Special issue on the 20th International Symposium on Flow Visualization (ISFV20)

Sciacchitano, A.; Discetti, Stefano

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Editorial

Special issue on the 20th International Symposium on Flow Visualization (ISFV20)

Andrea Sciacchitano[1,*] **and Stefano Discetti**[2]
[1] *Faculty of Aerospace Engineering, TU Delft, Delft, The Netherlands*
[2] *Department of Aerospace Engineering, Universidad Carlos III de Madrid, Leganés, Spain*
E-mail: *a.sciacchitano@tudelft.nl* and *sdiscett@ing.uc3m.es*

The 20th edition of the International Symposium on Flow Visualization (ISFV20) was held in Delft, the Netherlands, from 10–13 July 2023. Co-sponsored by the Visualization Society of Japan, the symposium gathered 120 participants from 21 countries all over the world. The works were presented in 20 Technical Sessions that covered a broad range of topics. According to tradition of the ISFV, two awards were delivered to outstanding scientists in the field of Flow Visualization: the da Vinci Award to Prof. Markus Raffel and the Asanuma Award to Prof. Yassin Hassan.

This Special Issue aims at collecting the most relevant works presented at the ISFV20 on the development and application of state-of-the-art measurement techniques for the visualization of fluid flows. These techniques include particle image velocimetry (PIV), Lagrangian particle tracking (LPT), temperature-sensitive paint (TSP), pressure-sensitive paint (PSP), as well as recent developments in machine learning tools for the enhancement of measurement accuracy and resolution. Although the symposium focuses on the visualization of fluid flows, several contributions are targeted to advance the flow measurement techniques mainly for two purposes. On the one hand, to improve the accuracy of planar and volumetric PIV and assess its capabilities in challenging relevant scenarios, also including novel processing methods based on machine learning. On the other hand, to enable the simultaneous evaluation of the flow velocity and additional relevant flow properties such as concentration, temperature and surface pressure.

Sperotto *et al* [1] introduces a novel meshless tracking assimilation to enhance the resolution of 3D time-resolved particle tracking velocimetry. The mathematical backbone is a regressor based on radial basis functions, which enforces physical constraints in its formulation. The method shows better performance than classical linear interpolation.

Wieneke and Rockstroh [2] propose an object-aware LPT (OA-LPT) framework to mitigate the shortcomings of state-of-the-art LPT when dealing with partially obstructed views. The method involves establishing depth maps for each camera to encode the position of the object. OA-LPT provides a computationally inexpensive improvement to existing LPT techniques when solid objects are present within the measurement domain.

Tauwald *et al* [3] present a study of nasal airflow dynamics using tomographic PIV. This work assesses the accuracy of tomographic PIV to enable the analysis of the flow structures in the nasopharynx during the physiological breathing

* Author to whom any correspondence should be addressed.

cycle. The technique provides interesting results in this configuration and can offer valuable information for validation of computational fluid dynamics (CFD) simulations.

Anjaneya Reddy *et al* [4] investigated the performance of the recurrent all-pairs field transform (RAFT) PIV on unseen data sets from experiments in the wake of a circular cylinder. Their results are overall consistent with standard PIV analysis and highlight the limited effectiveness of image preprocessing techniques when using RAFT-PIV for velocity field estimation.

Three works presented in this special issue deal with the development and application of approaches for the evaluation of the temperature either in the flow field or on the surface of solid objects. Käufer and Cierpka [5] introduced a Lagrangian approach for the simultaneous measurement of the velocity and temperature fields in 3D domains. For the kinematic part, the approach is based on the shake-the-box LPT algorithm, whereas for the temperature field particle image thermography is used with temperature-sensitive encapsulated thermo-liquid crystals as seeding particles. A novel neural network approach was developed for processing the temperature information, leading to relative uncertainties of about 6.5%. Venenciuc *et al* [6] implemented the single-shot lifetime method to acquire the temperature distribution on the surface of an SD7003 foil at Reynolds number of 60 000, in order to study the dynamics of the laminar separation bubble (LSB). The authors demonstrated the capability of the approach to measure the time-averaged locations of the LSB, namely separation, transition and reattachment, in good agreement with PIV measurements. In addition, the technique was also shown to capture the unsteady dynamics of shear layer vortices. Jung *et al* [7] discusses the fabrication of a thin TSP of less than 2 μm thickness, achieved via ball milling, to enhance the technique's spatio-temporal resolution. The authors report that an optimization of the milling conditions should be performed to strike a balance between emission intensity and measurement resolution.

In the work by Quinn *et al* [8], the use of the fast-response PSP technique was demonstrated for the quantitative measurement of the surface pressure in explosively-driven blast wave testing. The approach is able to accurately capture the dynamics of the wave front, with weak flow features also being visible. In addition, the authors propose a pixel-wise temporal deconvolution to enhance the technique's temporal response, based on the assumption of a step-change input of the surface pressure and first-order response of the PSP technique.

Sankar *et al* [9] address the topic of particle concentration evaluation from the PIV images, investigating two techniques, namely the exponential averaging-based sliding method and the Voronoi cell-based approach. The results demonstrate that the latter enables the accurate evaluation of small structures with high concentrations while also maintaining high reliability in regions with low concentrations.

We hope readers of Measurement Science and Technology will enjoy reading this Special Issue and learn more about the recent developments in flow-field diagnostics.

Data availability statement

All data that support the findings of this study are included within the article (and any supplementary files).

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ORCID iDs

Andrea Sciacchitano https://orcid.org/0000-0003-4627-3787
Stefano Discetti https://orcid.org/0000-0001-9025-1505

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