# 2018 14th IEEE/ASME International Conference on Mechatronic and Embedded Systems and Applications (MESA 2018)

Oulu, Finland 2-4 July 2018



IEEE Catalog Number: ISBN: CFP18MES-POD 978-1-5386-4644-1

#### **Copyright © 2018 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:	CFP18MES-POD
ISBN (Print-On-Demand):	978-1-5386-4644-1
ISBN (Online):	978-1-5386-4643-4

#### 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



# 2018 14th IEEE/ASME International Conference on Mechatronic and Embedded Systems and Applications (MESA)

## Artificial Intelligence and Emerging Technologies for Mechatronic and Embedded Systems

Century of manual remote control, automation, autonomy, and self-organization	
Aarne O Mämmelä (VTT, Finland), Jukka Riekki (University of Oulu, Finland)	1
Preventive Maintenance of Motors and Automatic Classification of Defects using Artificial Intelligence	
Ching-Yuan Chang (National Taipei University of Technology, Taiwan), Jyun-You Hong (National Taipei University of Technology, Taiwan), Wei-Chieh Chang (National Taipei University of Technology, Taiwan)	7
A Synergic Photometric Stereo and Super Resolution Approach for Optical Inspection	
Alessandro Galdelli (Università Politecnica delle Marche, Italy), Adriano Mancini (Dipartimento di Ingegneria dell'Informazione, Università Politecnica delle Marche, Italy), Emanuele Frontoni (Università Politecnica delle Marche, Italy), Primo Zingaretti (Università Politecnica delle Marche, Italy)	13
Intelligent Control for Lower Limb Rehabilitation System	
Chin-Sheng Chen (National Taipei University of Technology, Taiwan), Ming-Shium Hsieh (En Chu Kong Hospital, Taiwan), Feng-Chi Lee (Industrial Technology Research Institute, Taiwan), Yu-Hsin Lin (Shuz Tung Machinery Industrial Co., Ltd., Taiwan)	21
Flexible Signals and Images Lossless Compression Chip Design for IoT and Industry 4.0	
Shih-Lun Chen (Chung Yuan Christian University, Taiwan), Tsun-Kuang Chi (Chung Yuan Christian University, Taiwan), Chiung-An Chen (Ming Chi University of Technology, Taiwan), Chi-Hao Liao (Chung Yuan Christian University, Taiwan), Ting-Lan Lin (Chung Yuan Christian University, Taiwan)	24
University, Taiwan)	20

#### Mechatronics and Embedded Systems Applications

Accelerating Viterbi Algorithm using Custom Instruction Approach	
Waqar Ahmad (Concordia University, Canada), Imran Abbasi (National University of Sciences and Technology, Pakistan), Hasan Mahmood (Quaid-i-Azam University, Islamabad, Pakistan)	32
Validation of a Nonlinear Two-dimensional MacPherson Suspension System Model with Multibody Simulations	
Atte Rankinen (University of Oulu, Finland), Enso Ikonen (University of Oulu, Finland), Toni Liedes (University of Oulu, Finland)	39
Shake Table Testing of a Radar-Based Structural Health Monitoring Method	
Alexander Amies (University of Canterbury, New Zealand), Christopher Pretty (University of Canterbury, New Zealand), J. Geoffrey Chase (University of Canterbury, New Zealand), Geoffrey Rodgers (University of Canterbury, New Zealand)	44
Design, Development and Experimental Evaluation of a Vortex Actuation System	
George Andrikopoulos (Luleå University of Technology, Sweden), George Nikolakopoulos (Luleå University of Technology, Sweden)	50
Handling Process Overruns and Underruns on Multiprocessors in a Fault-Tolerant Real-Time Embedded System	
Jia Xu (York University, Canada, Canada)	56

#### Sensors and Actuators #1

Industrial Environment Mapping Using Distributed Static 3D Sensor Nodes	
Atle Aalerud (University of Agder & National Oilwell Varco, Norway), Joacim Dybedal (University of Agder, Norway), Erind Ujkani (University of Agder, Norway), Geir Hovland (University of Agder, Norway)	64
Simulation Analysis and Performance Evaluation of a Vibratory Feeder Actuated by Dielectric Elastomers	
Andrea Bonci (Università Politecnica delle Marche, Italy), Sauro Longhi (Università Politecnica delle Marche, Italy), Massimiliano Pirani (Università Politecnica delle Marche, Italy), Emanuele Lorenzoni (Università Politecnica delle Marche, Italy), Gianluca Rizzello (Saarland University, Germany), David Naso (Polytechnic University of Bari, Italy), Stefan Seelecke (Saarland University, Saarbrücken, Italy)	
2-DOF in-Plane Displacement Measurement by Wollaston Prism-based Interferometer	
Hung-Lin Hsieh (National Taiwan University of Science and Technology, Taiwan), Bo-Yen Sun (National Taiwan University of Science and Technology, Taiwan), Gang-Yu Fan (National Taiwan University of Science and Technology, Taiwan), JuYi Lee (National Central University,	
Taiwan)	76
RMAS: Relational Multiagent System for CPS Prototyping and Programming	
Andrea Bonci (Università Politecnica delle Marche, Italy), Massimiliano Pirani (Università Politecnica delle Marche, Italy), Carlo Bianconi (Università Politecnica delle Marche, Italy), Sauro Longhi (Università Politecnica delle Marche, Italy)	80
Filtering Scheme for Context-Aware Fog Computing in Cyber-Physical Systems	
Teemu Mononen (Tampere University of Technology, Finland), Mohammad M. Aref (Tampere University of Technology, Finland), Jouni	0(
Mattila (Tampere University of Technology, Finland)	86

## Diagnosis and Monitoring in Mechatronic Systems

Sensor-embedded Linear Ball Bearing for Linear Guide Way Pre-load and Straightness Monitoring

Chih-Chun Cheng (National Chung Cheng University & Advanced Institute of Manufacturing with High-tech Innovations, Taiwan), Wen-Nan Cheng (National Chung Cheng University, Taiwan), Mun-Jane Liao (National Chung Cheng University, Taiwan), Cheng-Kuo Sung (National Tsing Hua University, Taiwan) 93

 Fault Detection, Diagnosis and Fault Tolerant Output Control for a Remotely Operated Vehicle

Alessandro Baldini (Universita' Politecnica delle Marche, Italy), Antonio Fasano (University of Rome "La Sapienza" & University of Rome	
"Campus Bio-Medico", Italy), Riccardo Felicetti (Università Politecnica delle Marche, Italy), Alessandro Freddi (Università Politecnica delle	
Marche, Italy), Sauro Longhi (Università Politecnica delle Marche, Italy), Andrea Monteriù (Università Politecnica delle Marche, Italy)	104
Kinematic Fault Tolerant Control of a Dual-Arm Robotic System Under Torque Faults	
Alessandro Freddi (Università Politecnica delle Marche, Italy), Sauro Longhi (Università Politecnica delle Marche, Italy), Andrea Monteriù	
(Università Politecnica delle Marche, Italy), Davide Ortenzi (Università di Bologna, Italy), Daniele Proietti Pagnotta (Universita' Politecnica	
delle Marche, Italy)	111

# Mechatronics and Industry 4.0

How End Effector Absolute Accuracy Plays A Role in Industry 4.0 Po Ting Lin (National Taiwan University of Science and Technology, Taiwan), Po-Chun Juan (Chung Yuan Christian University, Taiwan), Shu-Ping Lin (National Taiwan University of Science and Technology, Taiwan), Wei-Hao Lu (National Taiwan University of Science and Technology, Taiwan), Zai-Gen Wu (National Taiwan University of Science and Technology, Taiwan) Design of an intelligent module for hydrostatic bearing	117
ChoYu Yang (National Tsin Hua University, Taiwan), YiFeng Chang (National Tsing Hua University, Taiwan), ChinWen Cheng (National Tsing Hua University, Taiwan), Cheng-Kuo Sung (National Tsing Hua University, Taiwan)	123
Role-based visualization of industrial IoT-based systems	
Mehdi Mahmoodpour (Tampere University of Technology, Finland), Andrei Lobov (Tampere University of Technology, Finland), Minna Lanz (Tampere University of Technology, Finland), Petteri Mäkelä (Seinäjoki University of Applied Sciences, Finland), Niko Rudnas (Seinäjoki University of Applied Sciences, Finland)	127
Machine Learning approach for Predictive Maintenance in Industry 4.0	
Marina Paolanti (Università Politecnica delle Marche, Italy), Luca Romeo (Universita' Politecnica delle Marche, Italy), Andrea Felicetti (Università Politecnica delle Marche, Italy), Jelena Loncarski (Uppsala University, Italy), Adriano Mancini (Università Politecnica delle Marche, Italy), Emanuele Frontoni (Università Politecnica delle Marche, Italy)	135

#### Robotics and Mobile Machines #1

Performance Analysis of a High-Speed Redundant Robot	
Massimo Callegari (Polytechnic University of Marche, Italy), Giacomo Palmieri (Polytechnic University of Marche, Italy), Matteo Palpacelli (Polytechnic University of Marche, Italy), Roberto Bussola (University of Brescia, Italy), Giovanni Legnani (University of Brescia, Italy)	141
Robot skills - modeling and control aspects	
Tapio Heikkilä (Technical Research Centre of Finland, Finland), Jari Ahola (VTT Technical Research Centre of Finland, Finland)	147
Spline-based energy-optimal trajectory planning for functionally redundant robots	
Paolo Boscariol (Università degli Studi di Padova, Italy), Dario Richiedei (Università degli Studi di Padova, Italy)	153
Inertial Sensor-Based State Estimation of Flexible Links Subject to Bending and Torsion	
Petri Mäkinen (Tampere University of Technology, Finland), Teemu Mononen (Tampere University of Technology, Finland), Jouni Mattila (Tampere University of Technology, Finland)	159

#### Mechatronic and Embedded Technologies in Intelligent Transportation Systems

Study of Optimization of Air Route Networks and Locations of Crossing Waypoints for SEA	
Zhao-Wei Zhong (Nanyang Technological University, Singapore), Jian-Hui Richard Yee (Nanyang Technological University, Singapore)	167
On the Traction control of Single-Track Vehicles in different trim conditions	
Andrea Bonci (Università Politecnica delle Marche, Italy), Riccardo De Amicis (Università Politecnica delle Marche, Italy), Sauro Longhi (Università Politecnica delle Marche, Italy), Emanuele Lorenzoni (Università Politecnica delle Marche, Italy)	173
A Smooth Traction Control Design for Two-Wheeled electric vehicles	
Andrea Bonci (Università Politecnica delle Marche, Italy), Riccardo De Amicis (Università Politecnica delle Marche, Italy), Sauro Longhi .(Università Politecnica delle Marche, Italy), Emanuele Lorenzoni (Università Politecnica delle Marche, Italy)	179

## Micro-/Nano-Manipulation Technologies and Applications

Robust tracking control of an XY compliant nanomanipulator with variable loads	
Xiaodong Yang (Tsinghua University, P.R. China), Zhen Zhang (Tsinghua University, P.R. China), Yiingchun Guan (Beihang University, P.R.	
China)	. 185
Smith Predictor Based H $\infty$ Control for Piezoelectric Nano Stages with Time Delays	
Zhiming Zhang (Shandong University, P.R. China), Peng Yan (Shandong University, P.R. China)	. 191
Improved particle swarm optimization for fast block matching with application to motion estimation in micro/nano systems	
Gaozhao Su (Shandong University, P.R. China), Guoliang LU (Shandong University, P.R. China), Peng Yan (Shandong University, P.R.	
China)	. 196

# Bio-Mechatronics - Medical Devices & Technologies

Biomechanical Design and Control of Lower Limb Exoskeleton for Sit-to-Stand and Stand-to-Sit Movements Muhammad Umer Khan (Atilim University, Ankara, Turkey, Turkey), Muhammad Hamza Qureshi (Air University, Pakistan), Zeeshan Masood (Air University, Pakistan), Linta Rehman (Air University, Pakistan), Muhammad Owais (Air University, Pakistan) 202

A Robust Method of Peak Detection in Noisy PPG Signals Using a Structure of IIR Filters	
Jake Campbell (University of Canterbury, New Zealand), Christopher Pretty (University of Canterbury, New Zealand), J. Geoffrey Chase (University of Canterbury, New Zealand), Phil Bones (University of Canterbury, New Zealand)	208
Crosstalk Reduction in Forearm Electromyography During Static Gripping	
Ben Fortune (University of Canterbury, New Zealand), Lachlan McKenzie (University of Canterbury, New Zealand), Logan Chatfield (University of Canterbury, New Zealand), Christopher Pretty (University of Canterbury, New Zealand)	214
Machine learning-based approaches to analyse and improve the diagnosis of endothelial dysfunction	
Chiara Calamanti (Università Politecnica delle Marche, Italy), Marina Paolanti (Università Politecnica delle Marche, Italy), Luca Romeo (Universita' Politecnica delle Marche, Italy), Michele Bernardini (Università Politecnica delle Marchei, Italy), Emanuele Frontoni (Università Politecnica delle Marche, Italy)	220

#### Mechatronic Control and Electrical Vehicular Systems #1

Questions regarding vehicle safety and the mathematical analysis of safety in large scale networks using positive dynamic s probability theory methods	systems and
Ferenc Szauter (Research Center of Vehicle Industy, Hungary)	
Recent Advance of Hybrid Energy Storage Systems for Electrified Vehicles	
Jiajun Liu (University of Victoria, Canada), Zuomin Dong (University of Victoria, Canada), Tianxu Jin (University of Science and Beijing, P.R. China), Li Liu (School of Mechanical Engineering, University of Science & Technology Beijing, P.R. China)	
Modeling and Simulation of Hybrid Electric Ships with AC Power Bus - A Case Study	
Hongbo Zhu (University of Victoria, Canada), Zuomin Dong (University of Victoria, Canada)	
Error analysis of numerical Weyl fractional derivatives in the case of certain Hölder continuous functions	
Juhani Nissilä (University of Oulu, Finland)	

#### Robotics and Mobile Machines #2

Experimental Setup for the Validation of the Bio-Inspired Thruster of an Ostraciiform Swimming Robot Daniele Costa (Università Politecnica delle Marche, Italy), Maurizio Brocchini (Polytechnic University of Marche, Italy), Massimo Callegari	
(Polytechnic University of Marche, Italy), Gianluca Zitti (Polytechnic University of Marche, Italy), Gianluca Zitti (Polytechnic University of Marche, Italy), Gianluca Zitti (Polytechnic University of Marche, Italy)	255
Visual Marker Guided Point Cloud Registration in a Large Multi-Sensor Industrial Robot Cell	
Erind Ujkani (University of Agder, Norway), Joacim Dybedal (University of Agder, Norway), Atle Aalerud (University of Agder & National Oilwell Varco, Norway), Knut Kaldestad (University of Agder, Norway), Geir Hovland (University of Agder, Norway)	261
Functional Design of Elloboat, a Tracked Vehicle for Launching and Beaching of Watercrafts and Small Boats	
Giovanni Otonello (Ellotech Srl, Italy), Giovanni Berselli (University of Genova, Italy), Luca Bruzzone (University of Genoa, Italy), Pietro Fanghella (University of Genoa, Italy)	267
Scalability of GPU-Processed 3D Distance Maps for Industrial Environments	
Atle Aalerud (University of Agder & National Oilwell Varco, Norway), Joacim Dybedal (University of Agder, Norway), Geir Hovland (University of Agder, Norway)	275

#### Mechatronic Control and Electrical Vehicular Systems #2

Control design of an electro-pneumatic gearbox actuator	
Adam Szabo (Budapest University of Technology and Economics, Hungary), Tamás Bécsi (Budapest University of Technology and Economics, Hungary), Péter Gáspár (Computer and Automation Research Institute of Hungarian Academy of Sciences, Hungary), Szilárd Aradi (Budapest University of Technology and Economics, Hungary)	280
Optimal Map-Based Mode Selection and Powertrain Control for a Multi-Mode Plug-in Hybrid Electric Vehicle	
Huanqing Wang (Michigan Technological University, USA), Kovid Sacheva (Michigan Technological University, USA), Joe Tripp (Michigan Technological University, USA), Darrell Robinette (Michigan Technological University, USA), Mahdi Shahbakhti (Michigan Technological University, USA), Mahdi Shahbakhti (Michigan Technological University, USA)	286
Research of vehicle parameter and sensor systems necessary to control autonomous vehicles	
Gabor Szakállas (Szechenyi Istvan University, Hungary)	292
Lateral control approach of powered parafoils combining wind feedforward compensation with active disturbance rejection control	
Shuzhen Luo (Nankai University, P.R. China), Qinglin Sun (Nankai University, P.R. China), Mingwei Sun (Nankai University, P.R. China), Hao Sun (Nankai University, P.R. China), Wannan Wu (Nankai University, P.R. China), Zeng-Qiang Chen (Nankai University, P.R. China) <i>A research on the state identification and control method based on extended state observer</i>	300
Zhenyan Wei (Beihang University & Beijing Aerospace Techonology Institute, P.R. China)	306

#### Robotics and Mobile Machines #3

Mobile Robotic Spatial Odometry by Low-Cost IMUs	
Xiaolong Zhang (Tampere University of Technology, Finland), Teemu Mononen (Tampere University of Technology, Finland), Mohammad M. Aref (Tampere University of Technology, Finland), Jouni Mattila (Tampere University of Technology, Finland)	311
Real-time and Robust Collaborative Robot Motion Control with Microsoft Kinect v2	
Burak Teke (Istanbul Technical University, Turkey), Minna Lanz (Tampere University of Technology, Finland), Joni Kämäräinen (Tampere University of Technology, Finland), Joni Kämäräinen (Tampere University of Technology, Finland)	317
Wearable Device to Record Hand Motions based on EMG and Visual Information	
Gustavo Garcia Ricardez (Nara Institute of Science and Technology, Japan), Atsushi Ito (Nara Institute of Science and Technology, Japan), Masahiro Yoshikawa (Osaka Institute of Technology, Japan), Ming Ding (Nara Institute of Science and Technology, Japan), Jun Takamatsu (Nara Institute of Science and Technology, Japan), Yoshio Matsumoto (National Institute of Advanced Industrial Science and Technology,	

323

Japan), Tsukasa Ogasawara (Nara Institute of Science and Technology, Japan)

Mobile Robotic Platforms to Support Smart Farming Efforts at UMES	
Abhijit Nagchaudhuri (University of Maryland Eastern Shore & Engineering and Aviation Complex, USA), Madhumi Mitra (University of Maryland Eastern Shore (Usiversity of Maryland Eastern	
Maryland Eastern Shore, USA), Christopher Hartman (University of Maryland Eastern Shore, USA), Travis Ford (University of Maryland	329
Eastern Shore, USA), Jesuraj Pandya (University of Maryland Eastern Shore, USA)	329
Scalable Autonomous Agronomical Smartbot	
Achala C. Athukorala (University of Moratuwa, Sri Lanka), Nipuna Ranasinghe (University of Moratuwa, Sri Lanka), Kosala Herath (University of Moratuwa, Sri Lanka), Peshala Jayasekara (University of Moratuwa, Sri Lanka), Thilina Lalitharatne (University of Moratuwa,	
Sri Lanka)	. 336
nsors and Actuators #2	

# Sensors and Actuators #2

Effects of DAC interpolation on the dynamics of a high speed linear actuator Francesco Aggogeri (Universita degli Studi di Brescia, Italy), Alberto Borboni (Universita degli Studi di Brescia, Italy), Mario Terzo (University of Naples Federico II, Italy), Salvatore Strano (University of Naples Federico II, Italy)	342
Nonlinear Model Based Control of MEMS Micro-Mirror	
Yonghong Tan (Shanghai Normal University, P.R. China), Ruili Dong (Donghua University, P.R. China)	
Low-Power Wake-Up System based on Frequency Analysis for Environmental Internet of Things	
Manon Fourniol (Aix Marseille Université & IM2NP, France), Valentin Gies (Universite de Toulon & IM2NP, France), Valentin Barchasz (SMIOT & Universite de Toulon, France), Edith Kussener (IM2NP/ISEN Toulon, France), Herve Barthelemy (Ecole Polytechnique Universitaire de Marseille, France), Remy Vauche (Aix-Marseille University, IM2NP, France), Hervé Glotin (Université du Sud Toulon-V	/ar /
Universitie de Marsene, marce), kenny vadere (Ax-Marsene Oniversity, Mazwi, marce), nerve Gottin (Oniversite du Sud Fodioriv	
Multi-Robot Coordination Through Mobile Agent	
Binsen Qian (University of California, Davis, USA), Harry Cheng (University of California, Davis, USA)	
An IoT Solution for Energy Management at Building and District Level	
Marco Arnesano (Università Politecnica delle Marche, Italy), Jack Dyson (Università Politecnica delle Marche, Italy), Marco Fagiani (Università Politecnica delle Marche, Italy), Adriano Mancini (Dipartimento di Ingegneria dell'Informazione, Università Politecnica delle Marche, Italy), Gian Marco Revel (Università Politecnica delle Marche, Italy), Marco Severini (Università Politecnica delle Marche, Italy) Stefano Squartini (Università Politecnica delle Marche, Italy), Lorenzo Zampetti (Università Politecnica delle Marche, Italy), Primo	
Zingaretti (Università Politecnica delle Marche, Italy)	