PROCESSING INTERFACES IN PIV ALGORITHMS – APPLICATION TO SLUG FLOWS

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It is known that the Particle Image Velocimetry (PIV) technique is affected by the presence in the flow images offeatures and patterns, such as the ones related to the presence of a boundary. In order to obtain results with a physical meaning near the boundaries extra information has to be provided *a priori* to the processing algorithm, such as the kinematics condition on the boundary. A study of the influence of the imposed condition on the boundary on the obtained velocity profile was made and an approach to overcome the referred problem was tested. It consisted in a combination of PIV and PTV (Particle Tracking Velocimetry), also designated in the literature by Super Resolution PIV. In this case the PTV technique is applied only near the boundaries in the cases where PIV interrogation windows overlap those boundaries. In order to make the tracking process of the PTV easier, PIV data is used as input data for the predictor's determination. To avoid the PIV biased values in the boundaries neighborhood, 4 methods were implemented. These methods are based on, among others, polynomial fits of the known values of the velocity profile, and they may use or not, information on the boundaries. With these methods to refine the PIV data, the obtained predictor for the tracking process is better, the one obtained with no refinement. Two ways of obtaining predictors for PTV were also tested and their performance compared. An interesting side effect of using the combined approach PIV+PTV is a gaining in spatial resolution.

Using PIV data of a two-phase flow (slug flow) the proposed methods were tested. The results in Figure 1 represent the velocity profile in the film of liquid that exists between the slug and the pipe's wall. The velocity profile with unknown conditions on the slug mask is shown along with the real one. The difference is remarkable. A considerable improvement was achieved using method #2, this method consists in finding a predictor for PTV using a second order polynomial fit on the PIV points not affected by the boundaries. The errors thus obtained are in the order of 5%. In this stage of development this method allows the simplification of the iteration procedure needed in order to obtain the condition on the wall. In a future step it is expected to improve these schemes in order to avoid the iteration process and avoid the wall interference.

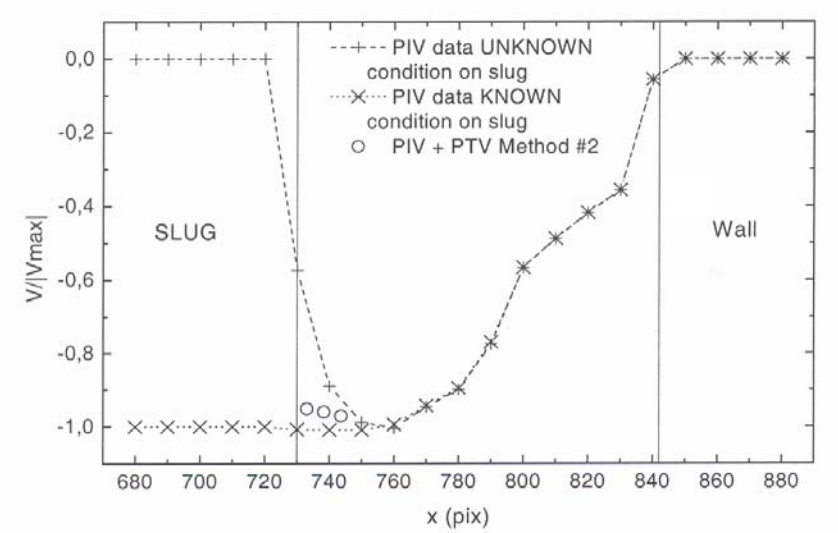

Figure 1: Obtained velocity profiles in the film flow that processes between a slug and the pipe wall. The « + » denotes the profile with unknown conditions in the slug, the « x » the real results and the circles the improvement near the slug boundary achieved.