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**Recent Researches in  
Mechanical and Transportation  
Systems**



*Proceedings of the 6<sup>th</sup> International Conference on  
Theoretical and Applied Mechanics (TAM '15)*



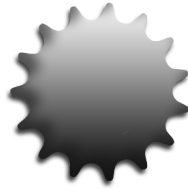
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*Salerno, Italy, June 27-29, 2015*

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# Table of Contents

<b><u>Plenary Lecture 1: Discipline of Driving Simulation – History, Theory and Use for HMI Research and Training Purposes</u></b>	11
<i>Petr Bouchner</i>	
<b><u>GNSS Positioning Availability Control for Transportation Applications</u></b>	13
<i>Demyanov V., Likhota R.</i>	
<b><u>Development of a Method for Analysing the Road Safety Conditions Related to Friction</u></b>	17
<i>Pasquale Colonna, Antonio Perruccio, Nicola Berloco, Paolo Intini, Vittorio Ranieri</i>	
<b><u>Driver’s Visual Attention Influenced by Static and Dynamic Roadside Billboards – Driving Simulator Study</u></b>	27
<i>Petr Bouchner, David Nádeník, Jan Válek, Stanislav Novotný, Jana Kadlecová</i>	
<b><u>Preliminary Results on Different Perspectives in Managing Rail Disruptions</u></b>	32
<i>Luca D’Acierno, Antonio Placido, Marilisa Botte, Bruno Montella</i>	
<b><u>Less is More: The Reduction of Beam Section for the Seismic Behaviour Improvement of Existing Steel MRFs</u></b>	38
<i>Rosario Montuori</i>	
<b><u>Experimental Measuring of Bed Shear Stress in Free Surface Flows</u></b>	48
<i>Giacomo Viccione, Marco Genovese, Fabio Rossi, Tony L. L. Lenza, Domenico Guida</i>	
<b><u>Instability in Disk Brake Systems</u></b>	54
<i>Marco C. De Simone, Alessandro Ruggiero, Domenico Guida, Zandra B. R. Chavez</i>	
<b><u>Analysis of Acoustic Emissions from Cement Beams when Applying Three-Point Bending with Different Loading Rates.</u></b>	57
<i>A. Kyriazopoulos, I. Stavrakas, C. Anastasiadis, D. Triantis</i>	
<b><u>Public Transportation Energy Consumption Prediction by Means of Neural Network and Time Series Analysis Approaches</u></b>	64
<i>Claudio Guarnaccia, Joseph Quartieri, Carmine Tepedino, Svetoslav Iliev, Silviya Popova</i>	
<b><u>Fuel Consumption Evaluation for the Testing of Advanced Driving Assistance Systems: First Issues and Solutions</u></b>	71
<i>Gennaro Nicola Bifulco, Francesco Galante, Luigi Pariota, Maria Russo Spina</i>	
<b><u>Problems of Driver Faults Projections on his/her Brain Signals</u></b>	78
<i>Mirko Novák, Josef Faber, Petr Bouchner, Stanislav Novotný</i>	
<b><u>Risk Impact Analysis of Traffic Volume and Heavy Goods Vehicles in a Bi-Directional Road Tunnel</u></b>	83
<i>Ciro Caliendo, Maria Luisa De Guglielmo</i>	
<b><u>MSA Algorithms for Solving the Combined Assignment-Control Problem</u></b>	90
<i>Mariano Gallo, Luca D’Acierno, Bruno Montella</i>	



<b><u>Driving Simulation for HMI Research and Training</u></b>	97
<i>Petr Bouchner</i>	
<b><u>The Tribological Effect of Glass Particles Waste Reinforcement within Epoxy Resin</u></b>	106
<i>Alessandro Ruggiero, Vincenzo D'Agostino, Massimiliano Merola, Petr Valasek, Karolina Dedicova</i>	
<b><u>Influence of Aerodynamics on Quadrotor Dynamics</u></b>	111
<i>Marco C. De Simone, Serena Russo, Alessandro Ruggiero</i>	
<b><u>Dry Friction Influence on the Response of a Mechanical System with two DOFs</u></b>	119
<i>Marco C. De Simone, Alessandro Ruggiero, Domenico Guida, Zandra B. R. Chavez</i>	
<b><u>Concept of Effective Stress and Shear Strength Interaction in Rotational Multiple Yield Surface Framework And Volume Change Behaviour of Banting Clay</u></b>	123
<i>Mohd Jamaludin Md Noor, W. F. Anderson</i>	
<b><u>Robust Simulation Model Approach to Evaluate Innovative Asymmetry Monitoring and Control Techniques in Critical Flap Failure and Aircraft Controllability</u></b>	133
<i>Dario Belmonte, Matteo D. L. Dalla Vedova, Paolo Maggiore</i>	
<b><u>Innovative Blade Design for Wind Generator Application</u></b>	143
<i>Sirigu G., Cassaro M., Battipede M., Gili P., Frulla G.</i>	
<b><u>Effects of Mechanical Backlash on Linear Electromechanical Actuators: A Fault Identification Method based on the Simulated Annealing Algorithm</u></b>	151
<i>M. D. L. Dalla Vedova, P. Maggiore, L. Pace</i>	
<b><u>The Theorem on Plastic Mechanism Control and its Applications</u></b>	157
<i>Vincenzo Piluso</i>	
<b><u>Railway Vehicle Modelling on an Isolated Track Defect of a Cosine Form</u></b>	167
<i>Konstantinos Giannakos</i>	
<b><u>System Dynamics Modelling for Electric and Hybrid Commercial Vehicles Adoption</u></b>	171
<i>Anna Corinna Cagliano, Antonio Carlin, Giulio Mangano, Giovanni Zenezini</i>	
<b><u>Proton Exchange Membrane Fuel Cell Performance Estimate through a Multidisciplinary Design Optimization Approach</u></b>	181
<i>Enrico Testa, Paolo Maggiore, Lorenzo Pace, Matteo D. L. Dalla Vedova</i>	
<b><u>Assessment of Non-Linear Static Analysis of Irregular Bridges</u></b>	187
<i>M. Jara, J. O. Navarro, J. M. Jara, B. A. Olmos</i>	
<b><u>Assessment of Masonry Arch Bridges Using FEM and Elasto-Plastic Model</u></b>	193
<i>Lucio Nobile, Veronica Bartolomeo</i>	
<b><u>An Hybrid FE/SEA Approach for Engine Cover Noise Assessment</u></b>	199
<i>D. Siano, M. Viscardi, R. Aiello</i>	

<b><u>Structural Dynamic Characterization of a Plate Type Element Oriented at Active Control Implementation</u></b>	206
<i>Massimo Viscardi, Romeo Di Leo</i>	
<b><u>Preliminary Studies on Criticalities and Opportunities for Virtual Testing of Driving Automation</u></b>	213
<i>Maria Russo Spena, Francesco Timpone, Flavio Farroni</i>	
<b><u>Capacity and Demand of Retrofitted Bridges with RC Jacketing</u></b>	220
<i>Conejo W. M., Jara J. M., Olmos B. A., Jara M.</i>	
<b><u>Experimental Analysis and Modeling of Transmission Torsional Vibrations</u></b>	227
<i>Enrico Galvagno, Guido Ricardo Guercioni, Mauro Velardocchia</i>	
<b><u>Network Signal Setting Design (NSSD). Literature Review and Research Perspectives</u></b>	234
<i>Silvio Memoli</i>	
<b><u>Environmental and Energy Implications of Electric and Plug-in Hybrid Electric Vehicles: An Application to a Real Case Study</u></b>	244
<i>Armando Carteni</i>	
<b><u>HIC Evaluation in Teenage Cyclist – SUV Accident</u></b>	252
<i>Filippo Carollo, Gabriele Virzi' Mariotti, Vincenzo Naso</i>	
<b><u>Advance Trends of Hybrid Electric Vehicles</u></b>	260
<i>Shahram Javadi, Mojgan Bashiri, Ahmad Reza Sajjadi</i>	
<b><u>The Use of Regression Trees in the Interpretation of Speed Data Belonging to an On-Road Experiment</u></b>	268
<i>Pasquale Colonna, Paolo Intini, Nicola Berloco, Filomena Mauriello, Antonio Perruccio, Vittorio Ranieri</i>	
<b><u>Spectral Properties of Orchestral Instruments Measured in the Concert Hall of a Public School</u></b>	278
<i>Alessandro Ruggiero, Marco C. De Simone, Domenico Russo, Domenico Guida</i>	
<b><u>On the Control of the Trajectory of M-Block</u></b>	282
<i>Ivanov A. P.</i>	
<b><u>Spherical Foundation Structural Seismic Isolation System: Development of the New Type Earthquake Resistant Structures</u></b>	287
<i>Azer A. Kasimzade, Eizaburo Tachibana, Yoichi Mukai, Sertac Tuhta, Gencay Atmaca</i>	
<b><u>PMV Index for Human Thermal Comfort: Data Uncertainty and Numerical Models</u></b>	293
<i>Andrea Manuello Bertetto, Luigi Antonio Besalduch, Edmondo Minisci, Martin Kubicek, Roberto Ricciu</i>	
<b><u>Study and Control of Unsteady Flow in the Turbocharger of Diesel Engines</u></b>	300
<i>Ahmed S. A. Hassan, Ali S. Z. Al-Shahrani</i>	

<b><u>Oscillatory and Nonoscillatory Criteria for Solutions of Second Order Linear Differential Functional Equations</u></b>	310
<i>Gevorg Grigorian</i>	
<b><u>On the Evaluation of Commercial FEA Software for Acoustic Performance of Complex System</u></b>	316
<i>Siano D., Aiello R., D'Agostino D.</i>	
<b><u>Authors Index</u></b>	324

## Plenary Lecture 1

### Discipline of Driving Simulation – History, Theory and Use for HMI Research and Training Purposes



#### Associate Professor Petr Bouchner

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**Abstract:** Interactive simulators are well known within the field of operators training for several decades of years. These were originally used as a substitute for extremely expensive devices – like airplanes, space vehicles, ships or army equipment. With their technological development and parallel cost decrease, they become more and more utilized for general training purposes, even for common car drivers. In recent 10 to 20 years we can recognize their massive entrance into the field of research, as their quality and capability of immersions have become sufficient for these tasks and contemporary they are available for reasonable price.

Problems of reliability and safety of interaction between the human operator (driver) and him/her controlled artificial system (machine, vehicle) are the crucial research tasks within the scope of safety in transport. A failure is often caused either by a bad design of the system or an insufficient or unsuitable training of the human operators. Since the only communication between the operator and artificial systems is realized via the interfaces, just the field of interfaces is the topic of our contemporary research performed in our laboratories.

The lecture introduces problems of the Human-Machine Interaction (HMI) research field as well as problems of user interfaces in systemic point of view. These will be discussed in general, seamlessly moving towards the field of driver-vehicle interaction reliability and safety. The objective approaches and measures to investigate in the reliability of operator-machine interaction are discussed as well as mathematical modeling tools. Beside those general approaches, the lecture introduces in more detail our main research focus - ergonomics and human factors in vehicle control. The presentation shows and explains main principles of the research tools – the advanced interactive ground vehicle simulators, which are continuously being developed by the Driving Simulation Research Group at Czech Tech Univ. It encompasses passenger cars, two-wheelers, trucks and/or rail engines. This field of R&D deals with simulation technology but also scenario and experiment design and mainly measurement tools and methods, which are fitted for particular experiment types. Indisputable role in this area is played by measuring devices, especially those which work with so called psychophysiological measures. The data measured during the experiments are usually hard to be interpreted in a straightforward way, mainly those which have biological nature - therefore also some advanced analytical and classification tools are discussed.

At the end of the presentation most recent and/or most valuable results and conclusions, which presents outputs of almost 15 years research effort in this area, will be shown. The lecture is accompanied with vivid videos.

**Brief Biography of the Speaker:** Academic career: 2003 - Master Degree at CTU Prague (Faculty of Electro-engineering), specialization in computer engineering, 2007 - Doctoral Degree at CTU Prague (Faculty of Transportation Sciences) “Driving simulators for HIM research”, 2011 degree of associate prof. (doc.) at CTU Prague. Since 2003 researcher and university teacher, since 2007 Head of Driving Simulation Research Group, since 2008 deputy head of Laboratory of Systems Reliability of FTS, CTU and Institute of Informatics of Academy of Sciences of Czech Republic, since 2011 head of Department of Vehicles at FTS CTU in Prague, since 2013 member of the faculty Scientific Board.

Scientific activities: research activities in interactive and driving simulator construction and development, HMI in vehicles, human factors in transportation, measurements and analysis of complex data, implementation of virtual reality tools into the experiments, design of experiments and their analysis, member of editorial board of scientific journal Neural Network World and scientific journal Advances in Transportation Studies. Since 2002 wrote several tens of papers, chapters in journals, book chapters, research report with topics on interactive simulators, human factors in transportation, ergonomics, driver's attention and fatigue, worked in expert groups of PIARC and European Committee, member of Czech National Committee for Norms, member of Czech Board for Cosmic Technologies. Main solver (responsible) of several national scientific and applied research projects (grants).