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Preface

This special issue of the *Computer Assisted Methods in Engineering and Science* comprises selected papers presented during the **International Conference on Inverse Problems in Engineering 2014** (**ICIPE2014**). The ICIPE2014 Conference took place in Kraków in May 2014. The ICIPE2014 was the 24th in the series of national and international meetings on inverse problems that were initiated at Michigan State University in 1988. The 2014 edition was the 8th International Conference. Both the Scientific Committee members and the participants came from many countries all over the world: USA, Brazil, Russia, Poland and France among others.

The primary purpose of the ICIPE conferences is to provide a forum for scientist and graduate students in sciences and engineering to present recent results concerning inverse problems. The problems coped with include theory, applications and numerical methods of the inverse problems solutions. The topics of the conferences cover inverse problems in all branches of science and engineering including thermal sciences, structure mechanics, fluid flows, medical applications and many others. During the 2014 conference 6 keynote lectures and 96 regular papers were presented.

The Special Issue begins with the paper by V. Condaminet et al. entitled *Identification of aerodynamic coefficients of a projectile and reconstruction of its trajectory from partial flight data*. In this paper several optimization techniques are proposed, both to identify the aerodynamic coefficients and to reconstruct the trajectory of a fin-stabilized projectile from partial flight data. To identify the set of aerodynamic coefficients, some optimization techniques are proposed. These techniques are compared when identifying the aerodynamic coefficients from both exact and noisy partial simulated flight data.

The paper entitled *Chlorophyll profile estimation in ocean waters by a set of artificial neural networks* is prepared by F. Dall Cortivo et al. (this paper will be published in issue CAMES 1/2015). In this work author proposed a methodology to estimate the profile of the chlorophyll concentration from the upwelled radiation at the surface of the ocean, using a system of artificial neural networks (ANNs). The input patterns to train the networks were obtained from the resolution of the radiative transfer equation, where the absorption and scattering coefficients were represented by bio optical models, with the profile of the chlorophyll concentrations based on a shifted-Gaussian model.

Next is the paper by M. Gandor et al. entitled *Application of inverse analysis in electromagnetic grinding of brown coal for obtaining an optimal particle size distribution – a heuristic approach*. The paper presents the research results of milling process optimization in the electromagnetic mill due to obtaining the predetermined particle size distribution of the brown coal. The paper proposes one of the concepts of adapting low-rank coal to being utilized in modernized and newly built plants, which is a simultaneous grinding and drying process in an electromagnetic mill system.

L. Gharsalli with coworkers in the paper titled *Variational Bayesian inversion for microwave breast imaging* considers microwave imaging as a nonlinear inverse scattering problem and tackles it within a Bayesian estimation framework. The tested object (a breast affected by a tumor) is supposed to be composed of compact regions made of a restricted number of different homogeneous materials. Some preliminary results, obtained by applying the proposed method to synthetic data, are presented and compared to those obtained by means of the classical contrast source inversion method.

The fourth contribution, by W. Al Hadad et al., is entitled *Regularization using truncated singular value decomposition for estimating the Fourier spectrum of a noised space distribution over an extended support*. This paper is devoted to a theoretical and numerical study of the different ways of calculating the Fourier transform of a noisy signal where the boundary conditions at the lateral boundaries of the measurement interval are not precisely known. This happens in different characterization problems where an infrared camera is used for temperature measurements. To overcome this difficulty, the interval where the Fourier transform is defined (its support) is supposed to be larger than the measurement domain.

The next paper titled *Efficient Markov chain Monte Carlo sampling for electrical impedance tomography* by E. Ma studies electrical impedance tomography (EIT) using Bayesian inference. The resulting posterior distribution is sampled by Markov chain Monte Carlo (MCMC). The paper studies a toy model of EIT and focuses on efficient MCMC sampling for this model.

The sixth paper, by D. Pepper et al., *A meshless method using global radial basis functions for creating 3-D wind fields from sparse meteorological data* considers the problem of developing an efficient numerical

method for creating 3-D wind fields utilizing sparse meteorological tower data. Node points are placed within a region of interest based on topological features. Meteorological data consisting of wind speeds and directions are obtained from instrumented towers located within a domain and used to create a temporary, interpolated data set to all nodal points. The meshless method (does not require connective mesh generation), based on the Kansa technique, creates a mass-consistent, 3-D wind field. The meshless method yields close approximations to results obtained with other numerical techniques.

The next contribution, by L.G. Silva et al., *Inverse problem in anomalous diffusion with uncertainty propagation* investigates an inverse problem which does not allow for simultaneous estimation of all model parameters. The characterization procedure is proposed in two steps: the first step is to estimate the diffusion coefficient and the second one is to estimate the complementary parameters. In this paper, it is assumed that the first step is already done and the diffusion coefficient is known within a certain degree of reliability. Therefore, this work is aimed at investigating the confidence intervals of the complementary parameters estimates considering both the uncertainties due to measurement errors in the experimental data and due to the uncertainty propagation of the estimated value of the diffusion coefficient. The inverse problem solution is carried out through the maximum likelihood approach, with the minimization problem solved with the Levenberg-Marquardt method. The estimation of the confidence intervals is carried out through a Monte Carlo analysis.

The last paper, by I. Sumida et al., *MPCA for Flight Dynamics Parameters Determination* is devoted to flight simulators, namely to the calibration of the simulation for simulators to have good adherence to reality, that is, identify the parameters that make the simulation as close as possible to the real dynamic. After determining these parameters, the simulator is ready to be used in human resources training or assessing aircraft. Parameter identification characterizes the aerodynamic performance of the aircraft and is formulated as a problem optimization. The calibration of a dynamic flight simulator is achieved by a new metaheuristic multiple particle collision algorithm (MPCA). Preliminary results show a good performance of the approach employed.

We are indebted to all authors for their contributions to this special issue, for their cooperation and support. We would also like to express our appreciation to Mr. B. Lempkowski, CAMES Editorial Coordinator, for his highly professional help in a preparation of this special edition. We do hope that this issue provides a window on the current interests in inverse problems, documenting at the same time recent advances in this fascinating research area.

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