Abstract

The main objective of this PhD thesis is the study of Diesel sprays under evaporative conditions by means of Large Eddy Simulations (LES) techniques. This study has been performed implementing a precise, low-demanding LES model in the free, full-purpose Computational Fluid Dynamics (CFD) code OpenFOAM.

The starting point was a careful and exhaustive review of the physical processes involved in sprays. An emphasis in CFD methodology, particularly for LES methods, was essential for the thesis, as we were able to find the possible problems and limitations of our approximation. Moreover, as the most widely used techniques for the industrial simulation of sprays are based on the Reynolds-Averaged Navier-Stokes models, we have highlighted the many advantages of LES modeling. As the latter are, by definition, more computationally expensive than RANS, we made an optimal configuration that, while it is able to recover accurately the experimental results, its characteristic time is in the same order of magnitude that RANS ones. As applicability is a must in this thesis, we use the surname "Engineering" LES.

One of the key points of the thesis has been the correct configuration of the flow turbulent conditions on the inlet. In order to get accurate results, the turbulent structures coming from this inlet need to be time- and space-coherent. An adequate calibration of this conditions is needed to perform any spray simulation.

Last but not least, all the simulations performed where validated against experiments, obtaining a very good agreement even close to the nozzle.