

Lecture Notes in Artificial Intelligence

10061

Subseries of Lecture Notes in Computer Science

LNAI Series Editors

Randy Goebel

University of Alberta, Edmonton, Canada

Yuzuru Tanaka

Hokkaido University, Sapporo, Japan

Wolfgang Wahlster

DFKI and Saarland University, Saarbrücken, Germany

LNAI Founding Series Editor

Joerg Siekmann

DFKI and Saarland University, Saarbrücken, Germany

More information about this series at <http://www.springer.com/series/1244>

Grigori Sidorov · Oscar Herrera-Alcántara (Eds.)

Advances in Computational Intelligence

15th Mexican International Conference
on Artificial Intelligence, MICAI 2016
Cancún, Mexico, October 23–28, 2016
Proceedings, Part I

Editors

Grigori Sidorov
Instituto Politécnico Nacional
Centro de Investigación en Computación
Mexico City
Mexico

Oscar Herrera-Alcántara
Universidad Autónoma Metropolitana
Mexico City
Mexico

ISSN 0302-9743 ISSN 1611-3349 (electronic)
Lecture Notes in Artificial Intelligence
ISBN 978-3-319-62433-4 ISBN 978-3-319-62434-1 (eBook)
DOI 10.1007/978-3-319-62434-1

Library of Congress Control Number: 2017940386

LNCS Sublibrary: SL7 – Artificial Intelligence

© Springer International Publishing AG 2017

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, express 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.

Printed on acid-free paper

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

Preface

The Mexican International Conference on Artificial Intelligence (MICAI) is a yearly international conference series that has been organized by the Mexican Society of Artificial Intelligence (SMIA) since 2000. MICAI is a major international artificial intelligence forum and the main event in the academic life of the country's growing artificial intelligence community.

MICAI conferences publish high-quality papers in all areas of artificial intelligence and its applications. The proceedings of the previous MICAI events have been published by Springer in its *Lecture Notes in Artificial Intelligence* series, vols. 1793, 2313, 2972, 3789, 4293, 4827, 5317, 5845, 6437, 6438, 7094, 7095, 7629, 7630, 8265, 8266, 8856, 8857, 9413, and 9414. Since its foundation in 2000, the conference has been growing in popularity and improving in quality.

The proceedings of MICAI 2016 are published in two volumes. The first volume, *Advances in Computational Intelligence*, contains 44 papers structured into seven sections:

- Natural Language Processing
- Social Networks and Opinion Mining
- Fuzzy Logic
- Time Series Analysis and Forecasting
- Planning and Scheduling
- Image Processing and Computer Vision
- Robotics

The second volume, *Advances in Soft Computing*, contains 44 papers structured into ten sections:

- General
- Reasoning and Multi-Agent Systems
- Neural Networks and Deep Learning
- Evolutionary Algorithms
- Machine Learning
- Classification and Clustering
- Optimization
- Data Mining
- Graph-Based Algorithms
- Intelligent Learning Environments

This two-volume set will be of interest for researchers in all areas of artificial intelligence, students specializing in related topics, and for the general public interested in recent developments in artificial intelligence.

The conference received for evaluation 238 submissions by 584 authors from 32 countries: Argentina, Brazil, Canada, Chile, China, Colombia, Costa Rica, Cuba, Czech Republic, Ecuador, France, Germany, Greece, Hungary, India, Iran, Ireland, Israel, Italy, Macao, Mexico, Pakistan, Russia, Serbia, Singapore, South Africa, Spain,

Thailand, Turkey, Ukraine, UK, and USA. Of these submissions, 86 papers were selected for publication in these two volumes after a peer-reviewing process carried out by the international Program Committee. The acceptance rate was 36.1%.

In addition to regular papers, the volumes contain two invited papers by the keynote speaker Vladik Kreinovich (USA):

- “For Multi-Interval-Valued Fuzzy Sets, Centroid Defuzzification Is Equivalent to Defuzzifying Its Interval Hull: A Theorem”
- “Metric Spaces Under Interval Uncertainty: Towards an Adequate Definition”

The international Program Committee consisted of 140 experts from 26 countries: Australia, Azerbaijan, Benin, Brazil, Canada, Colombia, Czech Republic, Finland, France, Germany, Greece, India, Israel, Italy, Japan, Luxembourg, Mexico, Poland, Russia, Singapore, Spain, Sweden, Switzerland, Turkey, UK, and USA.

MICAI 2016 was honored by the presence of renowned experts who gave excellent keynote lectures:

- Efstathios Stamatatos, University of the Aegean, Greece
- Imre J. Rudas, Óbuda University, Hungary
- Vladik Kreinovich, University of Texas at El Paso, USA
- Genoveva Vargas Solar, Centre national de la recherche scientifique, France

In addition, a special talk was given by Ángel Fernando Kuri Morales, ITAM, Mexico.

The technical program of the conference also featured tutorials presented by Félix Castro (UAEH), Miguel González Mendoza (ITESM), Oscar Herrera Alcántara (UAM), Francisco Viveros Jimenez (CIC-IPN), Alexei Morozov (IRE-RAS, Russia), and Ildar Batyrshin (CIC-IPN), among others. Four workshops were held jointly with the conference: the First International Workshop on Genetic Programming, the 9th International Workshop of Hybrid Intelligent Systems (HIS 2016), the Second International Workshop on Intelligent Decision Support Systems for Industry, and the 9th International Workshop on Intelligent Learning Environments (WILE 2016).

The authors of the following papers received the Best Paper Award based on the paper’s overall quality, significance, and originality of the reported results:

First place:	“Author Profiling with doc2vec Neural Network-Based Document Embeddings,” by Ilia Markov, Helena Gómez-Adorno, Juan-Pablo Posadas-Durán, Grigori Sidorov, and Alexander Gelbukh (Mexico) Prize from Springer: € 400; prize from SMIA: € 400
Second place:	“Using a Grammar Checker to Validate Compliance of Processes with Workflow Models,” by Roman Barták and Vladislav Kuboň (Czech Republic) Prize from Springer: € 300; prize from SMIA: € 300
Third place:	“Neural Network Modelling for Dissolved Oxygen Effects in Extensive Litopenaeus Vannamei Culture,” by José Juan Carbajal-Hernández and Luis P. Sánchez-Fernández (Mexico) Prize from Springer: € 200; prize from SMIA: € 200

The authors of the following papers selected among all papers of which the first author was a full-time student, excluding the papers listed above, shared the Best Student Paper Award:

First place:	“Relevance of Named Entities in Authorship Attribution,” by Germán Ríos-Toledo, Grigori Sidorov, Noé Alejandro Castro-Sánchez, Alondra Nava-Zea, and Liliana Chanona-Hernández (Mexico)
	Prize from Springer: € 50; prize from SMIA: € 50
	“A Compact Representation for Cross-Domain Short Text Clustering,” by Alba Núñez-Reyes, Esaú Villatoro-Tello, Gabriela Ramírez-de-la-Rosa, and Christian Sánchez-Sánchez (Mexico)
	Prize from Springer: € 50; prize from SMIA: € 50

The awards included significant monetary prizes sponsored by Springer and by the Mexican Society of Artificial Intelligent (SMIA).

We want to thank everyone involved in the organization of this conference. Firstly, the authors of the papers published in this book: It is their research work that gives value to the book and to the work of the organizers. We thank the track chairs for their hard work, and the Program Committee members and additional reviewers for their great effort in reviewing the submissions.

We would like to thank the Instituto Tecnológico de Cancún (ITCancún) for hosting the workshops and tutorials of MICAI 2016; particularly we thank Socorro Xóchitl Carmona Bareño, Director of the ITCancún, for her support and generosity. We also want to thank the staff of the Instituto Tecnológico de Cancún for their support in the organization of this conference. We gratefully acknowledge the sponsorship received from Springer for monetary prizes handed to the authors of the best papers of the conference. This generous sponsorship demonstrates Springer’s strong commitment to the development of science and their sincere interest in the highest quality of the conferences published in their series.

We are deeply grateful to the conference staff and to all members of the Local Committee headed by Fernando Antonio Koh Puga. We acknowledge support received from the project CONACYT 240844. The entire submission, reviewing, and selection process, as well as preparation of the proceedings, was supported free of charge by the EasyChair system (www.easychair.org). Finally, yet importantly, we are very grateful to the staff at Springer for their patience and help in the preparation of this volume.

October 2016

Grigori Sidorov
Oscar Herrera-Alcántara
Obdulia Pichardo-Lagunas
Sabino Miranda-Jiménez

Organization

MICAI 2016 was organized by the Mexican Society of Artificial Intelligence (SMIA, Sociedad Mexicana de Inteligencia Artificial) in collaboration with the Instituto Tecnológico de Cancún (ITCancún), the Centro de Investigación en Computación del Instituto Politécnico Nacional (CIC-IPN), the Universidad Autónoma de México Azcapotzalco (UAM), the Unidad Profesional Interdisciplinaria en Ingeniería y Tecnologías Avanzadas del Instituto Politécnico Nacional (UPIITA-IPN), and INFOTEC.

The MICAI series website is www.MICAI.org. The website of the Mexican Society of Artificial Intelligence, SMIA, is www.SMIA.org.mx. Contact details and additional information can be found on these websites.

Conference Committee

General Chair

Grigori Sidorov	Instituto Politécnico Nacional, Mexico
-----------------	--

Program Chairs

Grigori Sidorov	Instituto Politécnico Nacional, Mexico
Oscar Herrera Alcántara	Universidad Autónoma Metropolitana Azcapotzalco, Mexico
Sabino Miranda-Jiménez	INFOTEC, Mexico
Obdulia Pichardo Lagunas	Instituto Politécnico Nacional, Mexico

Workshop Chairs

Obdulia Pichardo Lagunas	Instituto Politécnico Nacional, Mexico
Noé Alejandro Castro Sánchez	Centro Nacional de Investigación y Desarrollo Tecnológico, Mexico

Tutorials Chair

Félix Castro Espinoza	Universidad Autónoma del Estado de Hidalgo, Mexico
-----------------------	--

Doctoral Consortium Chairs

Miguel Gonzalez Mendoza	Tecnológico de Monterrey CEM, Mexico
Antonio Marín Hernandez	Universidad Veracruzana, Mexico

Keynote Talks Chair

Sabino Miranda Jiménez	INFOTEC, Mexico
------------------------	-----------------

Publication Chair

Miguel Gonzalez Mendoza Tecnológico de Monterrey CEM, Mexico

Financial Chair

Ildar Batyrshin Instituto Politécnico Nacional, Mexico

Grant Chairs

Grigori Sidorov Instituto Politécnico Nacional, Mexico

Miguel Gonzalez Mendoza Tecnológico de Monterrey CEM, Mexico

Organizing Committee Chair

Fernando Antonio Instituto Tecnológico de Cancún, Mexico
Koh Puga

Area Chairs

Natural Language Processing

Grigori Sidorov Instituto Politécnico Nacional, Mexico

Sofía Natalia Galicia Haro Universidad Nacional Autónoma de México, Mexico

Alexander Gelbukh Instituto Politécnico Nacional, Mexico

Machine Learning and Pattern Recognition

Alexander Gelbukh Instituto Politécnico Nacional, Mexico

Data Mining

Miguel Gonzalez-Mendoza Tecnológico de Monterrey CEM, Mexico

Félix Castro Espinoza Universidad Autónoma del Estado de Hidalgo, Mexico

Intelligent Tutoring Systems

Alexander Gelbukh Instituto Politécnico Nacional, Mexico

Evolutionary and Nature-Inspired Metaheuristic Algorithms

Oliver Schütze CINVESTAV, Mexico

Jaime Mora Vargas Tecnológico de Monterrey CEM, Mexico

Computer Vision and Image Processing

Oscar Herrera Alcántara Universidad Autónoma Metropolitana Azcapotzalco,
Mexico

Robotics, Planning, and Scheduling

Fernando Martin Universidad Veracruzana, Mexico
Montes-Gonzalez

Neural Networks and Hybrid Intelligent Systems

Sergio Ledesma-Orozco

Universidad de Guanajuato, Mexico

Logic, Knowledge-Based Systems, Multi-agent Systems and Distributed AI

Mauricio Osorio

Jose Raymundo Marcial Romero

Fuzzy Systems and Probabilistic Models in Decision-Making

Ildar Batyrshin

Instituto Politécnico Nacional, Mexico

Bioinformatics and Medical Applications

Jesus A. Gonzalez

Instituto Nacional de Astrofísica, Óptica y Electrónica,
Mexico

Felipe Orihuela-Espina

Instituto Nacional de Astrofísica, Óptica y Electrónica,
Mexico

Program Committee

Juan C. Acosta-Guadarrama

Universidad Autónoma de Ciudad Juárez, Mexico

Fernando Aldana

Universidad Veracruzana, Mexico

Gustavo Arroyo

Instituto de Investigaciones Eléctricas, Mexico

Maria Lucia Barrón-Estrada

Instituto Tecnológico de Culiacán, Mexico

Ildar Batyrshin

Instituto Politécnico Nacional, Mexico

Igor Bolshakov

Russian State University for the Humanities, Russia

Ramon F. Brena

Tecnológico de Monterrey, Mexico

Eduardo Cabal-Yepez

Universidad de Guanajuato, Mexico

Hiram Calvo

Instituto Politécnico Nacional, Mexico

Nicoletta Calzolari

Istituto di Linguistica Computazionale – CNR, Italy

Erik Cambria

Nanyang Technological University, Singapore

Jorge Victor Carrera Trejo

Instituto Politécnico Nacional, Mexico

Maya Carrillo

Instituto Nacional de Astrofísica, Óptica y Electrónica,
Mexico

Heydy Castillejos

Universidad Autónoma del Estado de Hidalgo, Mexico

Oscar Castillo

Instituto Tecnológico de Tijuana, Mexico

Felix Castro Espinoza

Universidad Autónoma del Estado de Hidalgo, Mexico

Noé Alejandro

Centro Nacional de Investigación y Desarrollo

Castro-Sánchez

Tecnológico, Mexico

Hector Ceballos

Tecnológico de Monterrey, Mexico

Gustavo Cerda-Villafana

Universidad de Guanajuato, Mexico

Liliana Chanona-Hernandez

Instituto Politécnico Nacional, Mexico

Stefania Costantini

Università degli Studi dell'Aquila, Italy

Heriberto Cuayahuitl

Heriot-Watt University, UK

Erik Cuevas

Universidad de Guadalajara, Mexico

Guillermo De Ita

Universidad Autónoma de Puebla, Mexico

Asif Ekbal

Indian Institute of Technology Patna, India

Hugo Jair Escalante	Instituto Nacional de Astrofísica, Óptica y Electrónica, Mexico
Ponciano Jorge Escamilla-Ambrosio	Instituto Politécnico Nacional, Mexico
Vlad Estivill-Castro	Griffith University, Australia
Gibran Etcheverry	Universidad de Sonora, Mexico
Eugene C. Ezin	Institut de Mathématiques et de Sciences Physiques, Benin
Denis Filatov	Instituto Politécnico Nacional, Mexico
Juan J. Flores	Universidad Michoacana de San Nicolás de Hidalgo, Mexico
Andrea Formisano	Università di Perugia, Italy
Anilu Franco-Arcega	Instituto Nacional de Astrofísica, Óptica y Electrónica, Mexico
Alfredo Gabaldon	General Electric Global Research, USA
Sofia N. Galicia-Haro	Universidad Nacional Autónoma de México, Mexico
Ana Gabriela Gallardo-Hernández	Universidad Nacional Autónoma de México, Mexico
Carlos Hugo Garcia-Capulin	Universidad de Guanajuato, Mexico
Alexander Gelbukh	Instituto Politécnico Nacional, Mexico
Onofrio Gigliotta	University of Naples Federico II, Italy
Eduardo Gomez-Ramirez	Universidad La Salle, Mexico
Arturo Gonzalez	Universidad de Guanajuato, Mexico
Jesus A. Gonzalez	Instituto Nacional de Astrofísica, Óptica y Electrónica, Mexico
Miguel Gonzalez-Mendoza	Tecnológico de Monterrey CEM, Mexico
Felix F. Gonzalez-Navarro	Universidad Autónoma de Baja California, Mexico
Efren Gorrostieta	Universidad Autónoma de Querétaro, Mexico
Carlos Arturo Gracios-Marin	CERN, Switzerland
Joaquin Gutierrez	Centro de Investigaciones Biológicas del Noroeste S.C., Mexico
Rafael Guzman	Universidad de Guanajuato, Mexico
Yasunari Harada	Waseda University, Japan
Rogelio Hasimoto	Centro de Investigación en Matemáticas, Mexico
Antonio Hernandez	Instituto Politécnico Nacional, Mexico
Yasmin Hernández Pérez	Instituto de Investigaciones Eléctricas, Mexico
Alberto Hernández	Universidad Autónoma del Estado de Morelos, Mexico
Oscar Herrera	Universidad Autónoma Metropolitana Azcapotzalco, Mexico
Dieter Hutter	DFKI GmbH, Germany
Pablo H. Ibarguengoytia	Instituto de Investigaciones Eléctricas, Mexico
Oscar G. Ibarra-Manzano	Universidad de Guanajuato, Mexico
Héctor Jiménez Salazar	Universidad Autónoma Metropolitana, Mexico
Laetitia Jourdan	Inria/LIFL/CNRS, France

Pinar Karagoz	Middle East Technical University, Turkey
Ryszard Klempous	Wroclaw University of Technology, Poland
Olga Kolesnikova	Instituto Politécnico Nacional, Mexico
Vladik Kreinovich	University of Texas at El Paso, USA
Angel Kuri-Morales	Instituto Tecnológico Autónomo de México, Mexico
Mathieu Lafourcade	Le Laboratoire d'Informatique, de Robotique et de Microélectronique de Montpellier (UM2/CNRS), France
Ricardo Landa	CINVESTAV Tamaulipas, Mexico
Dario Landa-Silva	University of Nottingham, UK
Bruno Lara	Universidad Autónoma del Estado de Morelos, Mexico
Yulia Ledeneva	Universidad Autónoma del Estado de México, Mexico
Yoel Ledo Mezquita	Universidad de las Américas, Mexico
Eugene Levner	Ashkelon Academic College, Israel
Rocio Lizarraga-Morales	Universidad de Guanajuato, Mexico
Blanca Lopez	Instituto Politécnico Nacional, Mexico
Tanja Magoc	University of Texas at El Paso, USA
J. Raymundo Marcial-Romero	Universidad Autónoma del Estado de México, Mexico
Luis Martí	Universidade Federal Fluminense, Brazil
Lourdes Martínez	Universidad Panamericana, Mexico
Juan Martínez-Miranda	Centro de Investigación Científica y de Educación Superior de Ensenada, Mexico
Miguel Félix Mata Rivera	Instituto Politécnico Nacional, Mexico
Patricia Melin	Instituto Tecnológico de Tijuana, Mexico
Ivan Vladimir Meza Ruiz	Universidad Nacional Autónoma de México, Mexico
Efrén Mezura-Montes	Universidad Veracruzana, Mexico
Mikhail Mikhailov	University of Tampere, Finland
Sabino Miranda-Jiménez	INFOTEC, Mexico
Raul Monroy	Tecnologico de Monterrey CEM, Mexico
Omar Montaña Rivas	Universidad Politécnica de San Luis Potosí, Mexico
Manuel Montes-y-Gómez	Instituto Nacional de Astrofísica, Óptica y Electrónica, Mexico
Carlos Montoro	Universidad de Guanajuato, Mexico
Eduardo Morales	Instituto Nacional de Astrofísica, Óptica y Electrónica, Mexico
Guillermo Morales-Luna	CINVESTAV, Mexico
Masaki Murata	Tottori University, Japan
Michele Nappi	University of Salerno, Italy
Jesús Emeterio Navarro-Barrientos	Society for the Promotion of Applied Computer Science (GFAI e.V.), Germany
Juan Carlos Nieves	Umeå University, Sweden
C. Alberto Ochoa-Zezatti	Universidad Autónoma de Ciudad Juárez, Mexico
Ivan Olmos	Benemérita Universidad Autónoma de Puebla, Mexico
Sonia Ordoñez	Universidad Distrital F.J. de C., Colombia
Partha Pakray	National Institute of Technology Mizoram, India

Ivandre Paraboni	University of Sao Paulo, Brazil
Mario Pavone	University of Catania, Italy
Ted Pedersen	University of Minnesota Duluth, USA
Obdulia Pichardo-Lagunas	Instituto Politécnico Nacional, Mexico
David Pinto	Benemérita Universidad Autónoma de Puebla, Mexico
Hiram Ponce Espinosa	Tecnológico de Monterrey CCM, Mexico
Soujanya Poria	Nanyang Technological University, Singapore
Héctor Pérez-Urbina	Google, USA
Risto Fermin Rangel Kuoppa	Universidad Autónoma Metropolitana Azcapotzalco, Mexico
Iván Salvador Razo-Zapata	Luxembourg Institute of Science and Technology, Luxembourg
Orion Reyes	University of Alberta Edmonton AB, Canada
Alberto Reyes Ballesteros	Instituto de Investigaciones Eléctricas, Mexico
Carlos Alberto Reyes García	Instituto Nacional de Astrofísica, Óptica y Electrónica, Mexico
Arles Rodriguez	Universidad Nacional de Colombia, Colombia
Alejandro Rosales	Instituto Nacional de Astrofísica, Óptica y Electrónica, Mexico
Horacio Rostro Gonzalez	Universidad de Guanajuato, Mexico
Jose Ruiz-Pinales	Universidad de Guanajuato, Mexico
Chaman Sabharwal	Missouri University of Science and Technology, USA
Abraham Sánchez López	Benemérita Universidad Autónoma de Puebla, Mexico
Antonio-José Sánchez-Salmerón	Universitat Politècnica de València, Spain
Jose Santos	University of A Coruña, Spain
Friedhelm Schwenker	Ulm University, Germany
Shahnaz Shahbazova	Azerbaijan Technical University, Azerbaijan
Patrick Siarry	Université de Paris 12, France
Grigori Sidorov	Instituto Politécnico Nacional, Mexico
Bogdan Smolka	Silesian University of Technology, Poland
Juan Humberto Sossa Azuela	Instituto Politécnico Nacional, Mexico
Efstathios Stamatatos	University of the Aegean, Greece
Josef Steinberger	University of West Bohemia, Czech Republic
Alexander Tulupyyev	St. Petersburg Institute for Informatics and Automation of Russian Academy of Sciences, Russia
Fevrier Valdez	Instituto Tecnológico de Tijuana, Mexico
Manuel Vilares Ferro	University of Vigo, Spain
Esau Villatoro-Tello	Universidad Autónoma Metropolitana, Mexico
Aline Villavicencio	Universidade Federal do Rio Grande do Sul, Brazil
Francisco Viveros Jiménez	Instituto Politécnico Nacional, Mexico
Panagiotis Vlamos	Ionian University, Greece
Piotr W. Fuglewicz	TiP Sp. z o. o., Poland

Carlos Mario Zapata	Universidad Nacional de Colombia, Colombia
Jaramillo	
Ramón Zatarain	Instituto Tecnológico de Culiacán, Mexico
Alisa Zhila	IBM, USA
Reyer Zwiggelaar	Aberystwyth University, UK

Additional Reviewers

Adan Enrique Aguilar-Justo	Dagmar Monett-Diaz
Maria-Yaneli Ameca-Alducin	Alondra Nava-Zea
Andreas Attenberger	Felipe Ojeda-Cruz
Zbigniew Banaszak	Felipe De Jesús Ojeda-Cruz
Grzegorz Bocewicz	Rosa María Ortega-Mendoza
Wojciech Bozejko	Nahitt Padilla
Jose Camargo-Orduño	José Luis Paredes
Esteban Castillo	Carla Piazza
Silvio Ricardo Cordeiro	Edgar Alfredo Portilla-Flores
Víctor Darriba	Claudia E. Ramírez Hernández
Dario Della Monica	Gabriela Ramírez-De-La-Rosa
Saul Dominguez	Francisco J. Ribadas-Pena
Víctor Manuel Fernández Mireles	Francesco Ricca
Helena Monserrat Gómez Adorno	Daniel Rivas
Marcos Angel González-Olvera	Jorge Rodas
Mario Graff	Hector Rodriguez Rangel
César Guerra	Carlos Rodriguez-Donate
Helena Gómez-Adorno	Mariana Rojas-Delgado
Jorge Hernandez Del Razo	Salvador Ruiz-Correa
Geovanni Hernandez-Gomez	Ryan Stansifer
Luis M. Ledesma-Carrillo	Fernando Sánchez
Rocio Lizarraga-Morales	Kazuhiro Takeuchi
Misael Lopez Ramirez	Eric S. Tellez
Adrián Pastor Lopez-Monroy	Alejandro Antonio Torres García
Joji Maeno	Monica Trejo
Navonil Majumder	Yasushi Tsubota
Iliia Markov	Roberto Villarejo
Maria-Guadalupe Martínez-Peñaloza	Remy Wahnoun
Mariana-Edith Miranda-Varela	Sławomir Wojciechowski
Daniela Moctezuma	Miguel Ángel Álvarez Carmona

Organizing Committee

Local Chair

Fernando Antonio Instituto Tecnológico de Cancún, Mexico
Koh Puga

Logistics Chair

Oscar Andrés Cárdenas Instituto Tecnológico de Cancún, Mexico
Alvarado

Registration Chair

José Israel Cupul Dzib Instituto Tecnológico de Cancún, Mexico

Publicity and Event Follow-up Chair

Viviana Nasheli Instituto Tecnológico de Cancún, Mexico
Andrade Armenta

Members

Alejandro Filiberto Gómez Pérez
Luis Alfonso Marín Priego
Francisco José Arroyo Rodríguez
Juan Carlos Navarrete Montero
Florentino Chimal y Alamilla
Silverio Hernández Chávez
Juan Antonio Ruíz Velazco de la Garza
Octavio Ramírez López
Rosa Hilda Valencia Ruíz
Elisa Malibé Carballo Guillén
Domingo Ramos Hernández
Enrique Alberto Trejo Guzmán
Sixto Raúl Rodríguez Alvarado
Esmeralda Tepixtle Guevara
Juan Miguel Morán García
Emery Concepción Medina Díaz
Georgina Chan Díaz
Oscar San Juan Farfán, Instituto Tecnológico de Cancún, Mexico

Contents – Part I

Natural Language Processing

Best Student Paper Award, First Place:

Relevance of Named Entities in Authorship Attribution	3
<i>Germán Ríos-Toledo, Grigori Sidorov, Noé Alejandro Castro-Sánchez, Alondra Nava-Zea, and Liliana Chanona-Hernández</i>	

Best Student Paper Award, First Place:

A Compact Representation for Cross-Domain Short Text Clustering	16
<i>Alba Núñez-Reyes, Esaú Villatoro-Tello, Gabriela Ramírez-de-la-Rosa, and Christian Sánchez-Sánchez</i>	
Characteristics of Most Frequent Spanish Verb-Noun Combinations	27
<i>Olga Kolesnikova and Alexander Gelbukh</i>	
Sentence Paraphrase Graphs: Classification Based on Predictive Models or Annotators' Decisions?	41
<i>Ekaterina Pronoza, Elena Yagunova, and Nataliya Kochetkova</i>	
Mathematical Model of an Ontological-Semantic Analyzer Using Basic Ontological-Semantic Patterns.	53
<i>Anastasia Mochalova and Vladimir Mochalov</i>	
CookingQA: A Question Answering System Based on Cooking Ontology . . .	67
<i>Riyanka Manna, Partha Pakray, Somnath Banerjee, Dipankar Das, and Alexander Gelbukh</i>	
LEXIK. An Integrated System for Specialized Terminology	79
<i>Gerardo Sierra, Jorge Lázaro, and Gemma Bel-Enguix</i>	
Linguistic Restrictions in Automatic Translation from Written Spanish to Mexican Sign Language.	92
<i>Obdulia Pichardo-Lagunas, Bella Martínez-Seis, Alejandro Ponce-de-León-Chávez, Carlos Pegueros-Denis, and Ricardo Muñoz-Guerrero</i>	
Intra-document and Inter-document Redundancy in Multi-document Summarization.	105
<i>Pabel Carrillo-Mendoza, Hiram Calvo, and Alexander Gelbukh</i>	

Indexing and Searching of Judicial Precedents Using Automatic Summarization	116
<i>Armando Ordóñez, Diego Belalcazar, Manuel Calambas, Angela Chacón, Hugo Ordoñez, and Carlos Cobos</i>	

Discriminatory Capacity of the Most Representative Phonemes in Spanish: An Evaluation for Forensic Voice Comparison	127
<i>Fernanda López-Escobedo and Luis Alberto Pineda Cortés</i>	

A Speech-Based Web Co-authoring Platform for the Blind.	141
<i>Madeeha Batool, Mirza Muhammad Waqar, Ana Maria Martinez-Enriquez, and Aslam Muhammad</i>	

Social Networks and Opinion Mining

Friends and Enemies of Clinton and Trump: Using Context for Detecting Stance in Political Tweets.	155
<i>Mirko Lai, Delia Irazú Hernández Farías, Viviana Patti, and Paolo Rosso</i>	

Additive Regularization for Topic Modeling in Sociological Studies of User-Generated Texts	169
<i>Murat Apishev, Sergei Koltcov, Olessia Koltsova, Sergey Nikolenko, and Konstantin Vorontsov</i>	

Effects of the Inclusion of Non-newsworthy Messages in Credibility Assessment.	185
<i>Chaluemwut Noyunsan, Tatpong Katanyukul, Carson K. Leung, and Kanda Runapongsa Saikaew</i>	

On the Impact of Neighborhood Selection Strategies for Recommender Systems in LBSNs	196
<i>Carlos Ríos, Silvia Schiaffino, and Daniela Godoy</i>	

Fuzzy Logic

Invited paper:

For Multi-interval-valued Fuzzy Sets, Centroid Defuzzification Is Equivalent to Defuzzifying Its Interval Hull: A Theorem	211
<i>Vladik Kreinovich and Songsak Sriboonchitta</i>	

Invited paper:

Metric Spaces Under Interval Uncertainty: Towards an Adequate Definition . . .	219
<i>Mahdokht Afravi, Vladik Kreinovich, and Thongchai Dumrongpookaphoan</i>	

A Study of Parameter Dynamic Adaptation with Fuzzy Logic for the Grey Wolf Optimizer Algorithm	228
<i>Luis Rodríguez, Oscar Castillo, and José Soria</i>	
Interval Type-2 Fuzzy Logic for Parameter Adaptation in the Gravitational Search Algorithm	239
<i>Beatriz González, Fevrier Valdez, and Patricia Melin</i>	
Water Cycle Algorithm with Fuzzy Logic for Dynamic Adaptation of Parameters	250
<i>Eduardo Méndez, Oscar Castillo, José Soria, Patricia Melin, and Ali Sadollah</i>	
Off-line Tuning of a PID Controller Using Type-2 Fuzzy Logic	261
<i>Heberi R. Tello-Rdz, Luis M. Torres-Treviño, and Angel Rodríguez-Liñan</i>	
Detection of Faults in Induction Motors Using Texture-Based Features and Fuzzy Inference	270
<i>Uriel Calderon-Uribe, Rocío A. Lizarraga-Morales, Carlos Rodríguez-Donate, and Eduardo Cabal-Yeppez</i>	
Time Series Analysis and Forecasting	
Trend Detection in Gold Worth Using Regression	281
<i>Seyedeh Foroozan Rashidi, Hamid Parvin, and Samad Nejatian</i>	
Internet Queries as a Tool for Analysis of Regional Police Work and Forecast of Crimes in Regions	290
<i>Anna Boldyreva, Mikhail Alexandrov, Olexiy Koshulko, and Oleg Sobolevskiy</i>	
Creating Collections of Descriptors of Events and Processes Based on Internet Queries	303
<i>Anna Boldyreva, Oleg Sobolevskiy, Mikhail Alexandrov, and Vera Danilova</i>	
Planning and Scheduling	
Best Paper Award, Second Place:	
Using a Grammar Checker to Validate Compliance of Processes with Workflow Models	317
<i>Roman Barták and Vladislav Kuboň</i>	

On Verification of Workflow and Planning Domain Models Using Attribute Grammars	332
<i>Roman Barták and Tomáš Dvořák</i>	
Tramp Ship Scheduling Problem with Berth Allocation Considerations and Time-Dependent Constraints.	346
<i>Francisco López-Ramos, Armando Guarnaschelli, José-Fernando Camacho-Vallejo, Laura Hervet-Escobar, and Rosa G. González-Ramírez</i>	
Hierarchical Task Model for Resource Failure Recovery in Production Scheduling	362
<i>Roman Barták and Marek Vlk</i>	
A Multi-objective Hospital Operating Room Planning and Scheduling Problem Using Compromise Programming	379
<i>Alejandra Duenas, Christine Di Martinelly, G. Yazgi Tütüncü, and Joaquin Aguado</i>	
Solving Manufacturing Cell Design Problems Using the Black Hole Algorithm.	391
<i>Ricardo Soto, Broderick Crawford, Nicolás Fernandez, Víctor Reyes, Stefanie Niklander, and Ignacio Araya</i>	
Image Processing and Computer Vision	
Efficient Computation of the Euler Number of a 2-D Binary Image.	401
<i>Juan Humberto Sossa-Azuela, Ángel A. Carreón-Torres, Raúl Santiago-Montero, Ernesto Bribiesca-Correa, and Alberto Petrilli-Barceló</i>	
Image Filter Based on Block Matching, Discrete Cosine Transform and Principal Component Analysis	414
<i>Alejandro I. Callejas Ramos, Edgardo M. Felipe-Riveron, Pablo Manrique Ramirez, and Oleksiy Pogrebnyak</i>	
Support to the Diagnosis of the Pap Test, Using Computer Algorithms of Digital Image Processing	425
<i>Solangel Rodríguez-Vázquez</i>	
Implementation of Computer Vision Guided Peg-Hole Insertion Task Performed by Robot Through LabVIEW	437
<i>Andres Saucedo Cienfuegos, Enrique Rodriguez, Jesus Romero, David Ortega Aranda, and Baidya Nath Saha</i>	

Object Tracking Based on Modified TLD Framework Using Compressive Sensing Features	459
<i>Tao Yang, Cindy Cappelle, Yassine Ruichek, and Mohammed El Bagdouri</i>	
Parameter Characterization of Complex Wavelets and its use in 3D Reconstruction.	471
<i>Claudia Victoria Lopez, Jesus Carlos Pedraza, Juan Manuel Ramos, Elias Gonzalo Silva, and Efren Gorrostieta Hurtado</i>	
Methodology for Automatic Collection of Vehicle Traffic Data by Object Tracking	482
<i>Jesús Caro-Gutierrez, Miguel E. Bravo-Zanoguera, and Félix F. González-Navarro</i>	
Robotics	
GPS-Based Curve Estimation for an Adaptive Pure Pursuit Algorithm	497
<i>Citlalli Gámez Serna, Alexandre Lombard, Yassine Ruichek, and Abdeljalil Abbas-Turki</i>	
Collective Motion of a Swarm of Simulated Quadrotors Using Repulsion, Attraction and Orientation Rules	512
<i>Mario Aguilera-Ruiz, Luis Torres-Treviño, and Angel Rodríguez-Liñán</i>	
Design and Simulation of a New Lower Exoskeleton for Rehabilitation of Patients with Paraplegia	522
<i>Fermín C. Aragón, C. Hernández-Santos, José-Isidro Hernández Vega, Daniel Andrés Córdova, Dolores Gabriela Palomares Gorham, and Jonam Leonel Sánchez Cuevas</i>	
Sensorial System for Obtaining the Angles of the Human Movement in the Coronal and Sagittal Anatomical Planes	535
<i>David Alvarado, Leonel Corona, Saúl Muñoz, and José Aquino</i>	
Author Index	549

Contents – Part II

General

Normality from Monte Carlo Simulation for Statistical Validation of Computer Intensive Algorithms.	3
<i>Angel Fernando Kuri-Morales and Ignacio López-Peña</i>	

Are Android Smartphones Ready to Locally Execute Intelligent Algorithms?	15
<i>M. Ricardo Carlos, Fernando Martínez, Raymundo Cornejo, and Luis C. González</i>	

Reasoning and Multi-Agent Systems

Large Scale Reasoning Using Allen’s Interval Algebra	29
<i>Matthew Mantle, Sotirios Batsakis, and Grigoris Antoniou</i>	

Towards the Distributed Logic Programming of Intelligent Visual Surveillance Applications.	42
<i>Alexei A. Morozov, Olga S. Sushkova, and Alexander F. Polupanov</i>	

An Efficient Expert System for Diabetes with a Bayesian Inference Engine. . .	54
<i>Viridiana Cruz-Gutiérrez, Mario Alberto Posada-Zamora, and Abraham Sánchez-López</i>	

iEnsemble: A Framework for Committee Machine Based on Multiagent Systems with Reinforcement Learning	65
<i>Arnoldo Uber Junior, Paulo José de Freitas Filho, Ricardo Azambuja Silveira, Mariana Dehon Costa e Lima, and Rodolfo Wilvert Reitz</i>	

Exploring Complex Networks with Failure-Prone Agents	81
<i>Arles Rodríguez, Jonatan Gómez, and Ada Diaconescu</i>	

On the Conception of Intelligent Power Plants Based on Multiple Agent Systems	99
<i>Raul Garduno-Ramirez and Mónica Borunda</i>	

Neural Networks and Deep Learning

Best Paper Award, First Place:

Author Profiling with Doc2vec Neural Network-Based Document Embeddings	117
<i>Iliia Markov, Helena Gómez-Adorno, Juan-Pablo Posadas-Durán, Grigori Sidorov, and Alexander Gelbukh</i>	

Best Paper Award, Third Place:

Neural Network Modelling for Dissolved Oxygen Effects in Extensive Litopenaeus Vannamei Culture	132
<i>José Juan Carbajal-Hernández and Luis Pastor Sánchez-Fernández</i>	
Neural-Network Based Algorithm for Algae Detection in Automatic Inspection of Underwater Pipelines	141
<i>Edgar Medina, Mariane Rembold Petraglia, and José Gabriel Rodríguez Carneiro Gomes</i>	

Evolutionary Algorithms

Study on the Development of Complex Network for Evolutionary and Swarm Based Algorithms.	151
<i>Roman Senkerik, Ivan Zelinka, Michal Pluhacek, and Adam Viktorin</i>	
Estimation of Distribution Algorithms Based on the Beta Distribution for Bounded Search Spaces	162
<i>Rogelio Salinas-Gutiérrez, Ángel Eduardo Muñoz-Zavala, José Antonio Guerrero-Díaz de León, and Arturo Hernández-Aguirre</i>	
Automated Analog Synthesis with an Estimation of the Distribution Algorithm	173
<i>Aurora Torres, María Dolores Torres, and Eunice Ponce de León</i>	
Mathematical Model of Glucose Metabolism by Symbolic Regression $\alpha \beta$. . .	185
<i>Luis M. Torres-Treviño</i>	

Machine Learning

Jensen Inequality with Subdifferential for Sugeno Integral	193
<i>Anikó Szakál, Endre Pap, Sadegh Abbaszadeh, and Madjid Eshaghi Gordji</i>	

Towards a More General XCS: Classifier Fusion and Don't Cares in Actions	200
<i>Alejandro Garza-Cuellar, Manuel Valenzuela-Rendón, and Ricardo-Javier Parra-Álvarez</i>	
A Novel Artificial Hydrocarbon Networks Based Value Function Approximation in Hierarchical Reinforcement Learning	211
<i>Hiram Ponce</i>	
Wind Power Forecasting for the Villonaco Wind Farm Using AI Techniques	226
<i>Alberto Reyes, Pablo H. Ibargüengoytia, J. Diego Jijón, Tania Guerrero, Uriel A. García, and Mónica Borunda</i>	
Predicting the Need of Mechanical Ventilation in Guillain-Barré Patients Using Machine Learning Algorithms with Relevant Features	237
<i>José Hernández-Torruco, Juana Canul-Reich, and Oscar Chávez-Bosquez</i>	
A Robust Machine Learning Approach to Microprocessor Instructions Identification	248
<i>Hippolyte Djonon Tsague and Bheki Twala</i>	
Classification and Clustering	
Stochastic Semantic-Based Multi-objective Genetic Programming Optimisation for Classification of Imbalanced Data	261
<i>Edgar Galván-López, Lucía Vázquez-Mendoza, and Leonardo Trujillo</i>	
Consensus Clustering for Binning Metagenome Sequences	273
<i>Isis Bonet, Adriana Escobar, Andrea Mesa-Múnera, and Juan Fernando Alzate</i>	
Algorithm for Clustering of Web Search Results from a Hyper-heuristic Approach	285
<i>Carlos Cobos, Andrea Duque, Jamith Bolaños, Martha Mendoza, and Elizabeth León</i>	
Clustering Business Process Models Based on Multimodal Search and Covering Arrays	317
<i>Hugo Ordoñez, Jose Torres-Jimenez, Armando Ordoñez, and Carlos Cobos</i>	
Optimization	
A New Method to Optimize Dynamic Environments with Global Changes Using the Chickens-Hen' Algorithm	331
<i>Mostafa Zarei, Hamid Parvin, and Marzieh Dadvar</i>	

Transit Network Frequencies-Setting Problem Solved Using a New Multi-Objective Global-Best Harmony Search Algorithm and Discrete Event Simulation	341
<i>Edgar Ruano, Carlos Cobos, and Jose Torres-Jimenez</i>	
Optimal Pricing Model: Case of Study for Convenience Stores	353
<i>Laura Hervert-Escobar, Jesus Fabian López-Pérez, and Oscar Alejandro Esquivel-Flores</i>	
Method of Musical Composition for the Portfolio Optimization Problem	365
<i>Roman Anselmo Mora-Gutiérrez, Antonin Ponsich, Eric Alfredo Rincón García, Sergio Gerardo de-los-Cobos-Silva, Miguel Ángel Gutiérrez Andrade, and Pedro Lara-Velázquez</i>	
Metaheuristic Hybridized Applied to Solve the Capacity Vehicle Routing Problem.	377
<i>Ernesto Liñán-García, Linda Crystal Cruz Villegas, Pascual Montes Dorantes, and Gerardo Maximiliano Méndez</i>	
ABC-PSO: An Efficient Bioinspired Metaheuristic for Parameter Estimation in Nonlinear Regression	388
<i>Sergio Gerardo de-los-Cobos-Silva, Miguel Ángel Gutiérrez Andrade, Pedro Lara-Velázquez, Eric Alfredo Rincón García, Roman Anselmo Mora-Gutiérrez, and Antonin Ponsich</i>	

Data Mining

Data Mining in EEG Wave Trains in Early Stages of Parkinson's Disease . . .	403
<i>Olga S. Sushkova, Alexei A. Morozov, and Alexandra V. Gabova</i>	
Data Mining in the Analysis of Ocean-Atmosphere Dynamics in Colombia's Central Caribbean Ocean.	413
<i>Fran Ernesto Romero Alvarez and Oswaldo E. Vélez-Langs</i>	
Molecular Docking Based on <i>Ligand by Complexity LMC</i>	425
<i>Mauricio Martínez Medina, Miguel González-Mendoza, and Neil Hernández Gress</i>	
Integrating Information of Films by a Multi-source Combining Framework . . .	437
<i>Elias Dasturian, Hamid Parvin, and Samad Nejatian</i>	

Graph-Based Algorit

Computing the Clique-Width of Polygonal Tree Graphs.	449
<i>J. Leonardo González-Ruiz, J. Raymundo Marcial-Romero, J.A. Hernández, and Guillermo De Ita</i>	

A New Approach to Weakening and Destruction of Malicious Internet Networks	460
<i>Mark Korenblit</i>	

Intelligent Learning Environments

Toward Optimal Pedagogical Action Patterns by Means of Partially Observable Markov Decision Process	473
<i>Manuel Mejía-Lavalle, Hermilo Victorio, Alicia Martínez, Grigori Sidorov, Enrique Sucar, and Obdulia Pichardo-Lagunas</i>	
Data-Driven Construction of a Student Model Using Bayesian Networks in an Electrical Domain	481
<i>Yasmín Hernández, Marilú Cervantes-Salgado, Miguel Pérez-Ramírez, and Manuel Mejía-Lavalle</i>	
Strategic Learning Meta-model: A Selection Model of Learning Activities . . .	491
<i>Rafaela Blanca Silva-López and Oscar Herrera-Alcántara</i>	
CodeTraining: An Authoring Tool for a Gamified Programming Learning Environment	501
<i>María Lucía Barrón-Estrada, Ramón Zatarain-Cabada, and Mario Lindor-Valdez</i>	
Generating a Logical Structure for Virtualizing Physiotherapy Instructions Through NLP	513
<i>Sandeep Kumar Dash, Partha Pakray, and Alexander Gelbukh</i>	
Building a Corpus and a Local Binary Pattern Recognizer for Learning-Centered Emotions	524
<i>Ramón Zatarain-Cabada, María Lucía Barrón-Estrada, Francisco González-Hernández, Raúl Oramas-Bustillos, Giner Alor-Hernández, and Carlos Alberto Reyes-García</i>	
Affective Learning System for Algorithmic Logic Applying Gamification . . .	536
<i>Ramón Zatarain-Cabada, María Lucía Barrón-Estrada, and José Mario Ríos-Félix</i>	
Author Index	549