Preface

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Biographical notes: James Marco is a Chartered Engineer and a member of the Institution of Engineering and Technology (IET). He is a Senior Lecturer in the Department of Automotive Engineering at Cranfield University. His research interests include real-time control, physical systems modelling and the design and analysis of automotive control and software architectures, in particular, the application of these generic and enabling technologies to the design of new energy-efficient automotive technologies for hybrid electric and fuel cell vehicles.

Francis Assadian is a Professor of Automotive Engineering at Cranfield University. He earned his BSc in Mechanical Engineering from Oklahoma State University in 1982, MSc in Electrical Engineering from California State University, Sacramento in 1992, and PhD in Mechanical Engineering with emphasis in system modelling and control system design from University of California Davis in 1997. He has 30 years of industrial experience, of which 15 years are in the automotive domain. He has worked for companies such as Peugeot Citroen, Ford of Europe and Jaguar Land Rover. He joined the Automotive Engineering Department at Cranfield University in 2009. He has established and directed the Automotive Mechatronics Centre towards innovative research to assist in speeding up the introduction of current and future automotive green energy technologies. He is currently the Head of Department of Automotive Engineering. He is an Associate Editor of a number of journals, such as IFAC Journal of Control Engineering Practice and IEEE Journal of Vehicular Technology. He is a Fellow of the Institute of Mechanical Engineers.

Automotive mechatronics is a life-cycle activity that involves the multidisciplinary integration of physical systems (which may include elements of mechanical, electrical, hydraulic or pneumatic) with electronic digital control. It is widely recognised that a significant percentage of recent advancements and innovations within the automotive sector can be attributed to the specialised domain of mechatronics. The increasing trend for greater levels of vehicle electrification has encompassed every domain of the modern vehicle. Examples include the following

- The substitution of traditional mechanically controlled ancillary devices or the creation of completely new innovative subsystems that enable new vehicle features to be realised.

- The design of new low-emission hybrid electric and electric vehicles in which the entire powertrain can be considered a mechatronic system.
- Within the chassis domain, the design of new safety-critical mechatronic systems are vital for the realisation of new driver assistance and vehicle stability systems.
- Conversely, while not requiring the same degree of safety criticality, the body and infotainment domains of premium brand modern vehicles are underpinned by software intensive, highly networked, mechatronic systems.

However, the existing methods employed for the design and integration of automotive mechatronic systems are typically characterised by a series of networked propriety solutions. The traditional model within the automotive industry is for the vehicle manufacturer to outsource the development of a complete system to a supplier. The manufacturer then primarily acts as the systems integrator for the vehicle. The high levels of system complexity and interconnectivity found in today's automotive applications, coupled with the traditional mechanically-orientated view of the design and verification processes brings into doubt the long-term viability of this strategy. Automotive mechatronics addresses these challenges by naturally changing this mechanically oriented view of the vehicle to a unified mechatronic system view. Within a mechatronics approach, the electromechanical systems, including their control algorithms and software implementation, are designed as a single unit. Hence, multi-objective optimisation becomes inherent part of this design as vehicle control software and electromechanical system hardware are investigated and designed concurrently. Achieving robust-performance requirement becomes one of the key objectives of the mechatronic systems design. This requirement is addressed by utilising advanced robust control techniques. The aim of this special edition of the International Journal of Vehicle Design (IJVD) is to explore recent advances within the field of automotive mechatronics and in particular to highlight new innovations in design, analysis implementation. Papers have been selected for this special edition that demonstrate advancements in one or more key areas of the automotive mechatronics design process.