

# **Advances in Intelligent Systems and Computing**

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Jerzy Świder · Sławomir Kciuk ·  
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# Mechatronics 2017 - Ideas for Industrial Applications

 Springer

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# Foreword

There is no doubt that mechatronics is one of the elements conditioning the advent and success of the modern stage of industrial development. Knowledge on this subject is being developed both at worldwide universities and in industrial practice. Collaboration between these two entities is crucial for the results and the level of this development. Recent results of research works conducted by scientists and practitioners on development and application of mechatronics constitute the content of this book, the title of which explicitly underlines the application of mechatronics in industrial practice.

The majority, almost 20 percent of the published works in this book, are devoted to measuring techniques in mechatronic phenomena and related problems. The effectiveness, precision, and reliability of measurements in complex processes of controlling machines and devices often determine the success of these processes. Two equal groups of works, each comprising about 16 percent of the book volume, deal with robotics and design of mechatronic systems. Robotics and robotisation of modern industry are one of the hallmarks and measures of its development level, and the problems of control, sensing, programming, and safe cooperation between a robot and a human are of fundamental importance to mechatronic systems. Fourteen percent of the book's contents are the results of research and applications of mechatronics in medicine and in sport. This is an extremely important area of joint action of doctors and engineers, more and more often providing effects of biomechatronic character, having both scientific and utilitarian, but also deeply humanistic and social dimensions. The last largest group, 12 percent of the works included in the book, deals with modern applications of mechatronics in rapidly changing contemporary mining, which poses strict requirements regarding human safety and the natural environment. The remaining part of the book is devoted to applications of mechatronics in the automotive industry well known to use mechatronics in the design and manufacture of modern cars with exceptional intensity, in the development of the defense technology important in every society protecting its independence, in the extremely demanding aviation industry, in the modern food industry, as well as to teaching of mechatronics at universities and to the paradigm of Industry 4.0.

We hope that this edition of the book will be an important piece of information about the latest findings of researchers, industry representatives, and scientists from universities of technology working in the field of mechatronics, which is an exciting, modern, and fast-growing field of technics and technology, in particular in the context of such important industrial applications.

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December 2018

J. Świder  
S. Kciuk  
M. Trojnacki

# Contents

<b>Modelling Industrial Robot Fanuc ARC Mate 100iB in LabVIEW . . . .</b>	<b>1</b>
Wacław Banaś and Kamil Lysek	
<b>Recognition of Text Commands and Control of the Mobile Robot Starter Kit 2.0 . . . . .</b>	<b>10</b>
Wacław Banaś and Bartłomiej Nalepa	
<b>System for Positioning of the Roadheader in Roadways of Hard Coal Mines . . . . .</b>	<b>20</b>
Sławomir Bartoszek and Gabriel Kost	
<b>Biomechatronic Simulator for Fencing Training Using Virtual Reality Technology . . . . .</b>	<b>30</b>
Andrzej Bieniek, Anna Szczygiół, Miłosz Chrzan, Piotr Wodarski, Michał Morys, Bogdan Bacik, Grzegorz Juras, Robert Michnik, Katarzyna Paszek, and Marek Gzik	
<b>Application of Industrial Automatic Systems for Operating Parameters Identification of Mining Machines . . . . .</b>	<b>38</b>
Jarosław Brodny and Magdalena Tutak	
<b>Collection of Essential Methods Among the Beams Analysis as an Introduction into the Dynamic Reverse Task Solution of Bending Vibration within Mechatronic System . . . . .</b>	<b>52</b>
Andrzej Buchacz	
<b>Tunable Model of a Servo Hydraulic Tester for Shock Absorbers Vibrational Evaluation . . . . .</b>	<b>61</b>
Piotr Czop, Mariusz Hetmańczyk, Grzegorz Wszolek, and Jakub Słoniewski	

<b>Modelling and System Identification of a Monotube Shock Absorber</b> .....	70
Piotr Czop, Mariusz Hetmańczyk, Grzegorz Wszolek, and Jakub Słoniewski	
<b>Particle Image Velocimetry Technique Applied to Flow Evaluation Through a Shock Absorber Intake Valve</b> .....	81
Piotr Czop, Mariusz Hetmańczyk, Grzegorz Wszolek, Jakub Słoniewski, Damian Gąsiorek, and Zbigniew Buliński	
<b>Concept, Physical Design and Simulator of IRYS Social Robot Head</b> .....	91
Przemysław Dąbek, Maciej Trojnecki, Piotr Jaroszek, and Karolina Zawieska	
<b>Cognitive Maintenance and Polymorphic Production as the Leading Industry 4.0 Paradigms</b> .....	101
Marek Drewniak and Marek Gabryś	
<b>Concept of Coupling the Rehabilitation Treadmill with Foot Pressure Sensors</b> .....	111
Sławomir Duda and Grzegorz Gembalczyk	
<b>Forecasting of Methane Hazard State in the Exploitation Wall Using Neural-Fuzzy System</b> .....	119
Dariusz Felka and Jarosław Brodny	
<b>Modular Approach to the Planning of the Robot's Tasks in the Context of Holons and Graph-Based Methods</b> .....	134
Krzysztof Foit	
<b>Detection and Recording of Acoustic Emission in Discrete IGBT Transistors</b> .....	144
Radosław Gordon	
<b>Zero-Sum Differential Game in Wheeled Mobile Robot Control</b> .....	151
Zenon Hendzel and Paweł Penar	
<b>Numerical Analysis of the Dynamic Impact of a Gun Barrel During Firing</b> .....	162
Krzysztof Jamroziak, Mirosław Bocian, Dariusz Pyka, and Maciej Kulisiewicz	
<b>Concept of Sensor for Mining Machines Powered by Pressure Changes</b> .....	175
Dariusz Jasiulek	
<b>Model of Dynamics of the Three Wheeled Mobile Platform</b> .....	184
Anna Jaskot and Bogdan Posiadała	



<b>Control of Bucket Conveyor's Output</b> .....	192
Sebastian Jendrysik and Gabriel Kost	
<b>Magnetorheological Suspension Based on Silicone Oil</b> .....	201
Sławomir Kciuk, Monika Kciuk, Tomasz Machoczek, and Wojciech Klein	
<b>Experimental Verification of the Filtration Phenomena in Hydraulic Systems</b> .....	220
Klaudiusz Klarecki and Dominik Rabsztyn	
<b>Role of Didactical Stations in Education Process of Industrial Automatics Technical Staff</b> .....	231
Janusz Kobiałka and Wojciech Zawiejski	
<b>Image-Based Method for Knee Ligament Injuries Detection</b> .....	240
Piotr Kohut and Rafał Obuchowicz	
<b>Application of Surface Electromyographic Signals for Electric Rotor Control</b> .....	248
Agnieszka Konopelska and Mariola Jureczko	
<b>Voltage Source Inverter Synchronization with the Use of FFT Algorithm</b> .....	258
Maciej Kozak	
<b>Experimental Research Assessing Threat of EOD Technicians from Explosive Blast</b> .....	269
Edyta Krzystała, Krzysztof Kawlewski, Sławomir Kciuk, Tomasz Machoczek, and Grzegorz Bienioszek	
<b>Theoretical Analysis of Piezoelectric Transformers in Different Configurations</b> .....	277
Paweł Łabędzki, Rafał Pawlikowski, and Andrzej Radowicz	
<b>Fracture Surface Analysis of the EN AW-2017A-T4 Specimens with Rectangular Section</b> .....	290
Wojciech Macek, Sebastian Faszynka, and Adam Deptuła	
<b>Autonomous Robot Control System for Automation of Manipulations</b> .....	298
Julian Malaka	
<b>Advantages of Using Industrial Sensor Interfaces at the Machine Design Stage</b> .....	308
Piotr Michalski	
<b>Bisection Method for Measuring Integral Nonlinearity of Precision Thermometry Bridges</b> .....	314
Aleksandr Mikhal and Zygmunt L. Warsza	

<b>Applications of Composite Piezoelectric Transducers in Innovative Mechatronic Systems</b> .....	326
Marek Płaczek	
<b>Sensor-Less Bilateral Teleoperation System Based on Non Linear Inverse Modelling with Signal Prediction</b> .....	337
Mateusz Saków, Arkadiusz Parus, Mirosław Pajor, and Karol Miądlicki	
<b>Time Constant and Model-Free Signal Prediction in Communication Channel of Teleoperation System</b> .....	348
Mateusz Saków, Arkadiusz Parus, Mirosław Pajor, and Karol Miądlicki	
<b>Analysis of Selected Factors' Influence on the Specific Range of Modern Jet Transport Aircraft as a Complex Mechatronic System</b> . . . .	360
Robert Sklorz, Adrian Zieliński, and Jarosław Brodny	
<b>Investigation of Newly Developed Microwave Heated Moisture Analyzer Measurements of Ketchup and Milk Samples in Climatic Chamber</b> .....	377
Jakub Szwałkiewicz, Mateusz Kalinowski, and Roman Szewczyk	
<b>Computer Aided Planning of Adept Six-300 Robot Trajectories</b> .....	384
Tadeusz Szkodny	
<b>Control of Selected Operational Parameters of the Scraper Conveyor to Improve Its Working Conditions</b> .....	395
Jerzy Świder, Krzysztof Herbuś, and Kamil Szewerda	
<b>Power Quality in the “Shore to Ship” System – The Improvement of the Unbalanced Voltage Factor</b> .....	406
Dariusz Tamapowicz and Sergey German-Galkin	
<b>Mathematical Modelling and Selecting the Parameters of Magnetic Circuit of Disk Torque Converter</b> .....	417
Arkadiusz Tomas, Tomasz Trawiński, and Arkadiusz Mężyk	
<b>Modelling the Anthropomorphic Mechanical Hand</b> .....	427
Jakub Turek, Marek Daniszewski, Przemysław Wolnicki, Tomasz Machoczek, and Paweł Jureczko	
<b>Uncertainty Analysis of the Two-Output RTD Circuits on the Example of Difference and Average Temperature Measurements</b> .....	435
Zygmunt L. Warsza and Adam Idźkowski	
<b>Interactive Controller Aiding the Process of Upper Limb Rehabilitation</b> .....	447
Piotr Wodarski, Marek Gzik, Miłosz Chrzan, Andrzej Bieniek, Barbara Łopacka, and Robert Michnik	

**Double Physical Pendulum with Magnetic Interaction** . . . . . 455  
Mateusz Wojna, Jan Awrejcewicz, and Grzegorz Wasilewski

**Model of Trough-Beam Laser Sensor for Determining the Real  
Position and Real Response Time** . . . . . 465  
Mirosław Wolski, Tomasz Piątkowski, and Przemysław Osowski

**Application of the Parametric Identification While Modelling  
the Dynamics of the Electro-Hydraulic Drive** . . . . . 475  
Piotr Wos and Ryszard Dindorf

**Author Index** . . . . . 485

## About the Editors

**Professor Jerzy Świder** was awarded the PhD degree of technical sciences in 1981 in the discipline of machine design and maintenance from the Faculty of Energy and Mechanical Engineering of the Silesian University of Technology (SUT), and the DSc (habilitation) degree in the same discipline in 1992. Since 1996 (for two cadences), he was Vice-Dean and since 2005 (for the next two cadences) Dean of the Mechanical Engineering Faculty of the Silesian University of Technology (SUT), Gliwice, Poland. Currently, he is Full Professor (since 2000), Director of the Institute of Engineering Processes Automation and Integrated Manufacturing Systems (since 2005), and Director of doctoral studies in the field of machine design and maintenance (since 2017) at the same university and at the same faculty. Since 2017, he is Chairman of the scientific board of the KOMAG Institute of Mining Technology. He promoted 16 doctors of technical sciences. His research interests focus on graph theory and application, automation of processes, mechatronics, robotics and robotisation of technological processes. His most important projects include such elements as the design of automated production stations, the study of energy consumption by industrial robots, dynamics of systems with couplings, diagnostics of industrial networks, control and diagnostic systems for distributed drives, the use of artificial neural networks in control systems, simulation optimisation of shock absorbers, the mechatronic integrator of vehicle control procedures, the robotic cell for nondestructive quality control of glued connections of car bodies in the General Motors standard, and control of parameters of the scraper conveyor to optimise its working conditions. He is one of the main authors of research, didactics, and laboratories, created at the Mechanical Engineering Faculty of the SUT in the areas of automation, robotics, and mechatronics, in the close cooperation with leading industrial partners in this area.

**Slawomir Kciuk, PhD, DSc, Eng.** is Prominent Representative of science, who works at the Institute of Theoretical and Applied Mechanics at the Silesian University of Technology, Gliwice. Since 2017, he is Chairman of scientific board of the Research and Development Centre for Mechanical Appliances “OBRUM” Ltd. He is a long-standing, active member of Polish Society of Theoretical and

Applied Mechanics, and currently he is Member of the Board of this renowned society. His research covers a broad scope of issues from the dynamic problems of continuum mechanics and the usage of numerical methods in stereomechanical analysis of machine models to construction of high-speed tracked vehicles.

His science and research issues are mainly connected with the analysis of dynamic phenomena occurring in electromechanical systems. As far as his scientific activities are concerned, he deals with problems concerning the mechanical engineering discipline and, in particular, with analysis of dynamic phenomena in drive systems of mine shaft, theoretical and empirical modal analysis for identification of dynamic properties of machine sets as well as optimization of their dynamic characteristics, analysis of dynamic phenomena occurring in mechatronic sets, vibroisolation systems, and concurrent simulation including real characteristics of dumping elements of suspension systems, including tank suspensions.

**Maciej Trojnacki** received his MSc Eng. degree in aeronautic control systems in 1999 and PhD degree in machine construction and use in 2003, both from the Faculty of Mechanical Engineering and Aeronautics, Rzeszów University of Technology, Rzeszów, Poland. He received his DSc in mechanics in 2014 from the Faculty of Mechanical Engineering, Silesian University of Technology, Gliwice, Poland. Since 2008, he has been an expert in the National Centre for Research and Development and since 2015 Member of Program Committee of Science and Technology Conference Automation–Innovations and Future Perspectives, organized annually for over 20 years by Industrial Research Institute for Automation and Measurements (PIAP) in Warsaw, Poland.

Currently, he is Associate Professor and Head of Interdisciplinary Research Division in PIAP as well as Member of Scientific Council of PIAP. His research interests include mechanics, control, artificial intelligence, mechatronics, and robotics. In particular, he is a specialist in ground mobile robots (wheeled, legged, tracked, and hybrid ones) and self-driving cars in terms of construction, modeling, and simulation as well as control.

His most important projects realized in PIAP include “Multi Sensor Anti Sniper System (MUSAS)” financed by European Defence Agency (EDA) and Ministry of Science and Higher Education of Poland, “Integrated Mobile System for Support of Anti-terrorist and Anti-crisis Operations (Proteus)” financed from European Regional Development Fund within Innovative Economy Operation Programme, “Dynamics Modeling of a Four-wheeled Mobile Robot and Tracking Control with Limited Slip of Wheels” financed from the means of National Science Centre of Poland and “Study of New Spatial Scanning Head and Its Modification for Mobile Robots for Mapping of the Environment” financed by the National Centre for Research and Development of Poland within the framework of the Program of Applied Research.