THESE

Model-based approaches for flow estimation using Particle Image Velocimetry

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Particle Image Velocimetry (PIV) is one of the reference experimental methods for the study of complex flows. Still, PIV, either planar of tomographic, suffers from a set of limitations. The goal of the present thesis was to use and develop methods to overcome those limitations using physical-based modeling. In this regard, three different approaches have been explored.
The first approach aims at improving velocity and acceleration estimation in the context of Time-Resolved PIV (TRPIV). A novel algorithm has been developed: the Lucas-Kanade Fluid Trajectories (LKFT, Yegavian et al. 2016). This algorithm extends the two frame techniques to short image sequences assuming smooth polynomial trajectories for the flow. In a second part of the work, an approach to reconstruct the unsteady flow velocity field from the sole knowledge of the PIV mean flow and one or more unsteady point-wise measurements has been assessed and used on a round jet flow. This method, introduced by Beneddine et al. (2016), uses on the Parabolized Stability Equations (PSE). At last, the third method relies on the full unsteady incompressible Navier-Stokes equations to improve PIV measurement sequences. An unsteady velocity field strictly respecting the governing equations and as close as possible to the PIV measurement is searched for. This approach, using a variational data-assimilation framework, has been applied to synthetic and experimental configurations.

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Composition du jury

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