Preface

Haiwen Ge*

Production Engineering Center,
John Deere, Waterloo, IA 50703, USA
Email: heavengerc@gmail.com
*Corresponding author

Shijin Shuai

Department of Automotive Engineering,
Tsinghua University,
Haidian District, Beijing, 100084, China
Email: sjshuai@mail.tsinghua.edu.cn

Caroline L. Genzale

George W. Woodruff School of Mechanical Engineering,
Georgia Institute of Technology,
771 Ferst Drive, Altanta, GA 30332, USA
Email: caroline.genzale@me.gatech.edu

Biographical notes: Haiwen Ge received his BEng and MEng in Engineering Thermophysics from the University of Science and Technology of China in 1999 and 2002, respectively. In 2006, he received his DSc in Physical Chemistry from the University of Heidelberg. He joined Professor Reitz' group as a Postdoctoral Fellow in 2006. He worked at the Ford and FCA from 2010 to 2016. He was promoted to Senior Technical Specialist in Combustion Development at FCA in 2015. He is currently a Senior Combustion CFD Engineer at John Deere.

Shijin Shuai is a Professor in the Department of Automotive Engineering and the Vice Director of the Center for Combustion Energy at the Tsinghua University in China. He received his Bachelor's, Master's, and PhD in Internal Combustion Engine from the Huazhong University of Science and Technology in 1986, 1989, and 1998, respectively. He had one year research experience collaborated with Professor Reitz as a Visiting Scholarship from 2007 to 2008. He is currently the Director of Oil Products and Clean Fuels Committee of Chinese Society for Internal Combustion Engine and the Vice Director of SAE-China Alternative Fuel Vehicles Committee. He has received multiple awards for his research and teaching. His research focuses on numerical simulation of engine flow, spray and combustion, alternative fuels, and engine aftertreatments.

Caroline L. Genzale is an Assistant Professor in the Woodruff School of Mechanical Engineering at the Georgia Institute of Technology. She obtained her BS in Mechanical Engineering from the University of Southern California in 1997, and MS from the University of North Carolina at Charlotte in 2003. She received her PhD in Mechanical Engineering under Professor Reitz's supervision in 2009. Prior to joining Georgia Tech, she was a Postdoctoral

Researcher at the Sandia National Laboratories in Livermore, CA. Her lab at Georgia Tech, the Spray Physics and Engine Research (SPhERe) Lab, focuses on computational model development and laser-based measurements to accelerate fundamental understanding of fuel injection and in-cylinder combustion processes for internal combustion engines.

This special issue honours the recent retirement of Professor Rolf D. Reitz, following more than 40 years of noteworthy contributions to internal combustion engines research.

Professor Reitz received his BSc and MSc in Mechanical Engineering from the University of Cape Town, South Africa, in 1970 and 1972, respectively. He then moved to the USA and received an MS in Mechanics from the State University of New York, Stony Brook before moving to Princeton University, where he received his MA in Mechanical and Aerospace Engineering in 1975, followed by his PhD in 1978. During his Princeton years, Professor Reitz developed a comprehensive theoretical framework for the primary atomisation of diesel sprays, laying the foundation for one of his most noteworthy contributions to the internal combustion engine research community. Professor Reitz's wave breakup theory would later become widely adopted as the foundation for modelling direct-injection processes within engine computational fluid dynamics (CFD) simulations. Following his graduation from Princeton, Professor Reitz spent two years as an Associate Research Scientist at the Courant Institute of Mathematical Sciences from 1978–1980, followed by a three-year appointment as a Research Staff Member back at his PhD institution from 1980–1983. In 1983, Professor Reitz began a six-year career at General Motors R&D in Warren, MI, where he established himself as a leader in the development of engine CFD and spray modelling. In 1989, Professor Reitz began his academic career, joining the University of Wisconsin – Madison as an Associate Professor in Mechanical Engineering, where he spent the remainder of his career. At the University of Wisconsin – Madison, Professor Reitz continued to advance the state-of-the-art in engine CFD modelling, while also establishing advanced experimental engine research facilities in partnership with industry sponsors. He developed a vibrant and productive cross-disciplinary research group, of which we, the co-editors of this special edition, are fortunate to have participated in. During his tenure at the University of Wisconsin – Madison, Professor Reitz achieved the rank of Wisconsin Distinguished Professor and served twice as the Director of the Engine Research Center from 2001–2004 and from 2012–2015. Professor Reitz continues to serve as Emeritus Professor of Mechanical Engineering since 2015.

Over the course of his 40+ year career, Professor Reitz has made countless substantial and lasting contributions to engine CFD and spray modelling. His most notable contribution in this area, stemming from his earliest theoretical work as a PhD student at Princeton, is his development of the wave breakup model for Lagrangian-Eulerian CFD simulation of direct-injection fuel sprays. Other spray models, including wall impingement model, droplet distortion model, droplet interaction model, multi-component evaporation model, phenomenological nozzle flow model, linearised instability sheet atomisation (LISA) model for hollow cone spray, were developed by his group and remain widely adopted across the community to this day. He is also responsible for the development of RNG k-ε turbulence model, which is the most widely used turbulence modelling approach for Reynolds averaged Navier-Stokes (RANS) engine CFD simulations. His 1995 manuscript in combustion science and technology

introducing the RNG k-ε model is the second most cited paper in the history of the journal. He pioneered in applying detailed chemistry into engine combustion simulation with good computational efficiency. Many reduced mechanisms for different fuels and applications have been developed by his group. Several strategies such as adaptive multi-grid chemistry model and fast chemistry ODE solver have been enhanced. Level-set G-equation model has been implemented into KIVA for premixed flame. Discrete particle ignition Kernel (DPIK) model is still the most popular spark kernel model for SI engine combustion. His group developed several phenomenological soot models. Han and Reitz heat transfer model is one of a few default heat transfer models in the most of CFD codes. In fact, all commercial and open-source CFD software have incorporated Professor Reitz's spray, combustion, and emission models

In addition to his numerous contributions in the modelling and numerics of engine combustion, Professor Reitz has leveraged these innovations as tools to discover and optimise advanced combustion concepts, including his pioneering use of genetic algorithms for engine design optimisation. One of his greatest successes in this area was in the discovery of how multiple injection strategies can be used to provide significant in-cylinder emissions reductions, which is now implemented by all major diesel engine manufacturers. Most recently, Professor Reitz discovered and developed reactivity controlled compression ignition (RCCI) combustion, a dual-fuel low-temperature engine combustion strategy that utilises on-the-fly diesel and gasoline fuel blending in-cylinder to optimise combustion control and phasing. This groundbreaking strategy has demonstrated brake thermal efficiencies of up to 60% with very low NOx and soot emissions. Based on CFD analysis, he hypothesised and demonstrated that the duel-fuel combustion process is controlled by fuel reactivity gradients that can be optimised via the fuel-injection process. He has since demonstrated that the RCCI concept can be extended to a broad range of conventional and alternative fuels with different reactivity.

Professor Reitz has received numerous awards from SAE, ASME, DOE, UW-Madison. In 1998, Professor Reitz was appointed Fellow of the SAE. He was also appointed ASME Fellow in 2006. He served as Chairman of the Institute of Liquid Atomisation and Spraying Systems (ILASS-Americas) from 1999–2002. In 1999, he co-founded and serves as editor (American continent) of the *International Journal of Engine Research*. He served on the editorial board of the *International Journal of Powertrains*. He is currently the Specialty Editor-in-Chief of the new open access *Frontiers Journal of Engine and Automotive Engineering*.

This special issue includes four papers. The paper 'Partially premixed combustion multi-cylinder engine cycle-to-cycle-oriented temperature estimation and control' by Lianhao Yin, Gabriel Ingesson, Rolf Johansson, Per Tunestål and Bengt Johansson explained and compared two methods of intake air temperature estimation for PPC engine control. The paper 'Development of MGE 1.8T combustion system assisted by numerical simulation' by Jun Xin, Ming Chen, Xi Xin, Xiaomao Zhang, Yang Yang and Zheng Xu described a combustion system development process assisted by CFD for a 1.8L turbo GDI engine. The paper 'Simulation and experiments of advanced gasoline engine combustion modes from spark ignition to compression ignition' by Zhi Wang, Shijin Shuai, and Buyu Wang reported the latest progress in numerical and experimental studies of direct injection spark ignition (DISI), homogeneous charge compression ignition (HCCI), stratified charge compression ignition (SCCI), and multiple premixed compression ignition (MPCI) at Tsinghua University. The paper 'Natural gas/diesel

RCCI CFD Simulations using multi-component fuel surrogates' by Andrew G. Hockett, Greg Hampson and Anthony J. Marchese presented a numerical study of natural gas and diesel fuelled RCCI using a new fuel surrogate model and new chemical kinetic mechanism.

This special issue commemorates Professor Reitz' retirement, but he will not retire from his research. We are sure that Professor Reitz will continue his innovative career during the next decades. And we, together with the whole internal combustion engine community, wish him continuing health, progress, and success.