

Introducing the HOMER numerical benchmark: LPT and DA datasets of turbulent flow over moving panels

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Abstract

Following the First Challenge on Lagrangian Particle Tracking (LPT) and Data Assimilation (DA), organized in 2020 (see <http://cfdforpiv.dlr.de/> and Leclaire et al.), the next numerical benchmark activities within the HOMER project take as their objectives to assess LPT and DA algorithms in a fluid-structure interaction situation.

The physical situation that has been retained is that of a turbulent wall-bounded flow, with a part of the wall consisting of a flexible panel entrained in forced oscillation, a situation which has been investigated experimentally within one of the HOMER tasks, led by the Delft University of Technology. In the numerical benchmark, a spanwise infinite cylinder has been added within the turbulent boundary layer, in order to enhance the intensity of turbulent fluctuations in the flow, and of pressure fluctuations at the wall.

This communication focuses on the specific objectives of the benchmark compared to the challenge, the most salient of which would be:

- assessing the performance of marker tracking to measure the panel motion, velocity and acceleration, depending on the marker density and complexity of panel deformation
- assessing the capability of LPT to perform jointly measurements of the flow (by tracking the tracer particles), and of the panel motion (by tracking markers placed on it), with a single set of cameras viewing particles and markers, compared to performing LPT and marker tracking (or DIC) separately, e.g. using fluorescent markers and wavelength separation
- further investigating the impact of temporal truncation on the determination of acceleration by LPT, and of pressure by DA

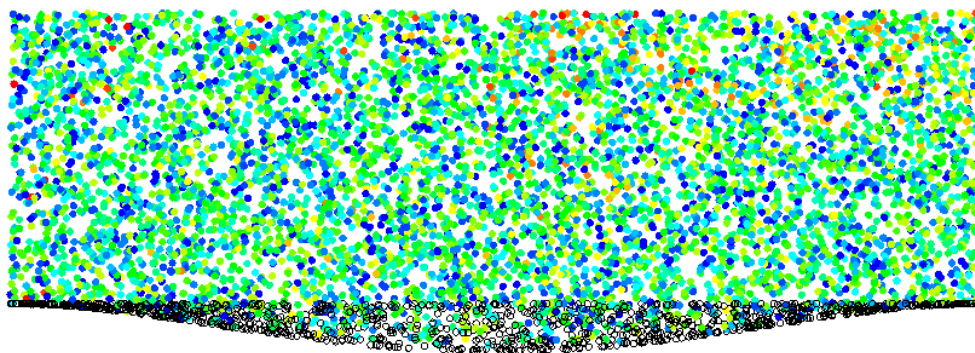


Figure 1: Instantaneous particle cloud (colored dots) and markers on the moving panel (hollow black circles) of the benchmark simulation, restricted to the zone of interest.

The communication will show how datasets, and their requested outputs from participants, have been designed in order to benchmark LPT and DA approaches along these lines. Details will be provided on the various acquisition situations considered, i.e. joint or separate LPT and marker tracking/DIC, different marker and particle seeding densities, and different acquisitions setups (two-pulse, four-pulse, time-resolved).

Acknowledgements

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 769237 HOMER.

References

- B. Leclaire, I. Mary, C. Liauzun, S. Péron, A. Sciacchitano, A. Schröder, Ph. Cornic, F. Champagnat, 1st challenge on Lagrangian Particle Tracking and Data Assimilation: datasets description and extension towards an online benchmark with automatic evaluation, ISPIV2021 conference, online, Aug. 1-4, 2021.