Summary

Since the last two decades of the XX century and still nowadays the automotive industry has resorted to the very understanding of the combustion process. Regarding the Diesel engine many contributions has been built from the machine itself or test rigs that simulate real operating conditions. Based on that, the use of non-intrusive optical techniques has propelled the understanding of Diesel combustion phenomena, and extended conceptual models as Dec stablishes the Diesel flame morphology from the visualization of the injection/combustion process.

From such combustion process picture, a review of the current state of the art has been done in order to assess on the still remain questions of the injection/combustion areas open to knowledge contribution. In that sense, it has been identified that Diesel flame transient evolution turns contradictory either on the final penetration result or the difficulties involved with reacting spray studies. While the quantification of the soot and its temperature in diffusive conditions might be related with high uncertainties of the experimental set-up, i.e. with the final result.

The approach of this thesis is experimental; therefore, it considers the experimental conditions to ideally address the investigation with two main optical techniques, schlieren visualization and the two color method. Regarding the first one, the solution to saturation of the camera sensor enabled a reliable penetration on the reacting spray penetration. This technique added value has helped to evaluate two different test rigs in order to define the ideal environment (optical technique + test rig) to better describe the reacting spray. Regarding two color thermometry, experimental calibration has helped to define the basis to obtain a spatial relationship of images with different spectral information and to significantly improve the technic results.

As a result, using standard techniques to investigate lift-off length of diffusion flames has helped to establish that the schlieren image with temporal resolution is feasible from the radial expansion in the auto-ignition area. Schlieren results: penetration, inert and reactive spray angle and lift-off have supported the description of the evolution of penetration flame phases, which compared with an inert jet have been modified by the establishment of the combustion. Depending on the radial and axial flame expansion the process description can be modified according to the variation of combustion conditions. Although, in the overall description framework the 5 stages of penetration: inert, self-ignition and expansion, stabilization, acceleration and quasi stationarity are kept. On the other

hand, research on competing fuels in the formation of soot as n-heptane and Diesel, has helped to establish the sensitivity of soot indicators under different operating conditions evaluated in an optical engine.

As an overall, understanding the evolution of the flame front penetration and soot formation in diffusive flames provides an extensive data with which it is possible to feed complex calculation models as the CFD and thus, provide additional elements for comprehending the radial and axial flame expansion processes; something that in the present work has been analyzed only from the macroscopic point of view document.