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Computer Aided Systems Theory – EUROCAST 2019

17th International Conference
Las Palmas de Gran Canaria, Spain, February 17–22, 2019
Revised Selected Papers, Part I

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Preface

The concept of CAST as a computer-aided systems theory was introduced by Franz Pichler in the late 1980s to refer to computer theoretical and practical development as tools for solving problems in system science. It was thought of as the third component (the other two being CAD and CAM) required to complete the path from computer and systems sciences to practical developments in science and engineering.

Franz Pichler, of the University of Linz, organized the first CAST workshop in April 1988, which demonstrated the acceptance of the concepts by the scientific and technical community. Next, Roberto Moreno-Díaz, of the University of Las Palmas de Gran Canaria, joined Franz Pichler, motivated and encouraged by Werner Schimanovich, of the University of Vienna (present honorary chair of Eurocast), and they organized the first international meeting on CAST (Las Palmas February 1989), under the name EUROCAST 1989. The event again proved to be a very successful gathering of systems theorists, computer scientists, and engineers from most European countries, North America, and Japan.

It was agreed that the EUROCAST international conference would be organized every two years, alternating between Las Palmas de Gran Canaria and a continental European location. Since 2001 the conference has been held exclusively in Las Palmas. Thus, successive EUROCAST meetings took place in Krems (1991), Las Palmas (1993), Innsbruck (1995), Las Palmas (1997), and Vienna (1999), before being held exclusively in Las Palmas in 2001, 2003, 2005, 2007, 2009, 2011, 2013, 2015, 2017 and 2019, in addition to an extra-European CAST conference in Ottawa in 1994. Selected papers from these meetings were published as Springer *Lecture Notes in Computer Science* volumes 410, 585, 763, 1030, 1333, 1798, 2178, 2809, 3643, 4739, 5717, 6927, 6928, 8111, 8112, 9520, 10671, and 10672, respectively, and in several special issues of *Cybernetics and Systems: An International Journal*. EUROCAST and CAST meetings are definitely consolidated, as shown by the number and quality of the contributions over the years.

With EUROCAST 2019 we celebrated our 30th anniversary. It took place at the Elder Museum of Science and Technology of Las Palmas, during February 17–22, and it continued with the approach tested at previous conferences as an international computer-related conference with a truly interdisciplinary character. As in the previous conferences, the participants profiles were extended to include fields that are in the frontier of science and engineering of computers, information and communication technologies, and the fields of social and human sciences. The best paradigm is the Web, with its associate systems engineering, CAD-CAST tools, and professional application products (Apps) for services in the social, public, and private domains.

There were specialized workshops, which, on this occasion, were devoted to the following topics:

1. Systems Theory and Applications, chaired by Pichler (Linz) and Moreno-Díaz (Las Palmas)
2. Pioneers and Landmarks in the Development of Information and Communication Technologies, chaired by Pichler (Linz) and Seising (Munich)
3. Stochastic Models and Applications to Natural, Social and Technical Systems, chaired by Nobile and Di Crescenzo (Salerno)
4. Theory and Applications of Metaheuristic Algorithms, chaired by Affenzeller, Wagner (Hagenberg), and Raidl (Vienna)
5. Model-Based System Design, Verification and Simulation, chaired by Nikodem (Wrocław), Ceska (Brno), and Ito (Utsunomiya)
6. Applications of Signal Processing Technology, chaired by Huemer, Zagar, Lunglmayr, and Haselmayr (Linz)
7. Artificial Intelligence and Data Mining for Intelligent Transportation Systems and Smart Mobility, chaired by Sanchez-Medina (Las Palmas), del Ser (Bilbao), Vlahogianni (Athens), García (Madrid), Olaverri-Monreal (Linz), and Acosta (La Laguna)
8. Computer Vision and Machine Learning for Image Analysis and Applications, chaired by Penedo (A Coruña), Rádeva (Barcelona), and Ortega-Hortas (A Coruña)
9. Computer and Systems Based Methods and Electronic Technologies in Medicine, chaired by Rozenblit (Tucson), Maynar (Las Palmas), and Klempous (Wrocław)
10. Advances in Biomedical Signal and Image Processing, chaired by Fridli (Budapest), Huemer, Kovacs, and Böck (Linz)
11. Systems Concepts and Methods in Touristic Flows, chaired by Palma-Méndez (Murcia), Rodriguez, and Moreno-Díaz Jr. (Las Palmas)
12. Systems in Industrial Robotics, Automation and IoT, chaired by Jacob (Kempten), Stetter (Munich), and Markl (Vienna)

In this conference, as in previous ones, most of the credit for the success is due to the workshop chairs. They and the sessions chairs, with the counseling of the International Advisory Committee, selected from 172 presented papers. After oral presentations and subsequent corrections, 123 revised papers are included in this volume.

The event and this volume were possible thanks to the efforts of the workshop chairs in the diffusion and promotion of the conference, as well as in the selection and organization of all the material. The editors would like to express their thanks to all the contributors, many of whom have already been Eurocast participants for years, and particularly to the considerable interaction of young and senior researchers, as well as to the invited speakers: Prof. Paul Cull, from Oregon State University, USA; Prof. Christoph Stiller, from Karlsruhe Institute of Technology (KIT), Germany; and Prof. Bruno Buchberger, from the Research Institut for Symbolic Computation (RISC), Johannes Kepler University Linz, Austria. We would also like to thank the Director of the Elder Museum of Science and Technology, D. José Gilberto Moreno, and the museum staff. Special thanks are due to the staff of Springer in Heidelberg for their valuable support.

Organization

EUROCAST 2019 was organized by the Universidad de Las Palmas de Gran Canaria, Spain, Johannes Kepler University Linz, Austria, and Museo Elder de la Ciencia y la Tecnología, Spain.



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Plenary Lectures

Tales of Computer and Systems Theory

Paul Cull

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Abstract. Were computers invented so that Norbert Wiener would not have to compute ballistic tables? Could a theoretical mapping between analysis and algebra allow scientists to turn animals inside out? What do Euclid and Lewis Carroll have to do with computer aided systems theory? These are some of the improbable questions we will explore in anecdotal history of computers and systems theory. This is not formal history, rather tales that are passed between colleagues and from teachers to students.

Among the questions we would like to answer these stand out:
Is EVERYTHING possible? Might the IMPOSSIBLE still be PRACTICAL?
Does theory drive practice or does practice drive theory?

In the end we may be left with more questions than answers.

Short CV: Paul Cull is a long time contributor to EUROCAST. He has been attending since the 1990s. His background is in mathematical biology and computer science. He did his graduate studies with Nicolas Rashevsky's group at the University of Chicago. His PhD thesis, under the direction of Luigi Ricciardi, was on the use of linear algebra for the analysis of neural nets. In 1970, he joined the faculty of Oregon State University as one of the founding members of the Computer Science Department. After many years of teaching and research, he is now Professor Emeritus.

Promises and Challenges of Automated Vehicles

Christoph Stiller

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Abstract. This talk discusses the state of the art and a potential evolution of self-driving cars. It will outline approaches and challenges for achieving full autonomy for self-driving cars and elaborate the potential of cooperativity for automated driving. The talk will look at homologation issues and how these are approached by different stakeholders.

We will look at many examples, including the DARPA and GCDC Challenges.

The talk will draw on lessons learned and challenges to be overcome from the perspective of the German Research Priority Program “Cooperative Interactive Automobiles.”

Short CV: Christoph Stiller studied Electrical Engineering in Aachen, Germany, and Trondheim, Norway, and received both his diploma and PhD (Dr.-Ing.) from Aachen University of Technology in 1988 and 1994, respectively. He worked with INRS-Telecommunications in Montreal, Canada, for a post-doctoral year in 1994/1995 and with Robert Bosch GmbH, Germany, from 1995–2001. In 2001, he became Chaired Professor and Director of the Institute for Measurement and Control Systems at Karlsruhe Institute of Technology (KIT), Germany.

Dr. Stiller serves as Senior Editor for the *IEEE Transactions on Intelligent Vehicles* (2015-present) and as Associate Editor for the *IEEE Intelligent Transportation Systems Magazine* (2012-present). He served as Editor in Chief of the *IEEE Intelligent Transportation Systems Magazine* (2009–2011). His automated driving team Annie-WAY were finalist in the Darpa Urban Challenge 2007 as well as first and second winner of the Grand Cooperative Driving Challenge in 2011 and 2016, respectively. He has served in several positions for the IEEE Intelligent Transportation Systems Society including being its President during 2012–2013.

Automated Mathematical Invention: Would Gröbner Need a PhD Student Today?

Bruno Buchberger

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Abstract. Wolfgang Gröbner (1899–1980) was my PhD advisor back in 1964 at the University of Innsbruck, Austria. The problem he posed to me had been formulated, in a slightly different form, by Paul Gordan in 1899 and was still open in 1964. Roughly, the problem asks for an algorithmic canonical simplifier for the congruence relations with regard to multivariate polynomial ideals. I solved the problem in 1965 in my PhD thesis by introducing what I later called the theory and method of “Gröbner bases”. The theory and method found numerous applications both inside mathematics and in basically all areas of science and technology in which non-linear polynomial systems play a role (e.g. robotics, cryptography, computer-aided design, software verification, systems theory, etc.)

In this talk I will, first, give an easy and practical introduction to the theory and method of Gröbner bases for those with no or only little background in this area. My main emphasis, however, will be on my recent research on automating mathematical invention. For this, I will take the theory of Gröbner bases as my main example. I will show how, by recent progress in automated reasoning and, in particular, my method of “Lazy Thinking” for the automated invention and proof of mathematical theorems and algorithms, my theory and method of Gröbner bases today could be “invented” completely automatically. In other words, *cum grano salis*, Professor Gröbner today would not need a PhD student for solving his problem any more.

From this, I will draw some conclusions on the future of mathematics.

Short CV: Bruno Buchberger is Professor Emeritus of Computer Mathematics at RISC (Research Institute for Symbolic Computation), Johannes Kepler University (JKU) in Linz, Austria.

Founding editor (1985–2000) of the *Journal of Symbolic Computation*. Founding chairman (1987–2000) of RISC. Founder and Director (1989–2013) of the JKU Softwarepark Hagenberg, the first Softwarepark as such, a world leading concept.

Author of the theory of Gröbner bases, established in his PhD thesis 1965 and expanded upon later in his publications. Since then, the theory has been a subject of over 20 textbooks, over 3,000 publications, and of a larger number of citations.

His current main research interest is on automated mathematical theory exploration (the “Theorema Project”).

Contents – Part I

Systems Theory and Applications

Design and Implementation of an Autopilot for an UAV	3
<i>Johannes von Eichel-Streiber, Christoph Weber, and Jens Altenburg</i>	
ROS-Based Architecture for Multiple Unmanned Vehicles (UXVs) Formation	11
<i>Raúl Sosa San Frutos, Abdulla Al Kaff, Ahmed Hussein, Ángel Madridano, David Martín, and Arturo de la Escalera</i>	
Knowledge Discovery: From Uncertainty to Ambiguity and Back	20
<i>Margaret Miró-Julà, Monica J. Ruiz-Miró, and Irene García Mosquera</i>	
From Linear Systems to Fuzzy Systems to Perception-Based Systems	28
<i>Rudolf Seising</i>	
A Latent Variable Model in Conflict Research	36
<i>Uwe M. Borghoff, Sean Matthews, Holger Prüßing, Christian T. Schäfer, and Oliver Stuke</i>	
Model Based Design of Inductive Components - Thermal Simulation and Parameter Determination	44
<i>Simon Merschak, Mario Jungwirth, Daniel Hofinger, and Günter Ritzberger</i>	
Predictive Model of Births and Deaths with ARIMA	52
<i>Diana Lancheros-Cuesta, Cristian Duney Bermudez, Sergio Bermudez, and Geovanny Marulanda</i>	
Automated Load Classification in Smart Micro-grid Systems	59
<i>Thomas Schlechter</i>	
An Overview About the Physical Layer of the VHF Data Exchange System (VDES)	67
<i>N. Molina, F. Cabrera, Victor Araña, and M. Tichavska</i>	
A Job-Seeking Advisor Bot Based in Data Mining	75
<i>J. C. Rodríguez-Rodríguez, Gabriele S. de Blasio, C. R. García, and A. Quesada-Arencibia</i>	

Bluetooth Low Energy Technology Applied to Indoor Positioning Systems: An Overview	83
<i>Gabriele S. de Blasio, A. Quesada-Arencibia, Carmelo R. García, and José Carlos Rodríguez-Rodríguez</i>	

Pioneers and Landmarks in the Development of Information and Communication Technologies

The Origin, Evolution and Applications of Visual Bio-cybernetics Concepts Included in the Original MIT-NASA Reports for Designing a Mars Rover (1965–1985).	93
<i>R. Moreno-Díaz Jr., R. Moreno-Díaz, A. Moreno-Díaz, and A. Moreno-Martel</i>	

Lotfi Zadeh: Fuzzy Sets and Systems	101
<i>Rudolf Seising</i>	

Mathematical Reconstruction of the Enigma	109
<i>Otmar Moritsch</i>	

Heinz von Foerster and Early Research in the Field of Pattern Recognition at the Biological Computer Laboratory	116
<i>Jan Müggenburg</i>	

Remarks on the Design of First Digital Computers in Japan - Contributions of Yasuo Komamiya	123
<i>Radomir S. Stanković, Tsutomu Sasao, Jaakko T. Astola, and Akihiko Yamada</i>	

From the Discovery of Electro-Magnetism and Electro-Magnetic Induction to the Maxwell Equations.	131
<i>Franz Pichler</i>	

Stochastic Models and Applications to Natural, Social and Technical Systems

Bounds on the Rate of Convergence for Nonstationary $M^X/M_n/1$ Queue with Catastrophes and State-Dependent Control at Idle Time	143
<i>Alexander Zeifman, Yacov Satin, Ksenia Kiseleva, Tatiana Panfilova, Anastasia Kryukova, Galina Shilova, Alexander Sipin, and Elena Fokicheva</i>	

Some Remarks on the Prendiville Model in the Presence of Jumps	150
<i>Virginia Giorno, Amelia G. Nobile, and Serena Spina</i>	

Continuous-Time Birth-Death Chains Generate by the Composition Method	158
<i>Virginia Giorno and Amelia G. Nobile</i>	

Unimodularity of Network Representations of Time-Series for Unbiased Parameter Estimation	167
<i>Florian Sobieczky</i>	
Volatility Modelling for Air Pollution Time Series	176
<i>G. Albano, Michele La Rocca, and C. Perna</i>	
HAR-type Models for Volatility Forecasting: An Empirical Investigation	185
<i>G. Albano and D. De Gaetano</i>	
On the Successive Passage Times of Certain One-Dimensional Diffusions . . .	195
<i>Mario Abundo and Maria Beatrice Scioscia Santoro</i>	
Diffusion Processes for Weibull-Based Models	204
<i>Antonio Barrera, Patricia Román-Román, and Francisco Torres-Ruiz</i>	
On the Integration of Fractional Neuronal Dynamics Driven by Correlated Processes	211
<i>Enrica Pirozzi</i>	
Simulation of an α -Stable Time-Changed SIR Model	220
<i>Giacomo Ascione</i>	
Some Results on a Growth Model Governed by a Fractional Differential Equation	228
<i>Antonio Di Crescenzo and Alessandra Meoli</i>	
Theory and Applications of Metaheuristic Algorithms	
Surrogate-Assisted Multi-Objective Parameter Optimization for Production Planning Systems	239
<i>Johannes Karder, Andreas Beham, Andreas Peirleitner, and Klaus Altendorfer</i>	
Surrogate-Assisted Fitness Landscape Analysis for Computationally Expensive Optimization	247
<i>Bernhard Werth, Erik Pitzer, and Michael Affenzeller</i>	
VNS and PBIG as Optimization Cores in a Cooperative Optimization Approach for Distributing Service Points	255
<i>Thomas Jatschka, Tobias Rodemann, and Günther R. Raidl</i>	
Concept for a Technical Infrastructure for Management of Predictive Models in Industrial Applications	263
<i>Florian Bachinger and Gabriel Kronberger</i>	

Guiding Autonomous Vehicles Past Obstacles – Theory and Practice	271
<i>Bin Hu, Clovis Seragiotto, Matthias Prandstetter, Benjamin Binder, and Markus Bader</i>	
Casual Employee Scheduling with Constraint Programming and Metaheuristics	279
<i>Nikolaus Frohner, Stephan Teuschl, and Günther R. Raidl</i>	
White Box vs. Black Box Modeling: On the Performance of Deep Learning, Random Forests, and Symbolic Regression in Solving Regression Problems	288
<i>Michael Affenzeller, Bogdan Burlacu, Viktoria Dorfer, Sebastian Dorl, Gerhard Halmerbauer, Tilman Königswieser, Michael Kommenda, Julia Vetter, and Stephan Winkler</i>	
Concept Drift Detection with Variable Interaction Networks	296
<i>Jan Zenisek, Gabriel Kronberger, Josef Wolfartsberger, Norbert Wild, and Michael Affenzeller</i>	
Visualization of Solution Spaces for the Needs of Metaheuristics	304
<i>Czesław Smutnicki</i>	
Preprocessing and Modeling of Radial Fan Data for Health State Prediction.	312
<i>Florian Holzinger and Michael Kommenda</i>	
On Modeling the Dynamic Thermal Behavior of Electrical Machines Using Genetic Programming and Artificial Neural Networks	319
<i>Alexandru-Ciprian Zăvoianu, Martin Kitzberger, Gerd Bramerdorfer, and Susanne Saminger-Platz</i>	
Solving a Flexible Resource-Constrained Project Scheduling Problem Under Consideration of Activity Priorities	327
<i>Viktoria A. Hauder, Andreas Beham, Sebastian Raggl, and Michael Affenzeller</i>	
A Simulated Annealing-Based Approach for Aid Distribution in Post-disaster Scenarios	335
<i>Alan Dávila de León, Eduardo Lalla-Ruiz, Belén Melián-Batista, and J. Marcos Moreno-Vega</i>	
Decision Diagram Based Limited Discrepancy Search for a Job Sequencing Problem	344
<i>Matthias Horn and Günther R. Raidl</i>	
The Potential of Restarts for ProbSAT.	352
<i>Jan-Hendrik Lorenz and Julian Nicklerl</i>	

Hash-Based Tree Similarity and Simplification in Genetic Programming for Symbolic Regression	361
<i>Bogdan Burlacu, Lukas Kammerer, Michael Affenzeller, and Gabriel Kronberger</i>	
Identification of Dynamical Systems Using Symbolic Regression	370
<i>Gabriel Kronberger, Lukas Kammerer, and Michael Kommenda</i>	
Data Aggregation for Reducing Training Data in Symbolic Regression	378
<i>Lukas Kammerer, Gabriel Kronberger, and Michael Kommenda</i>	
Genetic Programming Based Evolvment of Models of Models	387
<i>Mariia Semenkina, Bogdan Burlacu, and Michael Affenzeller</i>	
“Incremental” Evaluation for Genetic Crossover	396
<i>Erik Pitzer and Michael Affenzeller</i>	
A Model-Based Learning Approach for Controlling the Energy Flows of a Residential Household Using Genetic Programming to Perform Symbolic Regression	405
<i>Kathrin Kefer, Roland Hanghofer, Patrick Kefer, Markus Stöger, Michael Affenzeller, Stephan Winkler, Stefan Wagner, and Bernd Hofer</i>	
Understanding and Preparing Data of Industrial Processes for Machine Learning Applications	413
<i>Philipp Fleck, Manfred Kügel, and Michael Kommenda</i>	
Genetic Algorithm Applied to Real-Time Short-Term Wave Prediction for Wave Generator System in the Canary Islands	421
<i>C. Hernández, M. Méndez, and R. Aguasca-Colomo</i>	
A Heuristic Approach for Solving the Longest Common Square Subsequence Problem	429
<i>Marko Djukanovic, Günther R. Raidl, and Christian Blum</i>	
Investigating the Dynamic Block Relocation Problem	438
<i>Sebastian Raggl, Andreas Beham, and Michael Affenzeller</i>	
Multi-objective Evolutionary Approaches for Solving the Hybrid Flowshop Scheduling Problem.	446
<i>Fabricio Niebles-Atencio, Miguel Rojas-Santiago, and Daniel Mendoza-Casseres</i>	
Model-Based System Design, Verification and Simulation	
Models of the Heat Exchanger Assuming the Ideal Mixing	457
<i>Anna Czemplik</i>	

Algorithm to Express Lie Monomials in Ph. Hall Basis and Its Practical Applications	465
<i>Ignacy Duleba and Iwona Karcz-Duleba</i>	
Simulation Infrastructure for Automated Anesthesia During Operations	474
<i>Martin Hrubý, Antonio Gonzáles, Ricardo Ruiz Nolasco, Ken Sharman, and Sergio Sáez</i>	
Approximating Complex Arithmetic Circuits with Guaranteed Worst-Case Relative Error.	482
<i>Milan Češka jr., Milan Češka, Jiří Matyáš, Adam Pankuch, and Tomáš Vojnar</i>	
Solving String Constraints with Approximate Parikh Image	491
<i>Petr Janků and Lenka Turoňová</i>	
Verification of Architectural Views Model 1+5 Applicability	499
<i>Tomasz Górski</i>	
Modeling of Smart Contracts in Blockchain Solution for Renewable Energy Grid	507
<i>Tomasz Górski and Jakub Bednarski</i>	
Author Index	515

Contents – Part II

Applications of Signal Processing Technology

Robust Factor Analysis Parameter Estimation	3
<i>Rui Zhou, Junyan Liu, Sandeep Kumar, and Daniel P. Palomar</i>	
Multiple-Model Estimation Applied to Unequal, Heterogeneous State Space Models	12
<i>Dirk Weidemann and Edmond Skeli</i>	
A Gradient Ascent Approach for Multiple Frequency Estimation.	20
<i>Yuneisy E. Garcia Guzman, Michael Lunglmayr, and Mario Huemer</i>	
Enhanced Transform-Domain LMS Based Self-interference Cancellation in LTE Carrier Aggregation Transceivers	28
<i>Christian Motz, Oliver Ploder, Thomas Paireder, and Mario Huemer</i>	
Kernel Adaptive Filters: A Panacea for Self-interference Cancellation in Mobile Communication Transceivers?	36
<i>Christina Auer, Andreas Gebhard, Christian Motz, Thomas Paireder, Oliver Ploder, Ram Sunil Kanumalli, Alexander Melzer, Oliver Lang, and Mario Huemer</i>	
Acoustic Monitoring – A Deep LSTM Approach for a Material Transport Process	44
<i>Adnan Husaković, Anna Mayrhofer, Eugen Pfann, Mario Huemer, Andreas Gaich, and Thomas Kühas</i>	
Requirement-Adapted Enhancement of a Faraday Rotation Magnetometer’s Output	52
<i>Ruben Piegras, Sebastian Michlmayr, and Bernhard Zagar</i>	
Simultaneous Measurement of the Flow Velocities of Liquids and Gases	59
<i>Michael Schwarz, Bernhard Uhl, Bernhard Zagar, and Michael Stur</i>	
Counter-Based vs. Shift-Register-Based Signal Processing in Stochastic Computing	67
<i>Werner Haselmayr, Daniel Wiesinger, and Michael Lunglmayr</i>	

Artificial Intelligence and Data Mining for Intelligent Transportation Systems and Smart Mobility

Analyzing Network-Wide Effects of Cooperative Adaptive Cruise Control Without Traffic Signal Control at Intersections	79
<i>Mehmet Ali Silgu, Ismet Goksad Erdagi, and Hilmi Berk Celikoglu</i>	
Convolutional Gated Recurrent Units for Obstacle Segmentation in Bird-Eye-View	87
<i>Luigi Musto, Francesco Valenti, Andrea Zinelli, Fabio Pizzati, and Pietro Cerri</i>	
Lane Detection and Classification Using Cascaded CNNs	95
<i>Fabio Pizzati, Marco Allodi, Alejandro Barrera, and Fernando García</i>	
CNNs for Fine-Grained Car Model Classification	104
<i>H. Corrales, D. F. Llorca, I. Parra, S. Vigre, A. Quintanar, J. Lorenzo, and N. Hernández</i>	
License Plate Corners Localization Using CNN-Based Regression.	113
<i>D. F. Llorca, H. Corrales, I. Parra, M. Rentero, R. Izquierdo, A. Hernández-Saz, and I. García-Daza</i>	
Analysis on Pedestrian Green Time Period: Preliminary Findings from a Case Study	121
<i>Mehmet Ali Silgu, Gorkem Akyol, and Hilmi Berk Celikoglu</i>	
Intelligent Longitudinal Merging Maneuver at Roundabouts Based on Hybrid Planning Approach	129
<i>Carlos Hidalgo, Ray Lattarulo, Joshué Pérez, and Estibaliz Asua</i>	
Data Sources for Information Extraction in Automotive Forensics	137
<i>Andreas Attenberger</i>	
Autonomous Vehicle Architecture for High Automation.	145
<i>Miguel Ángel de Miguel, Francisco Miguel Moreno, Fernando García, Jose María Armingol, and Rodrigo Encinar Martin</i>	
A Mixed Integer Linear Programming Formulation for Green Vehicle Routing Problem: Case for Shuttle Services	153
<i>Selin Hulagu and Hilmi Berk Celikoglu</i>	
An Integrated Decision-Making Framework for Shuttle Bus Selection Using DEMATEL and MULTIMOORA Methods	161
<i>Sercan Akti and Hilmi Berk Celikoglu</i>	

Floating Car Data: Comparison of Smartphone and On-Board Diagnostics (OBD)	170
<i>Erum Naz, Franz Kopica, and Cristina Olaverri-Monreal</i>	
Promotion of Sustainable Transport by a Tracking System for Bicycles	177
<i>Daniel Braunauer, Franz Kopica, and Cristina Olaverri-Monreal</i>	
What Can Smart Mobility Offer to Tourism Economy?	182
<i>Juan Guerra-Montenegro, Javier Sánchez-Medina, David Sánchez-Rodríguez, and Itziar Alonso-González</i>	
Traffic Predictive Analysis Through Data Stream Mining	190
<i>Juan Guerra-Montenegro and Javier Sánchez-Medina</i>	
Smart Recommender for Blue Tourism Routing	197
<i>José A. Moreno-Pérez, Julio Brito Santana, Agustín Santana Talavera, Dagoberto Castellanos Nieves, Iradiel García Pérez, and Airam Expósito Márquez</i>	
Computer Vision, Machine Learning for Image Analysis and Applications	
Hand Gesture Recognition Using Computer Vision Applied to Colombian Sign Language	207
<i>I. C. Triviño-López, C. H. Rodríguez-Garavito, and J. S. Martínez-Caldas</i>	
Jupyter Notebooks for Simplifying Transfer Learning	215
<i>Manuel García-Domínguez, César Domínguez, Jónathan Heras, Eloy Mata, and Vico Pascual</i>	
Impact of the Circular Region of Interest on the Performance of Multimodal Reconstruction of Retinal Images	222
<i>Álvaro S. Hervella, José Rouco, Jorge Novo, and Marcos Ortega</i>	
Google Colaboratory for Quantifying Stomata in Images	231
<i>Ángela Casado-García, Jónathan Heras, and Alvaro Sanz-Sáez</i>	
Unsupervised Anomaly Map for Image-Based Screening	239
<i>Shaon Sutradhar, José Rouco, and Marcos Ortega</i>	
Automatic Identification of Diabetic Macular Edema Biomarkers Using Optical Coherence Tomography Scans	247
<i>Joaquim de Moura, Gabriela Samagaio, Jorge Novo, Pablo Charlón, María Isabel Fernández, Francisco Gómez-Ulla, and Marcos Ortega</i>	
DeepCompareJ: Comparing Image Classification Models	256
<i>A. Inés, C. Domínguez, J. Heras, E. Mata, and V. Pascual</i>	

Applying SSD to Real World Food Production Environments.	263
<i>Tilman Klaeger, Moritz Schroth, Andre Schult, and Lukas Oehm</i>	
Intuitive and Coherent Intraretinal Cystoid Map Representation in Optical Coherence Tomography Images	270
<i>Plácido Vidal, Joaquim de Moura, Jorge Novo, Manuel G. Penedo, and Marcos Ortega</i>	
Computer and Systems Based Methods and Electronic Technologies in Medicine	
Autoencoder Features for Differentiation of Leukocytes Based on Digital Holographic Microscopy (DHM).	281
<i>Stefan Röhrli, Matthias Ugele, Christian Klenk, Dominik Heim, Oliver Hayden, and Klaus Diepold</i>	
Automatic ECG Screening as a Supporting Tool on a Telemedicine Framework	289
<i>V. Mondéjar-Guerra, J. Novo, J. Rouco, M. Ortega, and M.G. Penedo</i>	
Adaptive Robotic Platform as an Inclusive Education Aid for Children with Autism Spectrum Disorder	297
<i>Diana Lancheros-Cuesta, Jorge Elicer Rangel, Jose Luis Rubiano, and Yenny Alexandra Cifuentes</i>	
Smart Sensors and Communication Technologies for Triage Procedures.	305
<i>Maciej Nikodem, Jan Nikodem, Ryszard Klempous, Paweł Gawłowski, and Marek A. Bawiec</i>	
Motion Capture Analysis Supporting Lifting Technique Optimization for Occupational Safety Diagnosis.	313
<i>Ryszard Klempous, Jan Nikodem, Konrad Kluwak, Maciej Nikodem, Anna Kolcz, Paweł Gawłowski, Jerzy Rozenblit, Christopher Chiu, and Marek Olesiak</i>	
Advances in Biomedical Signal and Image Processing	
ECG Morphological Changes Due to Age and Heart Rate Variability	323
<i>Kyriaki Kostoglou and Carl Böck</i>	
Overcomplete Multi-scale Dictionaries for Efficient Representation of ECG Signals.	331
<i>David Meltzer, David Luengo, and Tom Trigano</i>	
A Linear Parameter Varying ARX Model for Describing Biomedical Signal Couplings.	339
<i>Carl Böck, Kyriaki Kostoglou, Péter Kovács, Mario Huemer, and Jens Meier</i>	

ECG Segmentation by Adaptive Rational Transform	347
<i>Gergő Bognár and Sándor Fridli</i>	
Ensemble Learning for Heartbeat Classification Using Adaptive Orthogonal Transformations	355
<i>Tamás Dózsa, Gergő Bognár, and Péter Kovács</i>	
Epileptic Seizure Detection Using Piecewise Linear Reduction	364
<i>Yash Paul and Sándor Fridli</i>	
Improved Classification of Myoelectric Signals by Using Normalized Signal Trains	372
<i>Philip Gaßner and Klaus Buchenrieder</i>	
Hyperbolic Transformations of Zernike Functions and Coefficients	380
<i>Zolt Németh, Ferenc Schipp, and Ferenc Weisz</i>	
Neural Personal Profile Identification Based on Environmental Performance Analysis of Intelligent Building	388
<i>Andrzej Stachno</i>	
Systems Concepts and Methods in Touristic Flows	
Re-aligning Business Ecosystem Data Sharing to Support City Hotel Operations Planning	399
<i>Igor Perko and Luka Smigoc</i>	
A Survey to Create Attractive Contents for Tourism -To Comprehend Other Cultures-.	407
<i>Yuko Hiramatsu, Atsushi Ito, Akira Sasaki, Kazutaka Ueda, Rina Hayashi, Yasunari Harada, Hiroyuki Hatano, and Fumihiro Sato</i>	
Experiments of LoRa to Develop Services for Tourists	416
<i>Akira Sasaki, Munkhod Bayarsaikhan, Kingsam Law, Hiroyuki Hatano, Atsushi Ito, Yuko Hiramatsu, and Fumihiro Sato</i>	
Evaluation of Sightseeing Support Application Using BLE Beacon in Oku-Nikko	425
<i>Akira Sasaki, Rina Hayashi, Atsushi Ito, Yuko Hiramatsu, Kazutaka Ueda, Yasunari Harada, Hiroyuki Hatano, and Fumihiro Sato</i>	
CAST Dynamic Modeling of Competitive Tourism Destinations: Gran Canaria and Its Nordic Markets.	434
<i>R. Moreno-Díaz Jr. and A. Rodríguez-Rodríguez</i>	
Towards a Simulation Model of Competition Between Touristic Destinations Using Dynamic Systems Tools	442
<i>R. Moreno-Díaz Jr. and A. Rodríguez-Rodríguez</i>	

Systems in Industrial Robotics, Automation and IoT

IEC 61499 Runtime Environments: A State of the Art Comparison	453
<i>Laurin Prenzel, Alois Zoitl, and Julien Provost</i>	
Skill-Based Motion Control with OPC UA and Deterministic Ethernet.	461
<i>Marius Beller, Ben Schneider, and Alois Zoitl</i>	
Enhancing Industrial Maintenance Through Intelligent Data Analysis.	469
<i>Patrick Praher, Bernhard Freudenthaler, Werner Schröder, and Florian Sobieczky</i>	
Simulator for Planning Collision-Free Trajectories in Manipulation of Objects Applications	477
<i>J. S. Martinez-Caldas, C. H. Rodriguez-Garavito, Carolina Peña-Ortega, Alvaro A. Patiño-Forero, and Guillermo A. Camacho</i>	
Real-Time IoT-Based Production Planning and Control of Industrial Robots in an Automated Cyber-Physical Production System Under Dynamic Conditions: Lessons Learned from a Make-to-Order Usage Case.	485
<i>Joachim Berlak, Julia Berg, Michael Stangl, and Luciano Baumgart</i>	
A Smart and Flexible Study Course for Industry 4.0 – Systems Engineering	493
<i>Dirk Jacob</i>	
Simulation-Based Design and Evaluation of a Smart Energy Manager	500
<i>Tobias Rodemann and Kai Kitamura</i>	
Authentication of Internet Connected White Goods Using Gestures or Key Sequences	508
<i>Thomas Schlechter and Johannes Fischer</i>	
Author Index	513