INVESTIGATION OF THE FLOW AROUND AN EXHAUST VALVE FOR AN INTERNAL COMBUSTION ENGINE

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One way to increase the efficiency of an internal combustion engine is to increase the exhaust mass flow leaving the cylinder through the exhaust valve. The present project comprises a study the flow through the exhaust port of such an engine. The objectives of this work are to understand the flow behavior and to eventually improve the exhaust flow by changing the valve and exhaust geometry.

The first part is a numerical study of the flow using a CFD solver developed at VKI (Thor). Axisymmetric and 2D configurations are simulated to evaluate the correspondence between the actual valve and the one that is tested in a 2D test section facility at VKI. Although this numerical study shows large differences in flow topology for the 2D and axisymmetric computations, in both cases the flow is highly entropic (large pressure losses) and the parametric effects are the same. For example, in both sets of simulations no difference in the flow topology can be observed when the cylinder temperature is varying. However, the shock strengths, the detached flow extent, and the total pressure losses all increase when the valve opening is decreasing.

This numerical part is complemented by experiments that were conducted in a 2D test section facility at steady flow conditions. This set up allowed for Schlieren visualizations of flows and for pressure and temperature measurements. The experiments show that the numerical code used (THOR) is able to reproduce reasonably well these internal flows since good agreement (except for some detached flow regions) was found between experiments and computations (Fig. 1). This suggests that the THOR code can be reliably used for further analysis of the axisymmetric configuration. The trends observed in the experiments were the same as those noted in the previous numerical analysis. The facility shows good performance regarding the repeatability and the stability of the tests.

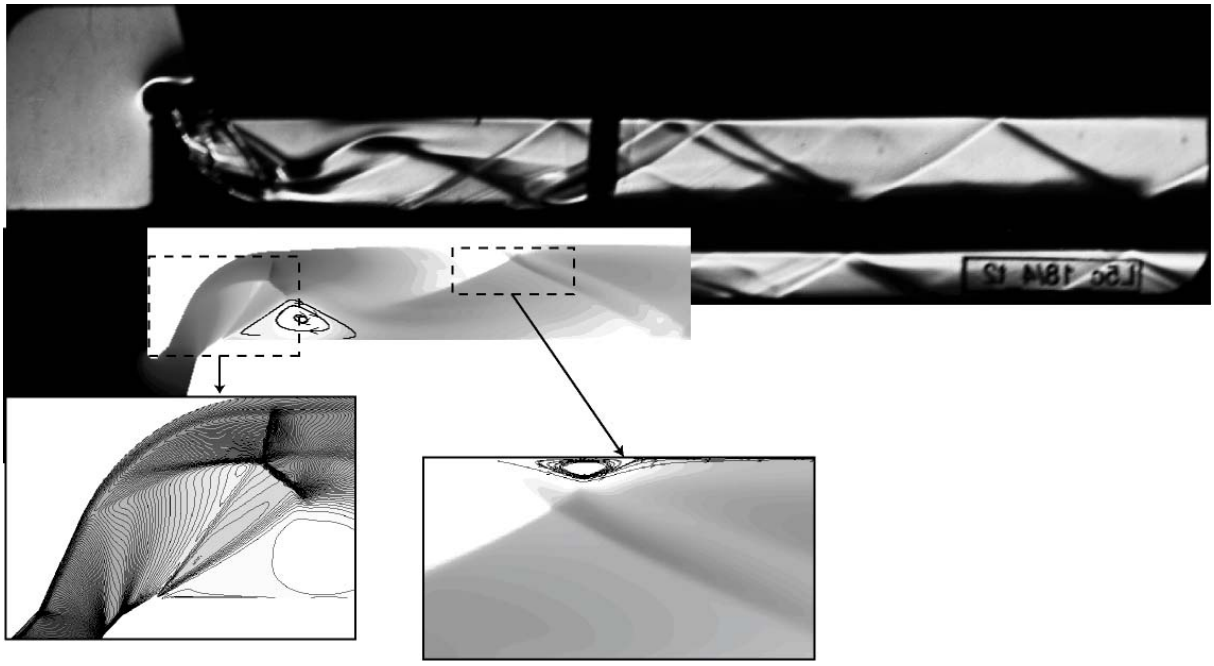

Figure 1 : Comparison between the computed density field (below) and Schlieren picture (above) for a valve opening of 5 mm