

Simultaneous 3D measurement of the translation and rotation of finite size particles and the flow field in a fully developed turbulent water flow

Simon Klein, Mathieu Gibert, Antoine Bérut, Eberhard Bodenschatz

(Submitted on 10 May 2012 (v1), last revised 13 Jul 2012 (this version, v2))

We report a novel experimental technique that measures simultaneously in three dimensions the trajectories, the translation, and the rotation of finite size inertial particles together with the turbulent flow. The flow field is analyzed by tracking the temporal evolution of small fluorescent tracer particles. The inertial particles consist of a super-absorbent polymer that renders them index and density matched with water and thus invisible. The particles are marked by inserting at various locations tracer particles into the polymer. Translation and rotation, as well as the flow field around the particle are recovered dynamically from the analysis of the marker and tracer particle trajectories. We apply this technique to study the dynamics of inertial particles much larger in size ($R_p/\{\eta\} \approx 100$) than the Kolmogorov length scale $\{\eta\}$ in a von Kármán swirling water flow ($R\{\lambda\} \approx 400$). We show, using the mixed (particle/fluid) Eulerian second order velocity structure function, that the interaction zone between the particle and the flow develops in a spherical shell of width $2R_p$ around the particle of radius R_p . This we interpret as an indication of a wake induced by the particle. This measurement technique has many additional advantages that will make it useful to address other problems such as particle collisions, dynamics of non-spherical solid objects, or even of wet granular matter.

Comments: 18 pages, 7 figures, submitted to "Measurement Science and Technology" special issue on "Advances in 3D velocimetry"

Subjects: **Fluid Dynamics (physics.flu-dyn)**

MSC classes: 76F05, 76-05, 76T20

Journal reference: Meas. Sci. Technol. 24 (2013) 024006

DOI: [10.1088/0957-0233/24/2/024006](https://doi.org/10.1088/0957-0233/24/2/024006)

Cite as: [arXiv:1205.2181](https://arxiv.org/abs/1205.2181) [physics.flu-dyn]

(or [arXiv:1205.2181v2](https://arxiv.org/abs/1205.2181v2) [physics.flu-dyn] for this version)

Submission history

From: Mathieu Gibert [[view email](#)]

[v1] Thu, 10 May 2012 07:49:46 GMT (5026kb)

[v2] Fri, 13 Jul 2012 14:05:30 GMT (10529kb)

[Which authors of this paper are endorsers?](#)

Download:

- [PDF](#)
- [PostScript](#)
- [Other formats](#)

Current browse context:

physics.flu-dyn

[< prev](#) | [next >](#)

[new](#) | [recent](#) | [1205](#)

Change to browse by:

[physics](#)

References & Citations

- [NASA ADS](#)

Bookmark([what is this?](#))

