CONEMAF: A MODULAR MULTI AGENT FRAMEWORK FOR AUTONOMIC NETWORK MANAGEMENT <i>Julien Boite, Gérard Nguengang, Maurice Israël and Vania Conan</i>	224
AN AGENT BASED SIMULATION OF THE DYNAMICS IN COGNITIVE DEPRESSOGENIC THOUGHT <i>Azizi Ab Aziz and Michel C. A. Klein</i>	232
<b>POSTERS</b>	
MAP EXPLORATION USING A LINE-BASED FORMATION OF MOBILE ROBOTS <i>Bart Wyns, Jens Boeykens and Luc Boullart</i>	241
SAM- Semantic Agent Model for SWRL Rule-based Agents <i>Julien Subercaze and Pierre Maret</i>	245
USING AGENTS TO CONFRONT SOME OF THE CHALLENGES OF KNOWLEDGE MANAGEMENT SYSTEMS <i>Javier Portillo-Rodríguez, Aurora Vizcaíno, Juan Pablo Soto and Mario Piattini</i>	249
MANAGING COMBINATORIAL OPTIMIZATION PROBLEMS BY MEANS OF EVOLUTIONARY COMPUTATION AND MULTI-AGENT SYSTEM <i>Mauricio Paletta and Pilar Herrero</i>	253
COMBINING SELF-MOTIVATION WITH LOGICAL PLANNING AND INFERENCE IN A REWARD-SEEKING AGENT <i>Daphne Liu and Lenhart Schubert</i>	257
FORMAL MODEL TO INTEGRATE MULTI-AGENT SYSTEMS AND INTERACTIVE GRAPHIC SYSTEMS <i>Gabriel López-García, Rafael Molina-Carmona and Javier Gallego-Sánchez</i>	264
INVOLVING WEB-TRADING AGENTS & MAS - An implementation for Searching and Recovering Environmental Information <i>L. Iribarne, N. Padilla, J. A. Asensio, F. Muñoz and J. Criado</i>	268
LEARNING ACTION SELECTION STRATEGIES IN COMPLEX SOCIAL SYSTEMS <i>Marco Remondino, Anna Maria Bruno and Nicola Miglietta</i>	274
DYNAMIC SERVICE DISCRIMINATION STRATEGY DEVELOPMENT USING GAME THEORY <i>Kwang Sup Shin, Suk-Ho Kang, Jae-Yoon Jung and Doug Young Suh</i>	282

PROGRAMMING REACTIVE AGENT-BASED MOBILE ROBOTS USING ICARO-T FRAMEWORK	287
<i>José M. Gascueña, Antonio Fernández-caballero and Francisco J. Garijo</i>	
A GENERIC COGNITIVE SYSTEM ARCHITECTURE APPLIED TO THE UAV FLIGHT GUIDANCE DOMAIN	292
<i>Stefan Brüggewirth, Ruben Strenzke, Alexander Alexander and Axel Schulte</i>	
MULTIAGENT SYSTEM FOR THE PREVENTION OF ACCIDENTS OF PEOPLE LIVING ALONE	299
<i>Miguel A. Sanz-Bobi, David Contreras, J. García de Diego, Alberto Pérez and Jose J. de Vicente</i>	
ARCHETYPE-BASED SEMANTIC INTEROPERABILITY IN HEALTHCARE	305
<i>Alberto Marques, António Correia, Lúcia Cerqueira, José Machado and José Neves</i>	
AGENCY SERVICES - An Agent-based and Services-oriented Model for Building Large Virtual Communities	309
<i>I. Lopez-Rodriguez and M. Hernandez-Tejera</i>	
A MOBILE INTELLIGENT SYNTHETIC CHARACTER WITH NATURAL BEHAVIOR GENERATION	315
<i>Jongwon Yoon and Sung-bae Cho</i>	
AN AGENT FRAMEWORK FOR PERSONALISED STUDENT SELF-EVALUATION	319
<i>María T. París and Mariano Cabrero</i>	
A TOOL ENVIRONMENT FOR SPECIFYING AND VERIFYING MULTI-AGENT SYSTEMS	323
<i>Christian Schwarz, Ammar Mohammed and Frieder Stolzenburg</i>	
HIERARCHICAL COORDINATION - Towards Scheme based on Problem Splitting	327
<i>Said Brahimi, Ramdane Maamri and Zaidi Sahnoun</i>	
KNOWLEDGE REPRESENTATION - An Ontology for Managing a Virtual Environment	332
<i>Lydie Edward, Kahina Amokrane, Domitile Lourdeaux and Jean-Paul Barthès</i>	
MULTI-AGENTS SYSTEM ON EPILEPTIC NETWORK	336
<i>Abel Kinie and Jean-Jacques Montois</i>	
TOWARDS ROBUST HYBRID CENTRAL/SELF-ORGANIZING MULTI-AGENT SYSTEMS	341
<i>Yaser Chaaban, Jörg Hähner and Christian Müller-Schloer</i>	
COORDINATION IN OPEN AND UNSTRUCTURED INTELLIGENT AGENT SOCIETIES - Using Distributed Planners on Top of a Semantic Overlay Network	347
<i>António Luís Lopes and Luís Miguel Botelho</i>	
AN APPROACH TO PERSONALISATION IN E-LEARNING SOCIAL ENVIRONMENTS	351
<i>Hend Ben Hadji and Ho-Jin Choi</i>	

## **SPECIAL SESSION ON COMPUTING LANGUAGES WITH MULTI-AGENT SYSTEMS AND BIO-INSPIRED DEVICES**

### **FULL PAPERS**

OVERVIEW OF INTERACTIVE GENETIC PROGRAMMING APPROACHES FOR CONVERSATIONAL AGENTS	359
<i>Diana Pérez-Marín and Ismael Pascual-Nieto</i>	

A MULTI-AGENT MODEL FOR SIMULATING THE IMPACT OF SOCIAL STRUCTURE IN LINGUISTIC CONVERGENCE <i>Gemma Bel-Enguix</i>	367
COGNITIVE PERSPECTIVES ON ROBOT BEHAVIOR <i>Erik A. Billing</i>	373
PARSING BY SIMPLE INSERTION SYSTEMS <i>Gemma Bel-Enguix, Pál Dömösi and Alexander Krassovitskiy</i>	383
BIOLOGICAL CONCEPT FORMATION GRAMMARS - A Flexible, Multiagent Linguistic Tool for Biological Processes <i>Veronica Dahl, Pedro Barahona, Gemma Bel-Enguix and Ludwig Krippahl</i>	388
THE LINGUISTIC RELEVANCE OF LINDENMAYER SYSTEMS <i>Leonor Becerra-Bonache, Suna Bensch and M. Dolores Jiménez-López</i>	395
PNEPS FOR SHALLOW PARSING - NEPs Extended For Parsing Applied To Shallow Parsing <i>Emilio del Rosal, Alfonso Ortega de la Puente and Diana Pérez-Marín</i>	403
AUTHOR INDEX	411



# USING AGENTS TO CONFRONT SOME OF THE CHALLENGES OF KNOWLEDGE MANAGEMENT SYSTEMS

Javier Portillo-Rodríguez<sup>1</sup>, Aurora Vizcaíno<sup>1</sup>, Juan Pablo Soto<sup>2</sup> and Mario Piattini<sup>1</sup>

<sup>1</sup>*ALARCOS Research Group, Information Systems and Technologies Department  
UCLM-INDRA Research and Development Institute, Escuela de Informática, Universidad de Castilla-La Mancha  
Paseo de la Universidad 4 - 13071 Ciudad Real, Spain  
{javier.portillo, aurora.vizcaino, mario.piattini}@uclm.es*

<sup>2</sup>*Mathematics Department, University of Sonora  
Blvd. Luis Encinas y Rosales s/n, Col. Centro, CP. 83000, Hermosillo, México  
jpsoto@gauss.mat.uson.mx*

**Keywords:** Agent architecture, Knowledge management systems, Communities of practice, Trust models.

**Abstract:** The importance of knowledge management has, in recent years, led to the incorporation of Knowledge Management Systems (KMS) into companies. Some of these KMS could be considered as Recommender Systems that are able to recommend knowledge, which is part of the company's intellectual capital. However, these KMS are not always welcome in the company, since the knowledge is not stored by using a quality control, or because employees feel that these kinds of systems, rather than helping them, cause them extra work. In this paper we present an agent architecture combined with a trust algorithm trying to avoid some of the problems that appear when a KMS is introduced into companies.

## 1 INTRODUCTION

In recent years, knowledge has become an extremely important factor (Hansen and Kautz, 2004). Subjects such as Knowledge Management are, therefore, currently of particular interest to organizations who are concerned about their employees' learning and competitiveness, since a suitable management of knowledge can help them to increase their members' collaboration and encourage them to share knowledge. At present organizations must operate in a climate of rapid market change and high information volume, which increases the necessity to create knowledge management systems (KMS) that support the knowledge process. It is possible to consider certain Recommender Systems as KMS, however, these kinds of systems are not always welcomed by a company's employees because (Lawton, 2001) on occasions employees waste a considerable amount of time searching for information, with regard to this, sometimes there is no quality control with regard to the KOs (Knowledge Objects) introduced into the system and employees may introduce information into the systems which is not very valuable.

Our work is focused on attempting to reduce the impact of these problems. We therefore use software agents to search for information on behalf of users, and these agents are in charge of recommending the most suitable knowledge to them.

We pretend to use our proposal in Communities of Practice (CoPs) which are a natural means of sharing knowledge, which is considered to be a critical factor for an organization's competitive advantage (Hansen and Kautz, 2004).

However, nowadays, these kind of communities, due to globalization, are geographically distributed and there are no face-to-face interactions. If CoP members are distributed and they do not know the other members trust between CoP members decrease. This situation could be a problem because people in general prefer to exchange knowledge with "trustworthy people" and if there is not enough trust among members knowledge exchange could decrease too. People with a consistently low reputation will eventually be isolated from the community since others will rarely accept their justifications or arguments and will limit their interactions with them. This issue, plus the problems pointed out previously, have led us to develop an agent architecture and a recommendation algorithm

to encourage the reuse of knowledge in CoPs. In order to tackle these problems, we have developed an agent architecture and a trust algorithm with which to rate KOs and Knowledge Sources (KSs) that produce these KOs. The software agents will therefore use this algorithm in order to decide whether a KO or KS should be recommended to a particular user.

Therefore in Section 2 the agent architecture is described and later, in Section 3, a recommender system and the recommender algorithm used by this system is explained. Finally, our conclusions are outlined in Section 4.

## 2 AN AGENT ARCHITECTURE

The agent architecture proposed is composed of two levels: reactive and deliberative-social. The reactive level is considered by other authors to be a typical level that an Agent Architecture must have (Ushida, 1998). A deliberative level is often also considered as a typical level, but a social level is not often considered in an explicit manner, despite the fact that these systems (MAS) are composed of several individuals, the interactions between them and the plans constructed by them. The social level is only considered in those systems that attempt to simulate social behaviour. Since we wish to emulate human feelings such as trust when working in CoPs, we have added a social-deliberative level that considers the social aspects of a community and which takes into account the opinions and behaviour of each of the members of that community.

Each of these levels is explained in greater detail in the following sub-sections.

### 2.1 Reactive Level

This is the level in charge of perceiving changes in its environment and responding to these changes at the precise moment at which they occur, i.e., when an agent executes another agent's request without any type of reasoning.

The components of the reactive level are (see Figure 1):

**Internal Model.** This component stores the individuals' features. These features will be consulted by other agents in order to discover more about the person represented by the User Agent

**Beliefs.** This module is composed of inherited beliefs (pre-defined beliefs) and lessons learned (obtained by interaction with the environment) from the agent itself.

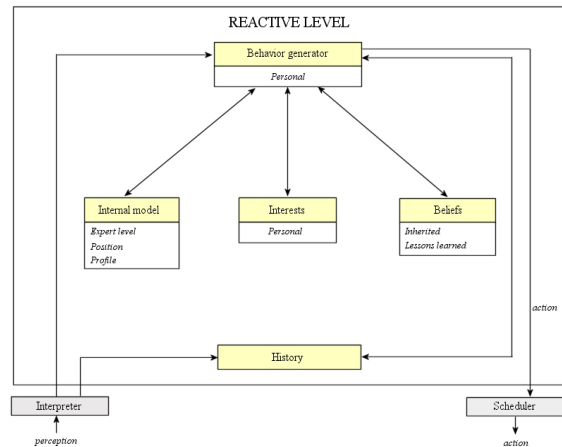


Figure 1: Reactive Level.

**Interests.** These are a special kind of beliefs. This component represents individual interests that an agent has with regard to a topic or a knowledge source.

**Behaviour Generator.** This component is fundamental to our architecture. It is here that the actions to be executed by the agent are triggered. Depending on the information received from the *Interpreter* module the agent makes a matching process to select the correspondent behaviour.

### 2.2 Deliberative-Social Level

At this level, the agent has a type of behaviour which is oriented towards objectives, that is, it takes the initiative in order to plan its performance with the purpose of attaining its goals.

The components of the deliberative-social level are (see Figure 2):

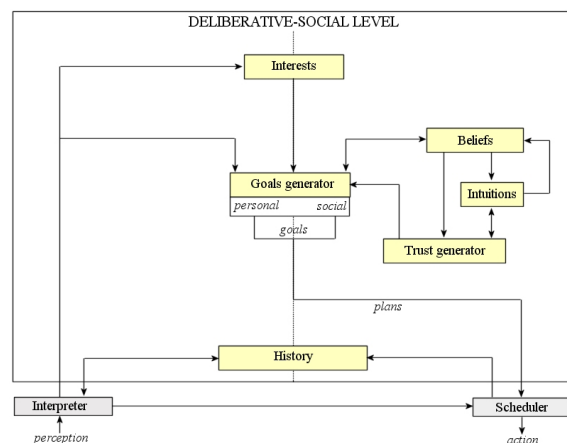


Figure 2: Deliberative-Social Level.

**Goals Generator.** Depending on the state of the agent, this module must decide what the most important goal to be achieved is.

**Social Beliefs.** This component represents a view that the agent has of the communities and their members, for instance, beliefs about other agents.

**Social Interests.** This is a special type of belief. In this case it represents interest in other agents.

**Intuitions.** We often trust more in people who have similar features to our own. Thus, in this research, intuition has been modelled according to the similarity between agents' profiles: the greater the similarity between one agent and another, the greater the level of trust. The agents' profiles may change according to the community in which they are working. This factor will be used in those cases when the agent doesn't have enough information to know if a KS is trustworthy.

**Plan Generator.** This component is in charge of evaluating how a goal can be attained, and which plans are most appropriate to achieve this.

**Trust Generator.** This module is in charge of generating a trust value for the knowledge sources with which an agent interacts in the community. To do this, the trust generator module considers the trust model explained in detail in (Soto et al, 2007) which considers the information obtained from the internal model and the agent's intuitions.

### 3 A RECOMMENDER SYSTEM

A recommender system has been developed in order to test the trust model and the multi-agent architecture. In this system each CoP member is represented by a software agent called a User Agent. A new community member must first join a community, which is done by using the "Register" menu and choosing a community from those which are available. Once registered, a member can provide new KOs or use those which are already available in the community and/or propose new subjects. One way to obtain KOs in a community is requesting a KO recommendation. To obtain a KO recommendation user has to use the "Recommend" menu and select a topic. To make the recommendation, the prototype will use a recommendation algorithm that has been design as follows.

The input the algorithm is a set of KOs. Each KO may or may not have been evaluated previously, signifying that a KO may already have a list of

evaluations (along with the identity of each person who evaluated it), or it may not have any evaluations. This aspect will be taken into account by the algorithm, which therefore distinguishes two groups:

Group 1 (G1): This group is formed of the KOs that have already been evaluated. This is the most important group since if the agents have previous evaluations of a KO they have more information about it, which facilitates the task of discovering whether or not its recommendation is advisable.

Group 2 (G2): these KOs have not been used previously so the agents do not have any previous evaluations of them. Let us now observe how each group is processed by the algorithm.

In G1 the KOs will be ordered by a Recommendation Rate which is calculated by the User Agent for each KO. Hence  $RR_k$  signifies the Recommendation Rate for a particular KO called  $k$ , and is obtained from:

$$RR_k = w1 * TE_i + w2 * TS_{ik} \quad (1)$$

where  $TE_i$  is the pondered mean of the evaluations determined by the trust that an agent "i" has in each evaluator (the person who has previously evaluated that KO).  $TE_i$  is calculated as:

$$TE_i = \frac{\sum_{j=1}^n E_{jk} * TS_{ij}}{\sum_{j=1}^n TS_{ij}} \quad (2)$$

Therefore,  $TS_{ij}$  is the trust value that the User Agent "i" has in the knowledge source "j", since in a CoP the source which provides a KO will usually be a CoP member.  $TS_{ij}$  therefore represents the trust that an agent "i" has in another agent "j" and  $E_{jk}$  is the evaluation that an agent "j" has made with regard to a particular KO "k".

The parameter  $TS_{ik}$  used in Formula (1) similarly indicates the trust that an agent "i" has in a knowledge source "k". In other words, the agent must take two things into consideration when calculating the  $RR_k$

- The other agents' opinions of a KO "k" pondered by the trust that agent "i" has in the person who provided that evaluation.
- The opinion that the agent "i" has in the agent that has provided the KO "k".

Both  $w1$  and  $w2$  are weights which are used to adjust the formula. The sum of  $w1$  and  $w2$  should be 1.

Group 2 will use another formula to calculate the  $RR_k$  for each KO since, in this case, there are no

results of previous evaluations of the KOs. This formula, not explained due to space problems, basically uses a pondered mean of the trust values that other agents have about the KS.

## 4 CONCLUSIONS

CoPs are a means of knowledge sharing. However, the knowledge that is reused should be valuable for its members, who might otherwise prefer to ignore the documents that a community has at its disposal. In order to encourage the reuse of documents in CoPs, in this work we propose a multi-agent recommender system with which to suggest trustworthy documents. Some of the advantages of our system are:

- The use of agents to represent members of the community helps members to avoid the problem of information overload since the system gives agents the ability to reason about the trustworthiness of the other agents or about the recommendation of the most suitable documents to the members of the community. Users are not, therefore, flooded with all the documents that exist with regard to a particular subject, but their agents filter them and recommend only those which are most trustworthy (when they have rates) or those which are provided by more trustworthy sources or sources which have preferences and features that are similar to those of the user in question.
- The system can detect those users with the greatest level of participation and those whose documents have obtained higher rates. This information can be used for two purposes: expert detection and/or recognition of fraudulent members who contribute with worthless documents. Both functionalities imply various advantages for any kind of organization, i.e., the former permits the identification of employee expertise and measures the quality of their contributions, and the latter permits the detection of fraud when users contribute with non-valuable information.
- The system facilitates the exchange and reuse of information, since the most suitable documents are recommended. The tool can also be understood as a knowledge flow enabler (Rodríguez-Elias et al, 2007), which encourages knowledge reuse in companies.

Furthermore, the proposed algorithm is quite flexible since in many situations weights are used to modify the formulas. This algorithm could, therefore, be used by the designers of other recommender systems who could decide what values they should give to these weights in order to adapt the formula to their needs.

## REFERENCES

- Hansen, B. and Kautz, K., (2004), "Knowledge Mapping: A Technique for Identifying Knowledge Flows in Software Organisations", in *Software Process Improvement*, LNCS 3281, Springer: 126-137.
- Lawton, G., (2001), "Knowledge Management: Ready for Prime Time?", in *Computer*, vol. 34(2): 12-14.
- Rodríguez-Elias, O., Martínez-García, A., Vizcaino, A., Favela, J., and Piattini, M. (2007). "A Framework to Analyze Information Systems as Knowledge Flow Facilitators", in *Information Software Technology*, vol. 50(6): 481-498.
- Soto, J. P., Vizcaino, A., Portillo, J., and Piattini, M., (2007), "Applying Trust, Reputation and Intuition Aspects to Support Virtual Communities of Practice", in *11th International Conference on Knowledge-Based and Intelligence Information and Engineering Systems (KES)*, LNCS 4693, Springer: 353-360.
- Ushida, H., Hirayama, Y., and Nakajima, H., (1998), "Emotion Model for Life like Agent and its Evaluation", in *Proceedings of the Fifteenth National Conference on Artificial Intelligence and Tenth Innovative Applications of Artificial Intelligence Conference (AAAI'98 / IAAI'98)*, Madison, Wisconsin, USA.

PROCEEDINGS INDEXED BY

