INTEGRATION AND EXPERIMENTAL VALIDATION OF VOF METHOD IN AUTOMOTIVE AERODYNAMIC COMPUTATIONS

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In rainy weather, in static or dynamic conditions, the deposited water interacts with the air flow, flows and accumulates in different areas of the vehicle (under-hood, dashboard cowl and under-floor). This water can lead to safety problems (electronic component alteration, short cut). For example, the dashboard cowl is a part which role is to route the fresh and dry air into the air conditioner system while evacuating the flowing water coming from the wind shield. Actually, these phenomena are evaluated during shower simulation testing requiring real car models. Indeed, if modifications are required, their costs are extremely high du to the advanced stage of the industrial design process.

The goal of the work is then to validate a numerical tool that allows the evaluation of such problems earlier in the industrial development process. These tools will be based on a two methods coupling, an Eulerian one called "VOF – Volume of fluid", and an aerodynamic one (LES or URANS). However, the limitations of existing models, mainly du to a restricted knowledge of the transfer phenomena through a phase discontinuity (called interface), don't allow obtaining satisfactory results with the industrial CFD software. The scientific objective is then the understanding of transfer phenomena through an air-water interface and finally to integrate and validate new coupling models in the industrial CFD software Fluent.

Based on experimental measurements (Particle Image Velocimetry) and CFD simulations, a 2d impinging jet academic configuration has been identified to develop the coupling models. The work is oriented onto 2 axes.
The first is the creation of an experimental validation database. An "interface Particle Image Velocimetry" measurement technique is especially developed for this purpose and gives access to the velocity and turbulence fields on both sides of the interface. LeDaR® real time interface tracking method is also performed on several configurations (flow rate, water level, use of obstacles…etc.). It gives information on the dynamics and statistic contents of the interface deformation.
The second axe is the evaluation and the development of coupling models between LES/URANS and VOF using the experimental database to perform the validation.

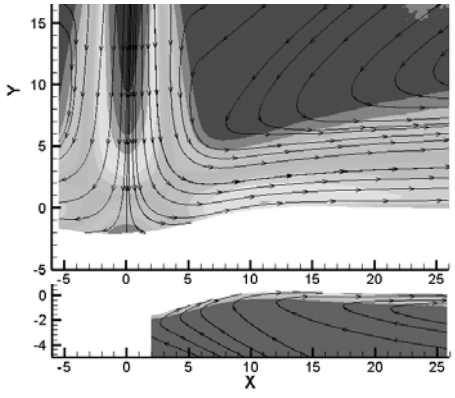

Figure 1: Interface PIV fields

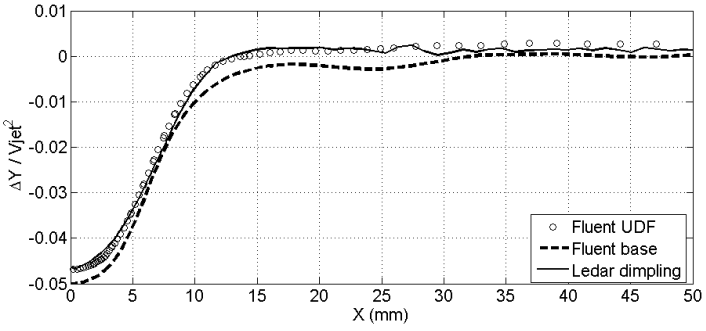

Figure 2: Interface deformation Exp/num correlation