Editorial

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During recent years, great effort has been given in the research and considerable success achieved in the development of the internal combustion engine, which is nowadays the most preferred prime mover in medium and medium–large units applications (truck driving, railroad locomotives, non-road mobile machinery, ship propulsion, electrical generation) as well as the sole competitor in the highly competitive automotive market.

For both spark and compression ignition engines, the emphasis is nowadays on reducing gaseous and particulate emissions. Sophisticated, high pressure injection systems, exhaust gas recirculation or selective catalyst reduction, multi-valve configurations with variable valve timing, variable geometry turbochargers, exhaust after-treatment systems with particulate traps or urea-based deNO_x are among the measures applied for reduction of pollutant emissions and fuel consumption. Moreover, carbon dioxide (CO_2) emissions are becoming increasingly important owing to their

connection with global warming; limiting CO_2 production can be achieved, primarily, through improvements in fuel economy and more extensive use of biofuels.

Unsurprisingly, the various technological advances mentioned above have also led to a significant increase in the complexity and cost of the engine and its control system, and this trend is sure to continue. More than in the past, combination of both internal engine measures and efficient exhaust after-treatment devices will be required. Since the number of engine (and turbocharger) controllable components rises continuously, complicated and sophisticated control algorithms are needed to achieve optimum performance. It is universally accepted today that great benefits in the analysis and control of internal combustion engines will (and have actually) come from optimising the interaction of all the associated engine sub-systems by detailed simulation models of the engine processes. The latter will also pave the way for more advanced engine concepts and alternative combustion systems, such as the homogeneous charge compression ignition and the low-temperature combustion.

Traditionally, the study of internal combustion engines operation has focused on the steady-state performance with minor, if any, attention paid to the transient operation. However, the majority of daily driving schedule involves transient conditions. In fact, only a very small portion of a vehicle's operating pattern is true steady-state, e.g. when cruising on a motorway. In recent years, the global concern on environmental pollution has intensified the respective studies; particulate, gaseous and noise emissions typically go way beyond their acceptable values following the extreme, non-linear and non-steady-state conditions experienced during the dynamic engine operation. Acknowledging these facts, various legislative directives in the European Union, Japan and the USA, have drawn the attention of manufacturers and researchers all over the world to the transient operation of engines, in the form of transient cycles certification for new vehicles.

This Special Issue of the *International Journal of Vehicle Design* attempts to address many of the above-mentioned topics. We received so many high quality papers that the issue has had to be divided into two parts - this issue is Part 1, and Part 2 will be published as 2009 Volume 50 Nos 1/2/3/4.

Part 1 consists of two sections. The first section (comprising five papers) is dedicated to *Spark Ignition Engines Operation*, covering various aspects ranging from modelling and knocking issues up to emissions and second-law analysis. The second section covers *Performance and Emissions during Transient Operation* (five papers).

Part 2 contains three sections, namely,

Fuel Injection and Spray Development (four papers)

Steady-state Engine Operation (four papers)

Use of Biofuels (six papers)

We would like to thank all the contributing authors for their high quality papers, as well as to congratulate them on their dedication to research into internal combustion engines. We also extend our gratitude to the reviewers for devoting their precious time.