

# **4th IFAC Workshop on Engine and Powertrain Control, Simulation and Modeling (E-COSM 2015)**

IFAC PapersOnline Volume 48, Issue 15

Columbus, Ohio, USA  
23-26 August 2015

**Editor:**

**Simona Onori**

ISBN: 978-1-5108-1824-8

**Printed from e-media with permission by:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571



**Some format issues inherent in the e-media version may also appear in this print version.**

Copyright© (2015) by Elsevier Limited  
All rights reserved.

Printed by Curran Associates, Inc. (2016)

For permission requests, please contact the publisher, Elsevier Limited  
at the address below.

Elsevier Limited  
360 Park Ave South  
New York, NY 10010

**Additional copies of this publication are available from:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571 USA  
Phone: 845-758-0400  
Fax: 845-758-2634  
Email: [curran@proceedings.com](mailto:curran@proceedings.com)  
Web: [www.proceedings.com](http://www.proceedings.com)

# TABLE OF CONTENTS

<b>Not Just for Fuel Economy: A Systematic Design and Exhaustive Search for Hybrid Multimode Light Trucks</b> .....	1
<i>Xiaowu Zhang, Huei Peng, Jing Sun</i>	
<b>Power-Split Hybrid Electric Powertrain Design with Two Planetary Gearsets for Light-Duty Truck Applications</b> .....	8
<i>Oguz H. Dagci, Huei Peng, Jessy W. Grizzle</i>	
<b>Optimal Sizing of a Series PHEV: Comparison between Convex Optimization and Particle Swarm Optimization</b> .....	16
<i>Mitra Pourabdollah, Emilia Silvas, Nikolce Murgovski, Maarten Steinbuch, Bo Egardt</i>	
<b>Downsizing Possibilities of the Range Extender on a Range Extender Vehicle Using Predictive Information</b> .....	23
<i>Victor Judez, Jonas Sjöberg</i>	
<b>A Second Generation Heat Transfer Simulator for Single-Cylinder Engines to Replicate Multi-Cylinder Engine Dynamics</b> .....	30
<i>First Travis C. Malouf, Second Michel Bauer, Third John J. Moskwa</i>	
<b>Air System Modeling of Light-duty Diesel Engines with Dual-loop EGR and VGT Systems</b> .....	38
<i>Kyunghan Min, Donghyuk Jung, Myoungcho Sunwoo</i>	
<b>Characterization of Exhaust Gas Recirculation for Diesel Low Temperature Combustion</b> .....	45
<i>Prasad Divekar, Qingyuan Tan, Xiang Chen, Ming Zheng</i>	
<b>A Diesel Engine Model Including Exhaust Flap, Intake Throttle, LP-EGR and VGT. Part I: System Modeling</b> .....	52
<i>Johannes Reb, Christoph Stürzebecher, Christian Bohn, Frank Märzke, Robert Frase</i>	
<b>A Diesel Engine Model Including Exhaust Flap, Intake Throttle, LP-EGR and VGT. Part II: Identification and Validation</b> .....	60
<i>Christoph Stürzebecher, Johannes Reb, Christian Bohn, Frank Märzke, Robert Frase</i>	
<b>Model and Discretization Impact on Oscillatory Optimal Control for a Diesel-electric Powertrain</b> .....	66
<i>Martin Sivertsson, Lars Eriksson</i>	
<b>An Equivalent Consumption Minimisation Strategy based on 1-Step Look-Ahead Stochastic Dynamic Programming</b> .....	72
<i>M. Fleuren, T. C. J. Romijn, M. C. F. Donkers</i>	
<b>Adaptive ECMS: A Causal Set-theoretic Method for Equivalence Factor Estimation</b> .....	78
<i>H. Chen, J. T. B. A. Kessels, S. Weiland</i>	
<b>An Optimal Energy Management System for Battery Electric Vehicles</b> .....	86
<i>B. Sakhdari, N. L. Azad</i>	
<b>Evaluation of CO<sub>2</sub> reduction in SI engines with Electric Turbo-Compound by Dynamic Powertrain Modelling</b> .....	93
<i>Ivan Arsie, Andrea Cricchio, Cesare Pianese, Vincenzo Ricciardi, Matteo De Cesare</i>	
<b>Powertrain Sizing of Electrically Supercharged Internal Combustion Engine Vehicles</b> .....	101
<i>Nikolce Murgovski, Sava Marinkov, Daniël Hilgersom, Bram De Jager, Maarten Steinbuch, Jonas Sjöberg</i>	
<b>Gain Scheduled Controller of EGR and VGT Systems with a Model-Based Gain Scheduling Strategy for Diesel Engines</b> .....	109
<i>Seungwoo Hong, Inseok Park, Jaesung Chung, Myoungcho Sunwoo</i>	
<b>Real-time Control of a Two-stage Serial VGT Diesel Engine Using MPC</b> .....	117
<i>Paul Dickinson, Keith Glover, Nick Collings, Yukio Yamashita, Yusuke Yashiro, Toru Hoshi</i>	
<b>Two-Stage Turbocharged Gasoline Engines: Experimental Validation of Model-based Control</b> .....	124
<i>Thivaharan Albin, Dennis Ritter, Norman Liberda, Stefan Pischinger, Dirk Abel</i>	
<b>The Pennsylvania State University's Advanced Vehicle Team: EcoCAR3 Year One Final Technical Report</b> .....	132
<i>Hugo H. McMenamin, Ryan Morris, Mohamed Wahba, Anthony Palacin, Gary Neal</i>	
<b>Vehicle Plant Model and Supervisory Control Development for a Parallel Pre-Trans Plug-In Hybrid Electric Vehicle</b> .....	139
<i>Sushil Kumar, Matthew West, Joshua Conter, Megan Cawley, Rashad Maady, Abdel Mayyas</i>	
<b>EcoCAR 3: Architecture Selection Validation through Vehicle Modeling and Simulation for the Colorado State University Vehicle Innovation Team</b> .....	147
<i>Clinton Knackstedt, Eric Jambor, Thomas Bradley</i>	
<b>Combustion Phase Control of SI Gasoline Engines Using Hypothesis Test</b> .....	153
<i>Jinwu Gao, Yuhu Wu, Tielong Shen</i>	

<b>On Beneficial Mode Switch Decisions based on Short-term Engine Load Prediction</b> .....	159
<i>Sandro P. Nüesch, Jeff Sterniak, Li Jiang, Anna G. Stefanopoulou</i>	
<b>Closed Loop Knock Intensity Characteristics of a Classical Knock Control System</b> .....	167
<i>James C. Peyton Jones, Jesse Frey</i>	
<b>Dual-loop Control of Free Piston Engine Generator</b> .....	174
<i>Xun Gong, Kevin Zaseck, Ilya Kolmanovsky, Hong Chen</i>	
<b>Cylinder Pressure-based Combustion Control with Multi-pulse Fuel Injection</b> .....	181
<i>Xi Luo, Shuli Wang, Bram De Jager, Frank Willems</i>	
<b>Implementation of a Novel Hydraulic Hybrid Powertrain in a Sports Utility Vehicle</b> .....	187
<i>Michael Sprengel, Tyler Bleazard, Hiral Haria, Monika Ivantysynova</i>	
<b>Simulation Framework for the Optimization of HEV Design Parameters: Incorporating Battery Degradation in a Lifecycle Economic Analysis</b> .....	195
<i>Ashish P. Vora, Xing Jin, Vaidehi Hoshing, Xiaofan Guo, Gregory Shaver, Wallace Tyner, Eric Holloway, Subbarao Varigonda, Joachim Kupe</i>	
<b>Receding Horizon Control for Distributed Energy Management of a Hybrid Heavy-Duty Vehicle with Auxiliaries</b> .....	203
<i>T. C. J. Romijn, M. C. F. Donkers, J. T. B. A. Kessels, S. Weiland</i>	
<b>Predictive Energy Management of Range-Extended Electric Vehicles Considering Cabin Heat Demand and Acoustics</b> .....	209
<i>Jörg Gissing, Thomas Lichius, Sidney Baltzer, David Hemkemeyer, Lutz Eckstein</i>	
<b>Vehicle Energy Management for On/off Controlled Auxiliaries: Fuel Economy vs. Switching Frequency</b> .....	217
<i>H. Chen, J. T. B. A. Kessels, S. Weiland</i>	
<b>Smart Energy Usage for Vehicle Charging and House Heating</b> .....	224
<i>Christofer Sundström, Mattias Krysander</i>	
<b>Sizing DC Link Filter Capacitors in Complex Electric Powertrains</b> .....	230
<i>Conrad Sagert, Markus Walter, Stefan Fandel, Oliver O. Sawodny</i>	
<b>Control by State Observer of PEMFC Anodic Purges in Dead-end Operating Mode</b> .....	237
<i>Maxime Piffard, Mathias Gerard, Eric Bideaux, Ramon Da Fonseca, Paolo Massioni</i>	
<b>Look-ahead Vehicle Energy Management with Traffic Predictions</b> .....	244
<i>Lars Johannesson, Magnus Nilsson, Nikolce Murgovski</i>	
<b>Effects of Time Horizon on Model Predictive Control for Hybrid Electric Vehicles</b> .....	252
<i>Amir Rezaei, Jeffrey B. Burl</i>	
<b>Prediction of Vehicle Velocity for Model Predictive Control</b> .....	257
<i>Amir Rezaei, Jeffrey B. Burl</i>	
<b>Model Predictive Energy Management for a Range Extender Hybrid Vehicle using Map Information</b> .....	263
<i>Daliang Shen, Valerie Bensch, Steffen Müller</i>	
<b>The Effect of Trip Preview Prediction Signal Quality on Hybrid Vehicle Fuel Economy</b> .....	271
<i>Thomas Cummings, Thomas H. Bradley, Zachary D. Asher</i>	
<b>Robust Nonlinear Control of Inertia Phase in Clutch-to-Clutch Shifts</b> .....	277
<i>Kirti D. Mishra, K. Srinivasan</i>	
<b>A Framework for Modeling and Optimal Control of Automatic Transmission Systems</b> .....	285
<i>V. Nezhadali, L. Eriksson</i>	
<b>An Objective Analysis of Drivability for Two Wheeler Powertrain with Control Oriented Dynamic Model</b> .....	292
<i>Himadri B Das, Simos A Evangelou, Samraj J Dhinagar</i>	
<b>Modeling of the OSU EcoCAR 2 Vehicle for Drivability Analysis</b> .....	300
<i>Christian Jauch, Katherine Bovee, Santhosh Tamilarasan, Levent Güvenc, Giorgio Rizzoni</i>	
<b>Development of a UDDS-Comparable Framework for the Assessment of Connected and Automated Vehicle Fuel Saving Techniques</b> .....	306
<i>Danielle Fredette, Craig Pavlich, Umit Ozguner</i>	
<b>Integrated Adaptive Cruise Control for Parallel Hybrid Vehicle Energy Management</b> .....	313
<i>Emre Kural, Bilin Aksun Güvenc</i>	
<b>Decentralized Predictive Cruise Control For Energy Saving In REEV Using V2I Information For Multiple-vehicles</b> .....	320
<i>Bassam Alrifaae, Jaime Granados Jodar, Dirk Abel</i>	
<b>Quantifying Performance of a Connected Vehicle by Optimal Control</b> .....	328
<i>Hyeongjun Park, Rohit Gupta, Edward Dai, James McCallum, Gregory Pietron, Matthew Shelton, Ilya Kolmanovsky</i>	
<b>Model Predictive Control Allocation in Electric Vehicle Drive Trains</b> .....	335
<i>T. Bächle, K. Graichen, M. Buchholz, K. Dietmayer</i>	

<b>Robust <math>H_{\infty}</math> Design of an Automotive Cruise Control System</b> .....	341
<i>Balázs Németh, Péter Gáspár, Rodolfo Orjuela, Michel Basset</i>	
<b>Improved Drive Cycle Following with an ILC Supported Driver Model</b> .....	347
<i>Lars Eriksson, Mikael Norrlöf</i>	
<b>Modular Heavy Duty Vehicle Modelling and User Interface Development</b> .....	354
<i>Mümin Tolga Emirler, Ismail Meriç Can Uygan, Kerem Köprübasi, Bülent Ünver, Bilin Aksun Güvenç, Levent Güvenç</i>	
<b>Real-Time Markov Chain Driver Model for Tracked Vehicles</b> .....	361
<i>Dexing Liu, Yuan Zou, Teng Liu</i>	
<b>Electro-thermal Control of Modular Battery using Model Predictive Control with Control Projections</b> .....	368
<i>Faisal Altai, Bo Egardt, Lars Johannesson</i>	
<b>State of Health Estimation for NCA-C Lithium-ion Cells</b> .....	376
<i>D. Di Domenico, P. Pognant-Gros, M. Petit, Y. Creff</i>	
<b>An Improved Impedance-Based Temperature Estimation Method for Li-ion Batteries</b> .....	383
<i>H. P. G. J. Beelen, L. H. J. Raijmakers, M. C. F. Donkers, P. H. L. Notten, H. J. Bergveld</i>	
<b>On-board Thermal Fault Diagnosis of Lithium-ion Batteries For Hybrid Electric Vehicle Application</b> .....	389
<i>Satadru Dey, Zoleikha Abdollahi Biron, Sagar Tatipamula, Nabarun Das, Sara Mohon, Beshah Ayalew, Pierluigi Pisu</i>	
<b>Model Based Design of Balancing Systems for Electric Vehicle Battery Packs</b> .....	395
<i>Thomas Bruen, James Marco, Miguel Gama</i>	
<b>Impact of Supercapacitor Ageing Model on Optimal Sizing and Control of a HEV using Combinatorial Optimization</b> .....	403
<i>Alan Chauvin, Alaa Hijazi, Ali Sari, Eric Bideaux</i>	
<b>Nonlinear Model Predictive Control of an Organic Rankine Cycle for Exhaust Waste Heat Recovery in Automotive Engines</b> .....	411
<i>Marco Crialesi Esposito, Nicola Pompini, Agostino Gambarotta, Vetrivel Chandrasekaran, Junqiang Zhou, Marcello Canova</i>	
<b>Control of Organic Rankine Cycle Systems on board Heavy-Duty Vehicles: A Survey</b> .....	419
<i>Paolino Tona, Johan Peralez</i>	
<b>Control Oriented Model for Diesel Oxidation Catalyst Diagnosis</b> .....	427
<i>C. Guardiola, B. Pla, J. Mora, D. Lefebvre</i>	
<b>A New Semi-Empirical Temperature Model for the Three Way Catalytic Converter</b> .....	434
<i>Stefano Sabatini, Irfan Kil, Joseph Dekar, Travis Hamilton, Jeff Wuttke, Michael A Smith, Mark A Hoffman, Simona Onori</i>	
<b>Control Design for a Thermal Hardware-in-the-Loop Test Bench for Automobile Thermal Management Systems</b> .....	441
<i>Christopher Gross-Weege, Thomas Lichius, Sidney Baltzer, Dirk Abel</i>	
<b>Battery SOH Management Research in the US-China Clean Energy Research Center-Clean Vehicle Consortium</b> .....	448
<i>Caihao Weng, Xuning Feng, Jing Sun, Minggao Ouyang, Huei Peng</i>	
<b>Functional Safety of Electrified Vehicles Through Model-Based Fault Diagnosis</b> .....	454
<i>Jiyu Zhang, Giorgio Rizzoni</i>	
<b>Priority-based Multi-level Monitoring of Signal Integrity in a Distributed Powertrain Control System</b> .....	462
<i>Vipin Kumar Kukkala, Thomas H. Bradley, Sudeep Pasricha</i>	
<b>Author Index</b>	