Preface

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Biographical notes: Weiwen Deng has been working for General Motors R&D Centre since 1996 in the areas of vehicle dynamics, controls and integration. As a Staff Researcher, he currently holds 11 US patents with another ten pending, and has co-authored over 20 publications. He is the recipient twice of the 'Boss' Kettering Award, the most prestigious technical award in General Motors Corporation.

Mark Howell is a Staff Researcher at General Motors R&D Centre in the areas of fault tolerant vehicle control, driver modelling and prognostics. Previous to this he was a Research Fellow in the Aeronautical and Automotive Engineering Department at Loughborough University on active suspension control, intelligent automotive systems and integrated chassis control systems. He currently holds two US patents with another six pending, and has co-authored over 20 publications.

The automotive industry has been enjoying a tremendous growth in vehicle control technologies in the past decade due to the thriving research and development of various microcomputer-based control systems. Each of the individual vehicle control systems and subsystems has improved the functionality to level way beyond anything that the traditional mechanical design could do. The overall vehicle performance is further advanced by connecting these systems together, sharing information and coordinating the control objectives.

Therefore, a new megatrend in automotive industry is taking shape: vehicle control integration. Integrated vehicle controls coordinate the controllable subsystems that affect safety, comfort and vehicle dynamics behaviour to achieve optimum vehicle performance in stability, ride and handling, as well as driver friendliness, and environment responsiveness. Vehicle system integration can be further extended to include passive safety systems, enabling performance enhancements beyond vehicle dynamics and stability control to occupant safety, collision avoidance and navigation. This integration can potentially be further enhanced with 'vehicle to vehicle' and 'vehicle to infrastructure' communication, and will eventually become an indispensable part of future intelligent transportation systems.

It is thus the aim of this special issue to provide a forum for both industry and academia to review the current developments and explore new approaches and technologies in this broad area. Various theories and methods are being developed that have enabled or greatly enhanced vehicle control and integration, such as observer design and estimation for both vehicle states and parameters, driver modelling and

driving skill level characterisation. The papers in this special issue focus on the development and application of these methods.

Integrated vehicle control systems incorporate drivers in the loop and therefore modelling the driver is important to assess his or her intentionality and ability. The paper by Ding et al. 'An analytical driver model for arbitrary path following at varying vehicle speed', presents an artificial neural network based analytical driver model. This model is based on the preview-follower theory and error elimination algorithm with all model parameters calculated analytically and is scheduled as a function of vehicle speed to ensure good performance for arbitrary path following at varying vehicle speed.

Driver skills are examined in the paper by Lin et al. 'Characterisation of driving skill level using driving simulator tests'. Driving skill characterisation is conducted through analysis and modelling in a range of challenging test manoeuvres using a driver simulator. In this study, a comprehensive driver model is used to characterise the driving skill, which incorporates various aspects of a driver's sensory-motor and decision-making abilities.

In the paper by Wang et al. 'The multi-agent driving assistance system', a multi-agent sensor network concept is developed with different types of sensors that are mutually incorporated with different comprehensive signal processing algorithms to enhance both in-sensor intelligence and inter-sensor collaboration. This is particularly useful in the construction of a driving assistance system under various complicated driving environments.

Various papers examine the ability of observes and Kalman filters to determine vehicle states and parameters. The paper by Baffet et al. 'Lateral vehicle-dynamic observers: simulations and experiments', proposes and compares four different observers for vehicle sideslip angle and lateral tyre forces, along with a road-friction identification method. These observers are derived from the extended Kalman filter, the single-track model, and use different tyre-force models, which are further compared in a professional vehicle simulator and via real experiment.

The paper by Daily et al. 'Cascaded observers to improve lateral vehicle state and tyre parameter estimates', presents a method to combine the best aspects of kinematics and model based estimators in a cascaded approach and extends the estimation of states and parameters into the non-linear region of the tyre, to produce high update, accurate, observable estimates of vehicle sideslip, utilising a two antenna GPS system. The algorithms were verified to be robust to parameters changing with ground conditions.

The paper by Best, 'Parametric identification of vehicle handling using an extended Kalman filter', proposes an extended Kalman filter based approach for model parameter estimation, which is demonstrated to be versatile, stable and easy to configure for both fixed and time-varying estimation, and to be robust to high noise/signal ratios. The proposed method may also be well suited to rapid prototyping and on line applications for integrated chassis control.

The paper by Chadli and El Hajjaji, 'Moment robust fuzzy observer-based control for improving driving stability', presents a study on yaw moment robust active control of vehicle lateral dynamics, in which a Takagi-Sugeno fuzzy model is used to represent vehicle non-linear lateral dynamics and a robust T-S controller based observer is designed. The proposed controller is shown, via simulation, to be very efficient under different driving conditions.

The paper by Mondal et al. 'An unknown input Kalman filter based component FDI algorithm and its application in automobiles', presents an Unknown Input Kalman Filter (UIKF) based Component Fault Detection and Isolation (CFDI) technique for a road vehicle model, affected by both plant and measurement noise. Numerical simulations are conducted to detect and isolate suspension faults of a road vehicle and demonstrate the effectiveness of the algorithm, which may be extended to the non-linear systems using different non-linear estimators.

The paper by Akhenak et al. 'Design of a sliding mode fuzzy observer for uncertain Takagi-Sugeno fuzzy model: application to automatic steering of vehicles', presents a development work on a robust sliding mode fuzzy observer with the presence of parametric uncertainties. The effectiveness of the approach is validated through simulation of vehicle yaw rate estimation.

Finally, Shraim et al. present a sliding model observer in the paper, 'Sliding mode observers to replace vehicles expensive sensors and to preview driving critical situations', to estimate various vehicle parameters as well as state variables. The results are further validated through simulator which indicate good performance and robustness.

In summary, this special issue emphasises the research and development on various emerging theories and methods in observer design and estimation theories for both vehicle states and parameters, and driver modelling and driving skill level characterisation.

It has been our pleasure and honour to work with experts in this field from both industry and academia to compile this special issue. We are very much impressed by the quality of the papers that we received. With all of the effort from both contributors and reviewers, we hope that these special issues achieve the goals we set forth. Finally, we would like to take this opportunity to thank both authors and reviewers for their contributions, and thank the journal staffs for their effort in the editing and publication of this special issue.