Preface

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Biographical notes: Guoming (George) Zhu is a Professor of Mechanical Engineering and Electrical/Computer Engineering at the Michigan State University (MSU). Prior to joining the MSU, he was a Technical Fellow in Advanced Powertrain Systems at the Visteon Corporation. He also worked for Cummins Engine Co. as a Technical Advisor. He earned his PhD in 1992 in Aerospace Engineering at the Purdue University. His received his BS and MS degrees in 1982 and 1984 respectively from the Beijing University of Aeronautics and Astronautics in China. His current research interests include closed-loop combustion control, LPV control of automotive systems, and hybrid powertrain control and optimisation. He has over 30 years of experience related to control theory and applications. He has authored or co-authored two books, more than 150 refereed technical papers, and 40 US patents. He was an Associate Editor for *ASME Journal of Dynamic Systems, Measurement and Control* and also is an SAE and ASME Fellow.

Although substantial advances have been made in electric vehicles in terms of battery and electric powertrain technologies, the market penetration of these vehicles is still marginal. Hybrid electric vehicles with efficient and clean combustion engines are more likely to meet the transportation needs in the foreseeable future. The 2012 position paper of the European automotive manufacturers association indicates that a realistic market share for new, electrically chargeable vehicles is estimated in the range of 2% to 8% in the next decade. Furthermore, electrification of heavy-duty vehicles and off-highway vehicles is even far-fetched and is primarily limited by the low energy densities of batteries (1–2 MJ/kg) compared to those of fossil fuels (42–44 MJ/kg). Therefore, internal combustion (IC) engines and their respective powertrains will continue dominating the ground transportation for the foreseeable future and beyond.

Engine combustion optimisation and control plays an important role in vehicle fuel economy and emissions. Substantial progress has been made in understanding combustion process, combustion modelling for real-time simulations, and model-based combustion control and optimisation. However, as the new engine sensing and actuating systems become available, the engine combustion optimisation becomes a multi-degree of freedoms control problem, which requires the application of the advanced control schemes such as model-based control, adaptive control, model-reference control, etc.

This special issue of the *International Journal of Powertrain* provides a sample of the modelling and control problems for IC engines and after treatment systems. In the first article, Chris Criens, Thijs van Keulen, Frank Willems, and Maarten Steinbuch discuss control-oriented multivariable system identification for turbocharged diesel engines,

where a time-efficient and accurate identification procedure is developed and experimentally validated over a range of engine operating conditions. In the second article, Liguang Li presents an ion-based method for in-cycle combustion diagnosis and control. The third article by Luke Blades, Roy Douglas, Geoffrey McCullough and Andrew Woods deals with the CO light-off performance of full-size-canned catalytic converters using the cored samples from the front and rear sections of the catalyst brick. Even though no clear correlation is found between the CO light-off performance and catalyst samples, but the simulation results using the analytical catalyst model indicate good correlations. In the fourth article, Junqiang Zhou, Lisa Fiorentini, and Marcello Canova present a model-based feedforward and closed-loop control of a diesel engine equipped with variable geometry turbocharger, exhaust gas recirculation, and variable geometry compressor systems. The last article by Richard Stobart and Zhijia Yang describes a control-oriented nitrogen-oxides emissions model of a diesel engine with very low computational load, where zero-dimensional one-zone nitric oxide formation model is used. These five articles provide a mixture of in-cycle combustion control, turbocharger modelling and control, emission formation and after treatment system models.

I would express my deep appreciation to the authors who made contributions to this special issue.