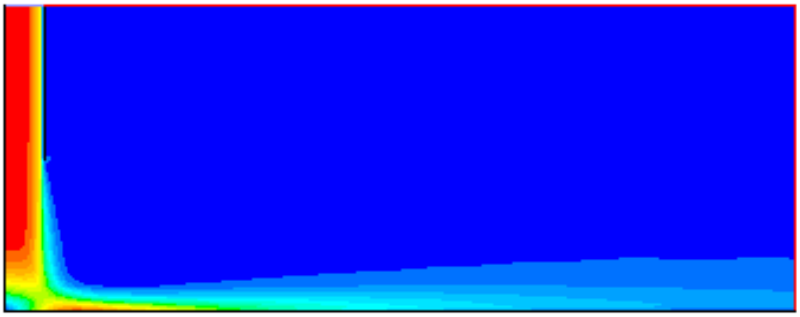
NUMERICAL STUDY OF TURBULENCE MODELS FOR IMPINGING GAS-JET SYSTEMS

Miguel Gustavo Coussirat Núñez, Argentina & Spain
Supervisors: J.-M. Buchlin & J.P.A.J. van Beeck

Starting from earlier eddy viscosity ***k*-ε** turbulence model, many kinds of turbulence models have appeared. None of these are general and useful for all kind of fluids that are studied in computational fluid dynamics (**CFD**) research. Depending on the problem to model, one of they shows better behavior than the other and many references about this subject can be seen in the literature. In the application of these turbulence models to industrial problems, a decision about what turbulent model works better is an open matter. In this context, an evaluation of turbulence models applied to impinging gas-jets systems to predict velocity and temperature fields has been made. Special emphasis is given to the performance of the V2F model (Durbin 1991). This model was specially developed for this kind of flows. It is expected that this model may improve the results obtained for the case of thermal convective exchange between impinging gas jets systems and solid surfaces.

In this work, comparisons between several turbulence models and extensive application to cases of thermal convective exchange between impinging gas jets systems and solid surfaces have been made. Emphasis has been put on the correct modeling of velocity and heat flux field in zones closest to the solid wall. A correct modeling of velocity in these zones, where the free jet become a wall jet with heat transfer flux, is necessary. There, turbulent impinging jets have complex features due to entrainment, stagnation, high streamlines curvature and inlet condition influences. These features prove to be somewhat difficult to represent for most existing turbulence models, which were essentially developed and tested for flow parallel to walls.

The main goal of this study was the evaluation of the behavior of several turbulence models and their comparison against experimental data. For define test cases to use, an extensive survey in the literature has been made. To have a good idea about the performance of the V2F model is necessary to test it against the other models and experimental impinging jet data. Impinging single round nozzles (**SRN**), single slot jet (**SSN**) and arrays of slot nozzles (**ASN**) are considered. Remarks about difficulties to find coherent and extensive impinging jets comparison in the literature have been made and with this work, an enrichment of the present numerical-experimental databases will be expected. Finally, some guidelines for industrial design are given.



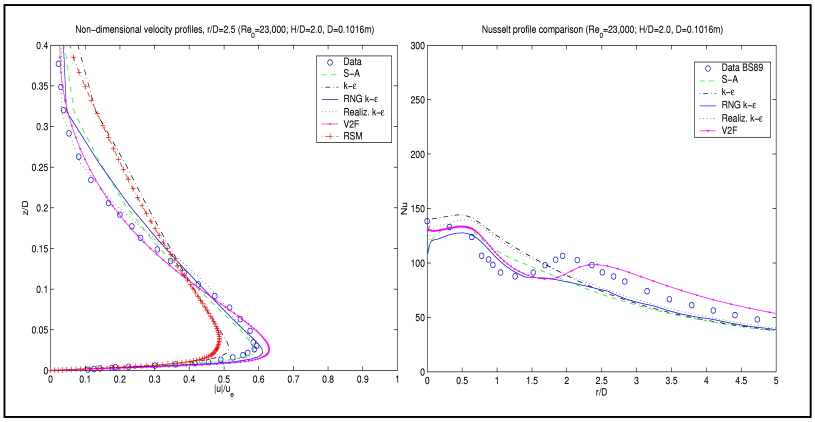


Figure 1: Mean velocity field in a single impinging jet (upper image).
Figure 2: Velocity profile obtained at r/D=1.5 with several turbulence models (lower left).
Figure 3: Mean Nusselt number along the wall for the same turbulence models (lower right)