PREFACE

This special section of the *International Journal of Applied Mathematics and Computer Science* is devoted to the presentation of selected papers rising issues belonging to the broad research field of cybernetics. The papers have been selected out of the cycle of oral presentations given on November 10, 2006 at the seminar of the Poznań Branch of the Polish Academy of Sciences entitled *Current Issues of Bio-Cybernetics*, and are their extended versions.

The first two papers are devoted to the topic of spiking neural networks - a computational model of biological neural systems, which maps its essential properties at the level of signal processing. In the paper by F. Ponulak, learning properties of spiking neural networks are investigated. The original algorithm of the learning method is specified, followed by an analysis addressing the problem of the impact of the algorithm's parameters on the efficiency of the learning process. Qualitative results are given.

The paper by I. Uysal, H. Sathyendra and J.G. Harris describes results in automatic speech recognition (ASR) obtained with biologically plausible system architectures. Namely, acoustic stimuli are converted into spikes trains, and the potential of spiking neural networks as both signal encoders and simple acoustic signals classifiers is investigated. The obtained results demonstrate the superiority of such an approach as compared to conventional ASR using a noisy vowel data set.

In the paper by J. Śmieja, models are proposed for supporting the analysis of signaling pathways, namely, gene transcription processes. In particular, the interferon- induced pathway is described in detail. Some model simplification suggestions are recommended as a result of the analysis. Simulation results based on the proposed models are compared with experimental biological data.

R. Cierniak in his paper addresses the problem of 3D image reconstruction from 2D projections by using a recurrent neural network of the Hopfield type. Source images are computed tomography images. The approach is based on network energy minimization in order to decrease the number of necessary projections while preserving the quality of the resulting image.

The section is concluded with the paper by M. Hrebień, P. Steć, T. Nieczkowski and A. Obuchowicz. It is an image processing paper, well situated within the context of modern cytology. Three image segmentation methods are evaluated in relation to a cell and nuclei separation problem. The investigated material is breast cancer needle biopsy images. The methods involved are watershed based segmentation, active contours based boundary extraction, and the GrowCut method for region growing based on a cellular automata concept. A significant part of the paper is devoted to material preparation issues and the preprocessing of source images.

All of the above contributions, although focused on particular issues from a broad field of biomedical engineering, demonstrate that concepts, models and methods originally conceived in the field of technology can contribute to the understanding of biological processes, at least to boost visual diagnostic aids, or can even open the way to novel prosthetic devices concepts based on non-classical paradigms. On the other hand, *biomimetics* is a very promising and inspiring way of actively searching for technical solutions to real-life problems. It always brings a lot of opportunities to challenge and rethink a number of "unquestionable" theories and modeling methods already in use.

Andrzej KASIŃSKI
Institute of Control and Information Engineering
Poznań University of Technology, Poland

June 2008