Introduction

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Biographical notes: Xu Wang received his BE (Hons) and MS in Internal Combustion Engine from Tianjin University, China in 1985 and 1989 and a PhD in Mechanical Noise and Vibration from Monash University, Australia in 1994. He is currently an Associate Professor in Automotive Engineering, at RMIT University, Australia. His research interests include the areas of vehicle design, development and manufacturing, noise and vibration control, design and construction of robots and manufacturing plants, material engineering, internal combustion engine, etc.

Noise and vibration of motor vehicles are increasingly important for the automotive industry and are concerns for both vehicle manufacturers and component suppliers. Elimination of unwanted noise and vibration heard and felt in vehicles has become a necessary vehicle design consideration as new sustainable power train technologies such as electric power train or hybrid power train technologies develop.

Automotive applications tend to require the high volume manufacture of parts and systems at low cost with high performance and high reliability, even in harsh environments. To replace conventional systems or introduce new capabilities and new systems into automobiles based on new materials and structures, and new technologies, it is necessary to add functionality, performance and adaptability without decreasing reliability, while marginally increasing cost and weight. However, to advantageously exploit the capabilities of new materials, structures and technologies in vehicle systems requires multidisciplinary approaches for design and optimisation, where improved controllability, maintainability and extendibility are key goals. These issues are expected to be well-addressed by concurrent investigations.

The papers in this issue demonstrate innovative solutions for noise, vibration and reliability in vehicle systems. This issue content covers the research areas in the engine vibration study, the exhaust noise and solutions, the tyre and road induced noise and vibration, the interior noise treatment and sound quality study, the vehicle wind noise study, the steering wheel vibration study and the suspension vibration energy harvesting study. In the engine vibration study, a new analytical approach for calculation of the bending vibration of the engine shafting system has been proposed where the influence of coupled product of inertia from the two-dimensional wave equations on prediction results is suggested to be considered. In the tyre and road noise and vibration study, the contact behaviour of single tread blocks is investigated by experiments and simulation where a slipped tyre tread block model based on Timoshenko's beam theory is set up to demonstrate the effects of the stick-slip vibrations or the contact between tread block elements. In the interior noise treatment and sound quality study, a computational model is developed based on structure-sound interaction method for the prediction of acoustic response. Topology optimisation method is used to design the front dash. Noise annoyance fuzzy index has been studied to evaluate the vehicle cabin noise and the goal programming approach has been used to optimise the vehicle cabin acoustical comfort. In the vehicle wind noise study, computational fluid dynamic and computational aero-acoustics models have been established to simulate and understand aerodynamic flow and noise generation in the A-pillar region of a scaled vehicle. In the steering wheel vibration study, the non-linear factors of tire lateral force and contact-impact force of kingpin clearance are considered and the research shows that the amplitude of steering wheel shimmy vibration and the occurring speed range increase with the clearance of the kingpin. In the suspension vibration energy harvesting study, the analytical and experimental results show that there exists up to 900 W of suspension vibration energy which can be harvested if normal shake absorbers of a vehicle are replaced by regenerative force actuators. The regenerative force actuators are able to convert the damped or thermally dissipated suspension vibration energy into electric energy for vehicle power source which is promising for a sustainability purpose.

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