Editorial “Thermo- and Fluid-Dynamic Processes in Direct Injection Engines” THIESEL2014 special issue

Raul Payri

Last September 2014, the eighth edition of THIESEL conference was held.1 Since 2000, when the first edition took place, this bi-annual conference has gained a consolidated position as a meeting point between industry, research institutions and academia involved in R&D for automotive and truck engines. Considering that engine science and technology have evolved during these years, with new emerging engine concepts, and that the frontiers between spark ignition and compression ignition (CI) are becoming more and more diffuse, the conference initially focused on diesel engines, but renewed its name to THIESEL Conference on ‘Thermo- and Fluid-Dynamic Processes in Direct Injection Engines’ considering both CI2 engine and spark-ignition engine.
It is generally agreed that the internal combustion engine will remain the main propulsion system for vehicles, trucks and buses in the next 20–30 years and, furthermore, will remain present even in hybrid and electrified vehicles. Therefore, innovative research on combustion engines represents a most promising way to a substantial reduction in pollutant emissions, until new solutions based on hydrogen and fuel cell technologies may reach their maturity.
Innovation, however, calls for important research efforts. On the combustion side, further developments in advanced control strategies and hardware will be able to fully exploit the flexibility provided by modern multiple injection systems.3 Regarding other engine processes, advances will also be necessary in thermal and air management of the engine in response to future demands for a precise control of heat flows, exhaust gas recirculation (EGR) and turbocharging system operation. Also, it is likely that new and challenging issues regarding after-treatment technology and engine noise abatement will arise.
The outlook allows for an optimistic view on the potential of clean and silent combustion engine technologies. However, their eventual success depends on the academic researchers’ awareness of the industry needs and on the will of the transportation industry to invest in medium- to long-term basic research. In this sense, THIESEL 2014 presents both industries with more than 25 different companies attending the conference together with 30 universities and research centres. The combination of both types of institutions will provide better engines in the near future.
This Special Issue is a selection of the best papers presented in the conference. From a total of 110 article proposals, only 42 made it to the conference as there are no parallel sessions in this 3-day event. From these articles published in the THIESEL 2014 conference proceedings,1 11 were selected and submitted for peer review in the International Journal of Engine Research. Selected papers include two papers related to fuel injection, 4,5 two papers on turbocharging6,7 and seven papers on combustion.8–14
With respect to the articles selected for the injection part, in the work of Watanabe et al.,4 the visualization of cavitation inside real-size nozzles is presented for different nozzle seats changing the sac volume, finding that vortex flow within the sac affects the spray characteristics at the beginning of needle lift.3 The visualization of the cavitation phase in real-size nozzles has been a very active research work as could be observed from the work of Reid et al.15 To pass from fuel injection system to combustion, the

most common situation is to use one-dimensional code for injection modelling 16,17 or to make use of zero dimensional codes for the prediction of spray characteristics.18,19 In the work of Busch et al.,5 a research single-cylinder engine is used to study the effect of close couple injections, finding that in an optimized pilot-main injection strategy, combustion noise can be reduced by 3 dB compared to non-optimized pilot-main strategies with no emissions penalty.

One of the papers on turbocharging deals with the acoustic characterization of turbocompressors7 using a piezoelectric sensor array and real exhaust gases, finding that in-duct noise measurements offer a cost effective way to characterize the sound field generated by the compressor. Wo¨ ehr et al.6 present a new variable geometry turbine used for heavy-duty engines and find that tangential velocity in the diffuser is not only beneficial for the efficiency at low mass flow rates but also holds the capability to influence the surge margin and thus helps to accomplish the needed torque at low engine speeds. Combustion papers are divided into modelling papers where different codes are used based on discrete droplet model (DDM) such as the work by Imaoka et al.,10 with Star-CD focused on diesel cold-start combustion, or the work by D'Errico et al.,14 presenting multiple representative interactive flamelets for modelling combustion with OpenFOAM. In both cases, the agreement between computational fluid dynamics (CFD) models and experimental results is remarkable and possess the question whether more advanced CFD modelling tools such as large eddy simulation (LES)20 are necessary for engine development.

In the case of experimental combustion work, a new two-stroke, high-speed, direct injection (HSDI) CI engine9 is presented in joint collaboration between CMT-Motores Termicos and Renault Automobiles where two combustion concepts, the conventional diesel combustion (CDC) concept using diesel fuel and the partially premixed combustion (PPC) concept using RON95 gasoline, were carried out in a two-stroke, poppet valve HSDI CI engine configuration. Two singlecylinder engines were used for combustion, one from Istituto Motori8 to study high-glycerol ethers/diesel blends and one from KAIST and University of Orleans12 to study JP-8 fuel effect on premixed charge ignition in a diesel engine. Finally, there is one paper about improvements in thermal efficiency of premixed diesel combustion11 and the work by Lindner et al.13 that found that the structure and composition of the soot are mainly influenced by the late combustion phase in a diesel commercial vehicle engine.

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