Preface

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Biographical notes: Jingzhou (James) Yang is an Assistant Professor at the Department of Mechanical Engineering, Texas Tech University, Lubbock, Texas. He received his BS and MS in Automotive Engineering from Jilin University, China and PhD in Mechanical Engineering from The University of Iowa. His previous positions include Senior Researcher with the Center for Computer-Aided Design, The University of Iowa and a Faculty Member at the Department of Automobile Engineering, Tsinghua University, China. He is a recipient of the 2001 Arch T. Colwell Award from SAE, the 2004 Outstanding Paper Award from ASME, and the 2007 Prometheus Award. His research interests include robotics, computational biomechanics, digital human modelling, human-centred design and ergonomics.

Joo Hyun Kim is currently a Postdoctoral Research Scholar with the US Army Virtual Soldier Research group in the Center for Computer-Aided Design, The University of Iowa, Iowa City, Iowa, USA. He received his PhD in Mechanical Engineering in 2006 from the same institute. His research interests include motion generation, dynamics and control of multi-body systems, balance and locomotion, optimisation and physics-based robotic/human motion simulation.

Digital human modelling and simulation has revolutionised the way new vehicles are designed, built, operated and maintained. Expected benefits include the reduction of development time and costs and an increase in quality. Furthermore, digital human technology is a key tool in human motion analysis, crash simulation, injury prediction and medical research. The quality of digital human simulation relies on the accuracy of human models. It is thus, important to validate human models and various simulation results. This special issue focuses on new research in digital human modelling and simulation, and applications in vehicle design for automobiles, aircraft, spacecraft, autonomous systems, etc.

It is a great honour and a pleasure to serve as guest editors for this special issue on 'Digital human modelling and simulation, and applications in vehicle design'. We would

like to thank everybody who has contributed to this issue. We are especially indebted to the referees for their valuable reports on the submitted manuscripts. This special issue contains eight papers that illustrate various aspects of digital human modelling and simulation in vehicle design. Of course, these articles represent only a small number of the interesting examples of models and applications. We hope that this special issue will stimulate further research in this field.

Here is a short description of the goals and achievements of each paper.

Valentini presents a methodology for implementing a three-dimensional virtual dummy for vibration investigations. The model uses a multi-body dynamics method and includes a detailed spine sub-model for accurate assessment of seated body vibration. The model can be used for assessment of vibration dose value and design optimisation of human-vehicle interface according to international standards.

Kim et al. propose a novel approach for predicting seated posture considering balance. This paper also derives the detailed calculation of balance criterion (zero-moment point) and reaction loads from the seat. The seated zero-moment point associated with different target points and external load magnitudes are demonstrated along with the prediction of natural seated posture.

Hanson et al. report that there are no significant differences in motion patterns between assemblers and end-users. Stature significantly affects joint angle distribution and joint angle velocity distribution. No stature effect has been found on time to perform ingress movements or on ingress technique. Age significantly affects all test parameters and is thus, an issue for developers to consider along with anthropometric variables like stature.

Högberg discusses digital human modelling as a design tool in the context of user-centred design. The paper takes a designer's view of DHM tools and illustrates how the tools can be of value in the design process, but also considers what implications this has on the functionality and usability of the tools.

Abdel-Malek et al. illustrate a physics-based digital human model. This model is a new generation of digital human simulation systems that allows for a user to interact with a digital character with full and accurate biomechanics and a complete muscular system, subject to the laws of physics.

Pudlo et al. demonstrate a method for simulating the car-entering movement based on recorded database. This method requires correcting the measured movement, determining the motion strategies and extracting a representative subject for each identified strategy, modelling a segment of the movement (e.g., the trajectories of the feet and the trunk's centre-of-mass) of the representative subject, and finally simulating the car-entering movement for a new subject.

Hong et al. developed a method of predicting accurate impact acceleration at pedestrians' medial knees, during low-speed collisions. Muscle activations are incorporated into the finite element human model for prediction and analysis. Experiments have been carried out to verify the model.

Acar et al. report the research for a design tool related to pregnant women's safety during car travel. This article explains the generation of a comprehensive parametric computer aided model of a pregnant occupant, 'Expecting'. The model can represent different-sized pregnant occupants as well as the size differences occurring in standing and seated postures. This model can be used as a design tool for automotive designers to help ensure that vehicle designs can accommodate the anthropometric needs of the pregnant occupants.