Editorial - IFP Energies nouvelles International Conference

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Oil & Gas Science and Technology - Rev. IFP Energies nouvelles **73**, E1 (2018)

https://doi.org/10.2516/ogst/2018001

Available online at:
www.ogst.ifpenergiesnouvelles.fr

Dossier LES4ICE'16 : LES for Internal Combustion Engine Flows Conference
Edited by C. Angelberger (Guest editor)

EDITORIAL OPEN ACCESS

IFP Energies nouvelles International Conference

LES4ICE – Large-Eddy Simulation for Internal Combustion Engine Flows, 30 November – 1 December 2016, Rueil-Malmaison, France

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Received: 12 January 2018 / Accepted: 16 January 2018

Further improving the environmental performances of Internal Combustion Engines (ICE) increasingly requires moving beyond traditional multidimensional simulation tools based on a cycle averaged approach (RANS), and to reliably predict and control individual engine cycles under realistic operating conditions. Large-Eddy Simulation (LES) offers this unique potential by predicting spatially filtered flow realisations, thus opening up new perspectives for extending the scope of application of CFD for ICEs.

Since its 1st edition in 2008, the LES4ICE conference provides a forum for exchange concerning research and development of LES and related experimental techniques for their application to ICE flows. It brings together researchers and engineers working in the field of piston engine combustion to debate the state of the art in LES applied to ICEs and examine advanced experimental techniques capable of supporting and validating its development.

The present special issue proposes an extract from the contributions to the 2016 edition of LES4ICE, following a reviewing process by the conference's Scientific Committee. The selected seven articles provide an overview on recent key advances in the domain of LES and related experimental techniques, and on their application to ICE flows.

An often neglected aspect of LES of piston engine flows is the unavoidable interaction between the numerical schemes used to solve the spatially filtered transport equations and the models required to close the unresolved terms in those equations. **T. Nguyen and AM. Kempf** [1] explore these aspects in relation to flow and combustion in a spark-ignition engine. They show how the level of dissipation from different numerical schemes can affect the LES predictions, and discuss in addition the relevance of widely used LES quality criterion in the presence of numerical dissipation.

Another key factor for ensuring an accurate resolution of the resolved scales in LES is the quality of the computational mesh which can be difficult to ensure during all phases of a four-stroke engine cycle. **Falkenstein *et al.*** [2] report on the development of a LES code combining overset Cartesian grids with an immersed boundary method to handle engine-like wall bounded geometries. A first application to the LES of a steady flow-bench allows validating the developed LES code by comparing its predictions with experimental findings.

Despite the increasing performance of massively parallel computers and the increased spatial resolution they allow, an accurate simulation of complex turbulent reactive flows still requires the availability of LES combustion models able to address turbulence/chemistry interactions at both the resolved and unresolved scales.

Davidovic *et al.* [3] propose a LES formulation of a Multiple Representative Interactive Flamelet model, and apply it to the LES of a reactive Diesel-like liquid spray in a well mastered constant volume vessel for which detailed experimental results are available via the Engine Combustion Network.

Yildar *et al.* [4] report the development of a LES model for combustion under Controlled Auto-Ignition conditions, and apply it to explore in detail the ignition and combustion mechanisms in a single cylinder engine running such a combustion mode.

Finally, a high-potential field for LES is its usage to gain an unprecedented detailed insight and understanding of turbulent flow and combustion in piston engines and how they impact their performances.

Nicollet *et al.* [5] report the usage of LES to confirm and complement findings from Particle Image Velocimetry studies of the flow at a late crank angle close to fuel injection resulting from the compression of a tumbling intake flow. This highly innovative approach was shown to allow identifying the causes for cyclic variability observed in a production direct injection spark-ignition engine.

Shekhawat *et al.* [6] present a study of the early flame kernel growth in a homogeneous charge spark-ignition research engine using PIV and LES, and on its link to cyclic combustion variability.

Finally **X. Yang and T-W. Kuo** [7] used LES of flow inside a motored research single cylinder engine to study the correlation between cyclic variability of the swirl generated by intake and compression and the variability of the intake valve curtain flow.

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