INVESTIGATION OF LIQUID JET INJECTION INTO A HYPERSONIC CROSSFLOW

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Transverse jet injection into a crossflow problem is encountered in many engineering applications and therefore it is classical problem and it is a research area of its own. Fuel injection into SCRAMJET combustion chambers and external cooling of re-entry vehicles are examples of such application areas. It is very difficult to simulate such kind of flow geometry, especially the injection area. Therefore it is preferred to start to numerical simulations at further downstream of the injection point with appropriate initial conditions. This project is an exploratory experimental project on the subject to investigate the possibility of the extraction of these initial conditions from experimental data with the usage of high speed camera as the main measurement system.

Experiments are done in VKI – H3 Hypersonic Wind Tunnel, where water was injected upwards over a sharp edged flat plat Consecutive images of the flowfield are acquired with high speed camera while the conditions of the water such as mass flow rate temperature etc. and the freestream flow was also measured. Data processing algorithms are developed to process these images and to extract information about the flowfield.

During the project; possible high speed camera and flow illumination configurations was investigated outside the wind tunnel to determine the best configuration to be used in the experiments. A model for the high speed camera is proposed and it was shown that with the current measurement system, it is not possible to extract information about the droplets disintegrated from the liquid jet but the extracted information are for the clumps (Large group of liquid particles moving with the same velocity), fractured from the body of the jet.

With the developed algorithms, penetration height, lateral extension, frequency content, mixing and velocity of the injected jet are calculated for selected test cases, which constitute the preliminary quantitative data that are needed to define an initial condition for the numerical calculations.

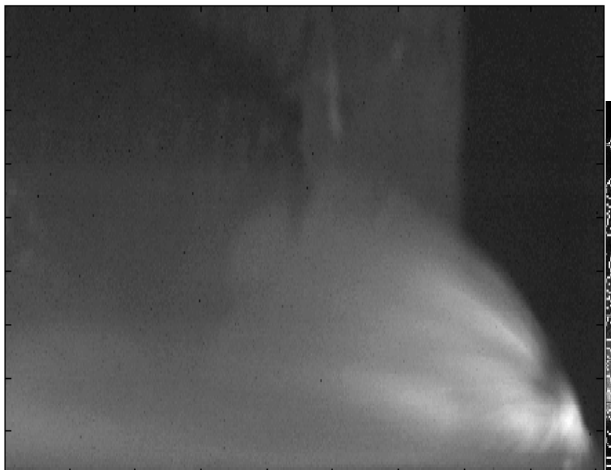

Figure 1: Instantaneous Image of The Flowfield

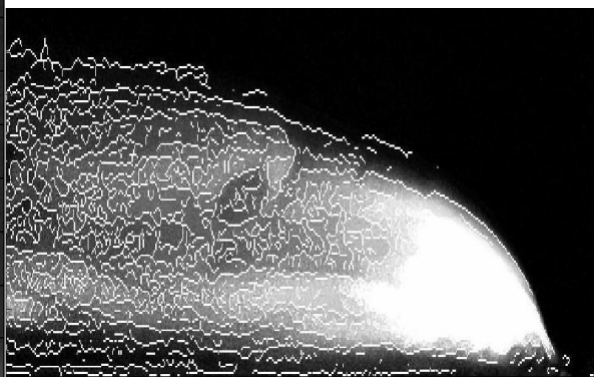

Figure 1: Standard Deviation Image and Detected Boundaries