Foreword

Subhash Rakheja*

CONCAVE Research Centre,
Concordia University,
1455 de Maisonneuve West, Montreal, Canada
E-mail: Subhash.rakheja@concordia.ca
*Corresponding author

Xiong Zhang

General Dynamics Land Systems,
1991 Oxford Street E, London, ON, Canada
E-mail: zhangx@gdls.com

Xiaobo Yang

Oshkosh Corporation,
P.O. Box 2566, Oshkosh,
WI 54903-2566, USA
E-mail: xyang@oshkoshcorp.com

Nong Zhang

University of Technology,
15 Broadway, Ultimo, Sydney, Australia
E-mail: nong.zhang@uts.edu.au

Biographical notes: Subhash Rakheja is a Professor in Mechanical Engineering and Vehicular Ergodynamics Research Chair at the CONcordiaCentre for Advanced Vehicle Engineering (CONCAVE), Concordia University. He is Fellow of the ASME and CSME (Canadian Society of Mechanical Engineers). His research expertise includes advanced transportation systems and highway safety, vehicle vibration control, advanced suspensions, human responses to workplace vibration, whole-body and hand-arm biodynamics, and driver-vehicle interactions. Apart from the *International J. of Vehicle Performance*, he is continuing to serve as an Editor of the *International J. of Industrial Ergonomics*.

Xiong Zhang is a Sr. Engineer in Systems Engineering, Engineering Development and Technology of General Dynamics Land Systems – Canada. He obtained his PhD from Concordia University at Montreal, Quebec, Canada. He has a research focus on the performance evaluation of ground vehicle systems from mobility, durability and safety perspectives. He was the sole Editor of the special issue series 'The performance and dynamics of diversified land vehicle systems' of *IJHVS*, the Lead Guest Editor of the special issue 'Design and control of unmanned ground vehicles' of *IJVAS*, and the Associate Editor of the *Int. J. of Heavy Vehicle Systems*.

Xiaobo Yang is currently a Sr. Chief Principal Engineer at Oshkosh Corporation, USA. With more than 20 years of experiences in automotive industry and university research in vehicle system dynamics and road loads analysis, he has published more than 40 technical papers, one book chapter and given numerous technical presentations or keynote speeches at international conferences and colloquiums. He has recently been elected as a Fellow of SAE International. He received his Bachelor degree from Sichuan Institute of Technology, Master degree from Jilin University of Technology, and Doctorate degree from Concordia University, respectively.

Nong Zhang received his ME and PhD from Shanghai JiaoTong University and University of Tokyo, respectively. He worked at several universities in China, Japan, USA and Australia before joining the University of Technology in Sydney, where he continues to work as Professor of Mechanical Engineering. His research interests and expertise are in the areas of dynamics and control of automotive systems including powertrains with various types of transmissions, hybrid propulsion systems, vehicle dynamics, passive and active suspensions; and mechanical vibration.

The editorial team is delighted to introduce this inaugural issue of the *International Journal of Vehicle Performance*, a journal of the *International Association for Vehicle Design*. The purpose of the Journal is to provide a medium for rapid dissemination of original works in theoretical and experimental developments in performance analyses and assessments of vehicle systems and subsystems applicable for road-, off-road, all-terrain and guided transport systems.

The editorial team believes that a journal focusing on performance aspects of current and evolving technologies was long overdue considering the lack of well-defined performance measures for road – as well as off-road vehicles. Moreover, the total performance evaluations of a vehicle involve multi-disciplinary foci such as those associated with fuel economy, environment, occupant and road safety, power management and controls, life cycle, and more. These involve broad challenges, particularly in defining performance measures that address the changing needs of the society and the global vehicle industry, developments in uniform or standardised measures, and developments in efficient measurement and analyses tools.

The performance may have some common and some widely different connotations in different types of vehicles. Irrespective of the differences, the quality and acceptability of a vehicle product is undoubtedly dependent on its performance under a broad spectrum of practical service conditions. The performance specifications of road vehicles, automobiles and commercial vehicles, generally refer to those related to vehicle dynamics, safety, fuel economy, driver comfort, cargo containment and protection, load capacity, operational cost and maintenance, and life cycle. Fuel efficiency is among the most important competitive factors in automobiles and commercial vehicles. The market forces have ensured continuous progresses in fuel economy and electric/electric-hybrid vehicle technologies with equal emphasis on emission reductions, which require advanced powertrain technologies, and lightweight materials. The performance analyses of electric and electric-hybrid vehicles, on the other hand, involve several additional measures related to sizing, power transmission and management, driving range, etc. With increasing vehicle populations worldwide, higher fuel price and growing demands for preserving the environment, increasingly stringent performance requirements are being imposed by the consumers and the policymakers.

While the traditional performance measures, invariably, refer to vehicular motion, ride, safety, handling and control, widely different measures have been used for commercial road- and off-road vehicles. The vehicle dynamics-related performance measures concern the vehicle handling, ease of control and operational safety. These are of particular concern for commercial freight vehicle combinations, which exhibit substantially lower roll and yaw stability limits. Commercial truck rollover and divergent yaw response (jackknife) are known to be major road safety risks, and these have been associated with severe human injuries and fatalities. Owing to their high centre of gravity, which tends to vary substantially with varying payload conditions, it is difficult to design commercial vehicles with optimal performances over the entire payload range. Future commercial vehicles will integrate innovative active safety controls together with advanced driver assist systems and semi-active/active suspensions to achieve optimal operational performance under varying load and environmental conditions. For unmanned vehicles, the majority of the vehicle-dynamics-related performances concern the guidance control, lateral dynamics, directional stability, sensitivity to disturbances, and steady and transient steering responses.

The vehicle-dynamics performance measures are of greater concern for hazardous material transportation. Liquid chemical products are known to induce additional forces and moments, attributed to cargo slosh under partial fill conditions, which adversely affect their stability limits. Owing to the severe fatalities, environmental and fire risks of accidents involving such vehicles, far more stringent performance measures may be needed. Moreover, the alternate innovative tank designs would be most desirable to not only enhance containment of the product in the event of an accident but also the anti-slosh performance.

The most distinctive performance features of off-road vehicles may be characterised by their mobility over unprepared terrains while maintaining their required operational functionalities. Relatively low ground contact pressure and a relatively high ground clearance are the key requirements for enhanced mobility performance of off-road vehicles soft and rigid terrains and obstacles. Depending on the type of vehicle, there exists an array of additional yet mandatory requirements that form the core of the performance specifications. For agriculture and forestry vehicles, the desired performance is emphasised in terms of drawbar efficiency, ride comfort, ease of operation and slope stability. For many industrial vehicles employed in the construction, mining and service sectors, the vehicle performance may be viewed from the perspective of transportation and production efficiency, environmental adaptation, load carrying capacity and maintenance costs. The ride vibration of such vehicles is also an important performance measure considering the array of drivers' health disorders that have been attributed to occupational exposure to whole-body vehicular vibration and shocks. While effective primary and secondary suspensions have been widely developed for limiting the whole-body vibration exposure of the drivers, the performance standards are lacking for assessing the coupled effects of suspensions on ride, handling, and roll and grade stability. Moreover, the whole-body vibration exposures of most of the off-rod vehicles exceed the safety limits stipulated in the International Standards and the EC guidelines.

Nevertheless, the off-road vehicle performance metric always incorporates the requirements on handling characteristics as well as safety, durability, manoeuvrability and fuel economy. The methods for measuring and evaluating off-road vehicle performance, however, vary greatly depending on the type of vehicle, wheeled or tracked, driver controlled or autonomous, terrestrial or extraterrestrial, and the target sector, e.g., agriculture, industry, planetary or military.

The military vehicles are expected to provide combat-related features, such as mobility, agility, protection and lethality to safely conduct mission assignments as required in territorial defence or contingency operations. Far more stringent specifications and standards have been formulated for military vehicles considering their multiple roles committed for varying missions and combat assignments. The performances of military vehicles are thus, invariably, evaluated on the basis of widely different military standards under realistic conditions signifying mission scenarios and environmental conditions. Modern military vehicles may undergo extreme environmental conditions, from the frigid temperatures of the arctic to the intense heat of the deserts, including rocky terrains, sand, mud, snow and ice, while maintaining the stability, structural integrity and operational capabilities. The tactical vehicles must withstand the shock and vibration impacts arising from running over rocky terrains and must be able to operate for long periods of time with minimal maintenance. The top cross-country speed allows the vehicle to move at the highest possible speed in a battlefield environment, thus minimising its exposure as a moving target. The grade performance in the order of 60%, and ability to negotiate large step obstacles and trenches are the most important components of mobility performance specifications of the military vehicles, despite the unfavourable terrain conditions. Acceleration requirements, on the other hand, directly relate to survivability as it enhances the dash capability and limits the exposure duration in a combating scenario.

Future vehicles and associated technologies will undoubtedly pose new performance requirements, which we may not be able to address with current performance analyses and assessments methods. The performance specifications always need to be updated with the ever-changing technologies, environments and the market/society needs. For instance, the future combat military vehicle products must be lighter, faster, and more deployable but at the same time more lethal and more survivable. Alternate electromagnetic armours may replace the thick armoured plates for superior survivability performance. Similarly, future work vehicles and technologies will emphasise greater load carrying capacities and operating speeds. Reliable active and semi-active suspensions and relevant performance specifications are expected to evolve to achieve greater cross-country speeds.

It is indeed most gratifying to see the inaugural issue of the *IJVP* in print, which was the result of consistent hard work by the staff at Inderscience, reviewers and contributing authors. It is however the beginning of a long and challenging road that lies ahead for the editors to ensure a timely and effective review process and publications of technical contributions leading to advancements in the field of performance analyses.