## 2024 21st International Conference on Mechatronics - Mechatronika (ME 2024)

Brno, Czech Republic 4-6 December 2024



IEEE Catalog Number: CFP2457K-POD ISBN: 979-8-3503-9491-7

## Copyright © 2024 by the Institute of Electrical and Electronics Engineers, Inc. All Rights Reserved

Copyright and Reprint Permissions: Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limit of U.S. copyright law for private use of patrons those articles in this volume that carry a code at the bottom of the first page, provided the per-copy fee indicated in the code is paid through Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923.

For other copying, reprint or republication permission, write to IEEE Copyrights Manager, IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854. All rights reserved.

\*\*\* This is a print representation of what appears in the IEEE Digital Library. Some format issues inherent in the e-media version may also appear in this print version.

 IEEE Catalog Number:
 CFP2457K-POD

 ISBN (Print-On-Demand):
 979-8-3503-9491-7

 ISBN (Online):
 979-8-3503-9490-0

## **Additional Copies of This Publication Are Available From:**

Curran Associates, Inc 57 Morehouse Lane Red Hook, NY 12571 USA Phone: (845) 758-0400

Fax: (845) 758-2633

E-mail: curran@proceedings.com Web: www.proceedings.com



## **Table of Contents**

Stanislav Vechet, Jiri Krejsa, Kuo-Shen Chen:	1
Vertical Stabilization of Bipedal Walking Drone PAVO with Proximal Policy Optimization	1
Vadim Starý, Václav Křivánek:	7
Integrating Mechatronics Principles in Modern Air Defence Systems	
Luca Andrea Mifsud, Thor Scicluna, Kenneth Scerri, Mario Farrugia:	13
Experimental Investigation of Downhill Regenerative Braking of Electric Vehicles from CAN Bus Data	
Luca Andrea Mifsud, Kenneth Scerri, Mario Farrugia:	
Regression Analysis of Factors Affecting Round-Trip Regenerative Braking Efficiency using Real-	19
World Data	
Mario Hirz, Christian Flechl, Nathanael Schachner, Alexander Pommer:	25
Novel Concept for Automated Charging of Professional Electric Vehicle Fleets	
Jean Motsch, Yves Bergeon, Vaclav Krivanek:	30
Optimization of Hyperspectral Image Classification Using Monte Carlo-Based Band Reduction	
Chi Chen, Kuo-Shen Chen, Stanislav Vechet, Yu-Jun Kuo:	20
An Integrated LCD Quality Assessment Flow based on the Integration of Image Processing,	38
Ergonomics, and Machine Learning	
Jan Snajder, Jiri Krejsa: Automation-Driven Dataset Preparation for Continuous Czech Sign Language Recognition	44
Huseyin Fatih Sen, Yavuz Selim Taspinar:	
Body Performance Analysis with Machine Learning and ANOVA Methods	49
Paweł Dymora, Mirosław Mazurek, Maciej Szuberla:	
Implementation of Artificial Intelligence in Internet Search	55
Paweł Dymora, Mirosław Mazurek, Jakub Adamek:	
Applying Artificial Intelligence Methods to Identify Selected Cybersecurity Problems in Computer	61
Networks	01
Ondrej Majercak, Jaroslav Romancik, Marek Vagas:	
IoT Approach Implementation based on Flexible and Robust Node-RED Platform for Workplace	67
Digitisation Increasing	
Akeel Othman, Dušan Maga, Jaromír Hrad:	
Energy-Aware Adaptive QoS Algorithm for IoT	72
Daniel Ferreira, Armando Cordeiro, Luís Rocha, J. Fernando Silva, E. Romero Cadaval, C. Roncero	
Clemente, Daniel Foito, V. Fernão Pires:	78
Seven-Level Transformerless Inverter with a Double Boost Controlled Cell	
Kusuma Priya Krovi, Jan Bauer:	84
Control Strategy of Buck and Boost Converters using MATLAB Software	04
Radek Musil, Radim Farana, Robert Rouš, Šimon Bilík:	89
Fuzzy Controller Tuning Methods for Typical Plant Types	63
Martin Juhas, Bohuslava Juhasova, Igor Halenar, Milan Daňo, Lenka Halenarova, Fedor Burčiar:	
StateFlow as a Tool of the Hybrid X-in-the-Loop Technique in the Model-Based Design Approach to	93
the Control Systems Design in Industrial Automation	
Shreyan Banerjee, Aasifa Rounak, Vikram Pakrashi:	
Adaptive Linear Control of a Cartpole using Minimum Spiking Neurons trained with Prescribed Error	100
Sensitivity	
Denis Benka, Gabriel Gaspar, Veronika Nemlahova, Eduard Nemlaha, Roman Budjac:	109
Proposal of a Remote-Control System for Building Lighting Management	
Daniel Stümke, Simon Peter, Daniel Görges:	114
Ellipse Fitting With a Dual Kalman Filter for an Adaptive Angle Tracking Observer	
Suliman Badour, Martin Novák: Real-Time Vision-Based Fault Detection System for FDM 3D Printing Using Convolutional Neural	119
Networks	119
Robert Rakay, Marek Vagas:	
Usage and Added Value of IO-Link Platform in the Context of Industry 4.0	128
Daniel Klíč, Martin Minarčík, Aleš Polzer, Jiří Tůma, Jiří Marek, Michal Holub:	
Digital Twin for CNC Machine Tools Design	134

Ľubica Miková, Erik Prada, Michal Kelemen, Ivan Virgala:	139
Modelling a Non-Holonomic Mechatronic System based on the Bicycle Chassis Principle Fedor Burčiar, Martin Juhas, Bohuslava Juhasova, Pavel Važan, Igor Halenar, Lenka Halenarova:	
Automated Production Data Integration and Processing via Simulation Based Digital Twin	144
Erika Sujová, Daniela Vysloužilová, Vanessa Prajová, Alžbeta Klimentová:	
Optimization of the Aluminium Waste Sorting Process by Using Simulation Models	148
Muhammad Imran Khan, Badr M. Alshammari:	15/
Modeling & Analysis of Quantum Confinement and Ballistic Transport Phenomena in 3D FinFET	154
David Grasev, Adolf Jílek:	158
A Novel Approach to Modeling of Compressor Characteristics	130
Vojtěch Zůbek, Jakub Hnidka:	163
Simplified 6DoF Flight Model of the Missile	
Denys Zaikin:	160
Comparison of Three-Winding Transformer Model Extraction Using FEMM and COMSOL	169
Multiphysics®	
Matija Hoić, Nenad Kranjčević, Dominik Birt:	179
Design of an Active Seat Suspension based on the Kempe Mechanism	
Jan Bajer, Miroslav Hrstka, Zahra Sharif Khodaei, M.H. Aliabadi, Zdenek Hadas: Geometry Optimization of a Highly Flexible Gradient Metamaterial Structure Using a Differential	186
Evolution Algorithm	100
Vladimir Skrivanek, Ondrej Rubes, Zdenek Hadas:	
Modal Properties Tuning Analysis of Dynamic System with Piezoelectric Components	192
Tomasz Haniszewski, Jerzy Margielewicz, Sławomir Bucki, Damian Gąska:	
The Influence of Approximating the Mechanical Characteristics of a Hyperelastic Vibration Amplifier	197
on its Dynamic Properties	137
Petr Sosna, Zdenek Hadas:	
Power Optimization of Hybrid Energy Harvestering from Mechanical Vibrations Using Piezoelectric	205
and Electromagnetic Mechanisms	
Jerzy Margielewicz, Damian Gąska, Tomasz Haniszewski, Sławomir Bucki:	
Selected Tools for the Analysis of Energy Harvesters Nonlinear Dynamics	210
Joanna Bijak, Grazia Lo Sciuto, Zygmunt Kowalik, Tomasz Trawiński:	
2D Finite Element Modeling and Analysis of Single-Turn Coil Configuration in Magnetic Spring	214
Energy Harvester	
Petar Gljušćić, Marko Perčić, Saša Zelenika:	220
Autonomous Energy Harvesting – based System for Honeybee Hive Monitoring	220
Jeong-Tae Kim, Quoc-Bao Ta, Ngoc-Lan Pham:	
Integrated Monitoring of Stress and Damage using CNN Deep Learning of Electromechanical	226
Impedance Responses of CSA Sensor	
Lukáš Zdražil, Zdeněk Roubal:	231
Electrical Properties Measurement of Building Materials	231
Pavel Krýsl, Martin Jára:	237
Design of Current Measurement Circuit using PCB Rogowski Coils for Resonant Converters	237
Jan Hejda, Patrik Kutilek, Petr Volf, Marek Sokol, Lydie Leova, Jan Tonner, Markéta Hejsková,	
Miroslav Rozloznik, Tommy Sugiarto, Yi-Jia Lin, Kun-Lun Huang, Wei-Chun Hsu:	241
Wearable System for Monitoring the Physical Conditions in Isolated, Confined and Extreme	_ · <b>-</b>
Environments	
Marek Nowakowski:	
Operational Environment Impact on Sensor Capabilities in Special Purpose Unmanned Ground	245
Vehicles	
Juraj Ďuďák, Daniel Gurín, Matúš Nečas:	250
Design of a Device for Automatic Evaluation of the Level of Individual Perception of Sensory Stimuli	
Denis Benka, Gabriel Gaspar, Roman Budjac, Rastislav Elias, Martin Skovajsa:	255
Design and Implementation of the Grouting Process Measurement Device with a Datalogger	
Alena Hajkova, Milos Hammer: Application of Modern Approaches to Solving Diagnostic Tasks in Industry	261
Application of Modelli Applicacies to Solville Diagillistic 1938s III IIIUUSLIV	

Igor Halenar, Bohuslava Juhasova, Martin Juhas, Lenka Halenarova:	268
Design of a Smart Condition Monitoring System of Equipment in the Production Process	200
Andrej Potanko, Adam Jelínek, Tomáš Marek, Aleš Polzer, Libor Žák, Michal Holub:	
Case Study of the Influence of Linearity Uncertainty on the Applicability and Capability of CNC	274
Machine Tools	
Lenka Halenarova, Pavol Tanuska, Bohuslava Juhasova, Martin Juhas, Igor Halenar:	
Design of a Data Collection Layer for Complementary Diagnostic and Condition Monitoring System	283
of a Robotic Workplace	
Thor Scicluna, Mario Farrugia:	
Experimental Investigation of an AdBlue® Injection System and Implementation on a Dual-Fuel	289
(Diesel/LPG) Engine	
Diogo Marciano, Mafalda Seixas, Rita Pereira, Armando Cordeiro, Rui Guerreiro, José G. Lopes,	
V. Fernão Pires, Sónia F. Pinto:	297
Improving Safety Roads with LoRa Communication Devices: Features and Limitations	
Josef Casar, Vilem Hanus, Pavel Rehak:	303
Sensors Combinations as a Key for Effective Air Defence	
Karel Hruska, Lukas Sobotka, Zdenek Frank, Jan Laksar:	310
Optimal Parameters Choice for Synchronous Reluctance Machines	
Patrik Kalaj, Radek Čermák:	318
Iron Loss in Multiphase Machines	
Hikaru Suzuki, Katsuhiro Hirata, Noboru Niguchi:	326
Torque Improvement Method for Flux Modulated Motor by Inserting Magnets between Pole Pieces	
Kaito Hori, Katsuhiro Hirata, Noboru Niguchi:	331
Bearingless Magnetic-Geared Motor Achieving Both Stable Magnetic Levitation and High Torque	
Lukas Sobotka, Aleš Palkovič, Jiří Teichman, Roman Pechánek:	336
Parametric Optimization of the Cooling Ducts of the PMSM	
Jan Laksar, Martin Bělík, Karel Hruska:	342
Additional Losses in the Winding under Higher Frequency Current	٠.ـ
Mikuláš Szabari, Jan Berhold, Jan Vetiška, František Bradáč, Michal Holub, Martin Dix:	349
Case Study of Robot Machining at Different Working Space Locations	3-3
Ondrej Vanicek, Michal Chalus, Jindrich Liska:	355
Coverage Path Planning for Robotic Laser Surfacing Applications Based on 3D Scanning	333
Darina Hroncová, Patrik Šarga, Erik Prada, Ľubica Miková:	
Complete Kinematic Analysis of the Joint Variables of the Robot Mechanism During the End-	361
Effector's Movement Along a Circular Path	
Jui-Chien Tu, Yun-luang Wang, Jia-Chang Wang, Filip Ksica, Zdenek Hadas:	367
Development of Integrated 3D Printing and Automated Embedding System	
Suliman Badour, Martin Novák:	
Kinematic Analysis and Torque Dynamics of a 5-DOF Robotic Manipulator for Enhanced Precision	373
and Fault Detection in FDM 3D Printing	
Ramy ElMallah, Nima Zamani, Chi-Guhn Lee:	_
Human 0, MLLM 1: Unlocking New Layers of Automation in Language-Conditioned Robotics with	381
Multimodal LLMs	
Soňa Michalková, Kryštof Wojnarowský, Šimon Kolenyák, Matěj Kantor, Jakub Arm:	389
Design a Coffee-making Process Unit using Virtual Twin and Virtual Commissioning	