PREFACE

Soft computing techniques are nowadays tools renowned in both control and fault diagnosis. This methodology covers neural networks, fuzzy systems and evolutionary computation, and can lead to the accommodation of more complex processes, improved performance as well as considerable time savings and cost reductions. Requirements for a precise and accurate analytical model imply that any following modeling error will affect the performance of the resulting fault detection and isolation or control schemes. This is particularly true for dynamically non-linear and uncertain systems, which represent a majority of real processes. To circumvent this precision problem, soft computing approaches are used.

The workshop on *Soft Computing in Control and Fault Diagnosis*, held in Zielona Góra (Poland) on 22 April 2005, was dedicated to selected methods of soft computing and their application to control and fault diagnosis of dynamic systems. The main attention was focused on neural networks, which can be trained to reproduce specified system behaviour from data sets alone. The main feature of neural networks is their ability to model any non-linear function, given suitable weighting factors and an appropriate architecture. The key advantage of fuzzy logic is that it allows system behaviour to be described by *if-then* relations.

The present special section includes seven papers presented during the workshop, sponsored by the *Committee on Automatic Control and Robotics* of the *Polish Academy of Sciences*. Paper 1 describes the usage of fuzzy reasoning techniques and neural networks structures in model-based predictive control. Applications of fuzzy systems of the Takagi-Sugeno type to explicit and numerical non-linear predictive control algorithms are presented. Moreover, many techniques using neural network modeling to improve structural or computational properties of such algorithms are discussed. The work of Papers 2, 3 and 4 is devoted to different aspects of fuzzy logic and its use in diagnostic reasoning and control systems. In Paper 2, a problem of fuzzy logic reasoning that takes into account the uncertainty of the relation between faults and symptoms is investigated by Kościelny and Syfert. Some unclear, unsolved or partly solved problems of fuzzy logic, which hinder a precise transformation of expert knowledge about the analysed process in a fuzzy controller, are discussed by Piegat in Paper 3. Kosiński, in Paper 4, focuses on fuzzy number calculus. Paper 5 of the section, by Kowalczuk and Białaszewski, is concerned with evolutionary computations to increase the effectiveness of evolutionary multi-objective optimization solvers used for designing observers in fault detection schemes. Recent developments regarding the application of evolutionary algorithms and neural networks to fault diagnosis are presented by Witczak. Here the main attention is paid to techniques that integrate the classical (analytical) and soft computing methods. The DAMADICS fault detection benchmark dealing with a valve actuator is considered for illustrating the performance of some approaches. In Paper 7, Kasiński and Ponulak describe a supervised learning method for spike time coding in spiking neural networks.

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