

# **Studies in Computational Intelligence**

Volume 648

## **Series editor**

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Editors

# Innovative Approaches and Solutions in Advanced Intelligent Systems

 Springer

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# Preface

This volume is a selected collection of papers presented and discussed at the International Conference “Advanced Computing for Innovation (ACoIn 2015)”. The papers report innovative approaches and solutions in hot topics of computational intelligence—advanced computing, language and semantic technologies, signal and image processing, as well as optimisation and intelligent control.

*Advanced Computing* is presented by five papers. The work of I. Dimov and V. Todorov is related to *efficient methods and tools for analysis of reliability of large-scale models*. The authors present an error analysis of an almost optimal Monte Carlo algorithm based on balancing the systematic and stochastic error. This contribution to the solution of hard computational problems is relevant to environmental sciences and computational physics. Three other papers concern *high-performance computing in engineering and environmental problems*. S. Stoykov and S. Margenov propose and analyse some numerical methods for computing nonlinear frequency-response curves of plates with complex geometries. They show that parametric study on the dynamics of complex structures can be carried out deploying appropriate parallel implementation. K. Liolios et al. describe a numerical simulation of biochemical oxygen demand removal in Horizontal Subsurface Flow Constructed Wetlands (HSF CW). The simulated experimental data is obtained from five pilot-scale HSF CW units. A. Liolios et al. present an approach that can be effectively used for numerical investigation the seismic inelastic behaviour of cultural heritage industrial buildings of reinforced concrete strengthened by cable elements and subjected to multiple earthquakes. The authors propose an approach for selecting the optimal cable-bracing scheme by using computed damage indices. The paper of J. Kohler et al. is related to *application of cloud computing for processing Big Data*. The authors propose an original query rewriting approach that parallelises queries and joins in an order that has been implemented and tested for performance gains. The approach can be used for improving data security and privacy, especially in public cloud computing environments.

Five papers present innovative approaches in the areas of *Language, Semantic and Content Technologies*. The paper of V. Cantoni et al. is focused on *digital preservation of cultural heritage for research and education*. It describes an innovative use of interactive digital technologies in cultural heritage presentation practices exemplified by multimodal interaction modalities developed for the Exhibition “1525–2015. Pavia, the Battle, the Future. Nothing was the same again”—a satellite event of the Universal Exposition Expo 2015 in Milan. Two papers are devoted to *application of data mining methods for analysing Big and Educational Data*. S. Boytcheva et al. present a novel cascade data mining approach for frequent pattern mining, sequence mining and periodical events mining applied to discovery of complex temporal relationships between disorders and their treatment. An evaluation of the approach on real data is provided. I. Nikolova et al. describe application of educational data mining to a real educational web portal—UCHA.SE with the goal to improve the quality of the educational services provided by the site and its revenue generation. The extracted predictive rules are used to make recommendations to the UCHA.SE development team. Two other papers are related to *advanced methods and tools for processing of textual and semantic data*. O. Kanishcheva and G. Angelova present an original integrated approach for word sense disambiguation of image tags that can be applied for improving machine translation of tags or image similarity measurement. K. Simov et al. describe an approach for the enrichment of word sense disambiguation knowledge bases with data-driven relations from a gold standard corpus (annotated with word senses, valency information, syntactic analyses, etc.). The paper is focused on Bulgarian and English as use cases, but the approach is scalable to other languages as well.

*Signal and Image Processing* issues are discussed in eight papers. The work of A. Nikolov et al. is related to *advanced methods for biometric analysis*. The authors describe a novel multimodal ear database characterised by different types of ear representation, either 2D or 3D, depending on the device used for data acquisition. The database can be used as a benchmark to test different pattern recognition methods on a set of images captured in known conditions, and to highlight the strengths and the weaknesses of each approach in terms of recognition accuracy and robustness. Several problems of *smart multi-sensor signal and image processing* are treated in the following six papers. S. Ilchev and Z. Ilcheva propose a modular digital watermarking service coupled with steganalysis suitable both for commercial and non commercial users. The service acts as intermediary facilitating the payment flow for commercial uses and is able to gather and provide statistics about image distribution and popularity. S. Harizanov investigates several techniques for restoring images corrupted by a non-invertible or ill-conditioned linear transformations and Poisson noise. These techniques are based on image domain decomposition and give rise to multi-constraint optimisation problems. D. Karastoyanov et al. present a new type of graphical Braille screen containing a matrix with linear electromagnetic micro drives and non-magnetic needles, passing through the axes of the electromagnets. P. Koprinkova-Hristova et al. discuss an application of a recently developed smart approach for feature extraction from multi-dimensional data sets using Echo state

networks to the focalised spectra obtained from multi-sensor measurements of an acoustic camera. The aim of the study is development of a remote diagnostic system for prediction of bearing wearing out. V. Kudriashov proposes new detection rules for multistatic reception of non-stationary random Wiener acoustic signals. The rules are suitable for such applications as monitoring aircraft engine noise at landing/take off, and testing of a car engine. I. Chirka suggests two novel techniques for the interpolation of acoustic fields generated by a single acoustic source based on sinewave model and instantaneous phase measurement, and generation of virtual microphones. The approaches allow improving the accuracy of source localisation avoiding the necessity of using expensive equipment. Some *speech analysis* problems are considered in the paper of P. Mitankin and S. Mihov, who propose an original algorithm to be integrated in the decoding stage of the speech recognition pipeline. The innovative aspect is the implicit generation of a much larger set of decoding candidates than the state-of-the-art N-best approach.

Three papers present innovative results in the areas of *Optimisation and Intelligent Control of Traffic*. S. Fidanova proposes a model of the passenger flow suitable for analysing existing public transportation systems. The task is defined as a multi-objective optimisation problem that can be solved by an ant colony optimisation algorithm. T. Stoilov et al. introduce an innovative idea for the formal description of the urban traffic control based on a bi-level model. Such an approach gives the potential for increasing the space of the control allowing simultaneously the minimisation of the waiting vehicles and maximisation of the traffic flows. A. Balabanov proposes an original algorithm based on fast finding of solutions of Riccati equations for synthesis of a steady-state Kalman estimator, which can be used for online applications such as estimations of the real traffic intensity.

We would like to thank the members of the ACOMIN 2015 Programme Committee, who reviewed the submissions thoroughly and fairly, and the AComIn project (Advanced Computing for Innovation, FP7 Capacity grant 316087) for the generous support provided to the ACOMIN 2015 conference.

February 2016

Svetozar Margenov  
Galia Angelova  
Gennady Agre

# Organization Committee

The International Conference Advanced Computing for Innovation (ACOMIN 2015) was organised by the Institute of Information and Communication Technologies at the Bulgarian Academy of Sciences (IICT-BAS) in the frame of the FP7 project “Advanced Computing for Innovation” (AComIn) grant agreement 316087. The conference was held during 10–11 November 2015 in Sofia, Bulgaria and was aimed at providing a forum for international scientific exchange between Central/Eastern Europe and the rest of the world in several fundamental for computational intelligence topics enabling radical progress and development of novel applications.

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