**Studia i Monografie**
z. 594

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# HIGH-PERFORMANCE TECHNOLOGIES OF MODELING AND IDENTIFICATION OF COMPLEX MULTI-COMPONENT SYSTEMS AND PROCESSES

ISSN 1429-6063
ISBN 978-83-66903-75-3

OFICYNA WYDAWNICZA

Opole 2024 POLITECHNIKA OPOLSKA

**OPOLE UNIVERSITY OF TECHNOLOGY**



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Prószkowska 76 Street



Typesetting: Oficyna Wydawnictw Politechniki Opolskiej
Print run … copies. Publishing sheet 13,5. Printed sheet 13,5.
Print and cover: Sekcja Poligrafii Politechniki Opolskiej

# PREFACE

This monograph reveals the fundamental ideas, mathematical models and high-performance technologies of identification of complex multi-component systems and processes of different nature and space-time structure. The identification technologies considered in the monograph include deterministic and stochastic approaches to modeling processes in physical (cyberphysical, nanoporous) and biological (neuro and cardio) systems. Also this monograph highlights new approaches to the development of high-performance super-computer technologies for modeling and identification based on parallel computations of complex cyberphysical systems in the presence of a large amount of feedback and interactions that are controlled by the network of computing elements. Despite the different nature of the studied cyberphysical systems, their behaviors and the state are determined by many distributed feedback influences such as cognitive ones (influence of certain neural nodes of the cerebral cortex (CC) on the behavior of the behavior of a particular organ or part of the human body, such as the limbs of the right hand, eyelids, eyeballs etc.) and those of physical nature (concentration effects of adsorbed components of contaminants and nanosources in the conditions of dynamic equilibrium in a certain layer of the nanoporous system) and other interactions. The proposed methodology corresponds to a number of priority research areas of European programs (Horizon Europe), related to the modern computer technologies for cyber physical systems (Computing technologies and engineering methods for cyber physical systems of systems (CPSS)). The design of the considered CPSS is based on new science-intensive technologies of object description, new computing solutions taking into account the architecture of computer systems and software (parallel algorithms of multiparameter identification).

The key problem of the monograph is the developpment of the high-performance supercomputer technologies multiparameter identification of complex cyber physical systems (neuro-bio-nanomedical and nanoporous physical systems) with feedback-connections and interactions on the basis of parallel computations. Such CPSS may include also cognitive feedback (for neuro-biosystems) to determinate the parameters of the behavior and the state of individual executive elements of the systems and the optimal parameters of these influences to obtain the predicted systems behavior. In medical applications according to the specified European programs special attention is paid to new digital systems of diagnostics and treatment. In this context, the proposed methods of designing nanomedical neuro-bio-CPSS are focused on determining the parameters of abnormal movements of patients with tremor (T-objects) caused by the negative effects of a number of neural nodes of CC. The second type of considered feedback-systems (nanoporous CPSS) are related to solving the problem of global warming and the implementation of safe energy strategies through the introduction of smart nanosystems to adsorption harmful emissions of carbon oxides and other greenhouse gases.

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