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. Prior 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. As you may see from the selected papers, the integrated vehicle control has been progressing rapidly with the development and experimentation of new control methodologies.

Several of the papers in this issue examine novel control strategies for control of the vehicle dynamics. The paper by Yu and Gao, 'Two-degree-of-freedom vehicle

steering controllers design based on four-wheel-steering-by-wire', proposes an effective control of both front and rear wheel steering with a combined approach for both four-wheel-steering and steer-by-wire system. This approach improves not only vehicle dynamic tracking performance, but also control robustness to various parameter uncertainties and operating conditions. An approach that guarantees both tracking performance and robust stability is described in the paper 'Study on vehicle chassis control integration based on vehicle dynamics and separate loop design approach' by Shen and Yu. They propose using a two-loop control design structure, with the H_∞ mixed sensitivity loop-shaping combined with LQR algorithm as the main-loop design.

An approach that enables flexibility for control engineers to systematically tune vehicles to desired levels of handling performance is described in a paper by Chen and Chandy, 'Active handling enhancement for chassis control systems'. They propose a unified algorithm to enhance vehicle handling performance with a Dynamic FeedForward (DFF) control.

The complexity of full non-linear MPC for real-time implementation is addressed in a paper by Chang and Gordon, 'Model-based predictive control of vehicle dynamics'. They propose a new model-based hierarchical control strategy with three-layer control architecture for vehicle stability control.

A guidance strategy that extends the functionalities of lane keeping and lane departure warning systems is proposed in a paper by Brandt et al. 'Towards vehicle trajectory planning for collision avoidance based on elastic bands'. A hazard map that can incorporate moving obstacles is developed and for use by a potential-field based trajectory planning system.

The paper by Yu and Özgüner, 'Advanced headway control via adaptive seeking sliding mode for autonomous on-road vehicles', proposes an adaptive seeking sliding mode control method with a hybrid headway control scheme for automated vehicle headway controller. This method achieves better performances in smooth operation, disturbance rejection, control continuity and fuel efficiency.

Finally, three other interesting topics are also covered in this issue: Samaali, Abichou and Beji proposes an iterative backstepping technique and the Lyapunov function based control with a continuous time-varying command for longitudinal and horizontal stabilisation of an under-actuated vehicle; Wu and Chen proposes a hierarchical modelling method in an HIL simulation experiment, which makes it possible that a half vehicle suspension can be treated as two quarter suspensions for better and more effective real-time simulation. Kim proposes a method for real-time vehicle controls evaluation using system architecture and requirements engineering processes with the advantages of being both flexible and fast for product development.

In summary, this special issue emphasises the research and development on vehicle control and integration by actively coordinating vehicle subsystems to achieve optimum vehicle performance.

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.