Evaluation and Validation of ELSA Model in Diesel Sprays: 3D Cavitating Nozzles Case

S. Hoyas[†], A. Gil[†], P. Fajardo[†], D. Khuong-Anh[†*], F. Ravet[‡]
[†] CMT-Motores Térmicos, Universitat Politècnica de València, Valencia 46022, Spain
serhocal@mot.upv.es, angime@mot.upv.es, pabfape@mot.upv.es, and ankh2@mot.upv.es
[‡] Renault, 1 Avenue du Golf 78288, Guyancourt, France
frederic.ravet@renault.com

Abstract

Computational Fluid Dynamic (CFD) techniques have become one of the main tools in the design and development of diesel engines. There exist, however, some drawbacks and problems that must be overcome in the next years. One of the challenges is to predict accurately the couple between the flow inside the nozzle and the spray, including the primary break-up and the secondary atomization. In the last years, several authors have been developed the Eulerian-Lagrangian Spray Atomization (ELSA) model. ELSA model combines an Eulerian and Lagrangian descriptions by coupling these two methods properly. ELSA model also accounts for the modeling of droplets and their formation process, particularly in the dense spray region. The ELSA model for diesel spray modeling has been recently implemented and developed into Star-CD CFD commercial code. Author's effort was focused on a detailed validation and evaluation of the fuel injection in diesel engines using this last implementation. Spray atomization, spray formation and macroscopic characteristics of diesel spray behavior were investigated. The overall work has been conducted in non-evaporative conditions. As cavitation greatly affects to spray behavior and it is though that cavitating nozzles will be present in most of close future engines, this sort of configuration has been chosen for validation. Velocity profiles at the section area of the nozzle exit obtained from trusted and experimentally validated RANS internal flow simulation were used. Results have been validated again experimental data, mostly coming from CMT-Motores Térmicos institute. It was found that the ELSA model reproduces accurately the experimental results.

* Corresponding author: ankh2@mot.upv.es