

IN APPLICATION

Volumetric Flow Field Imaging

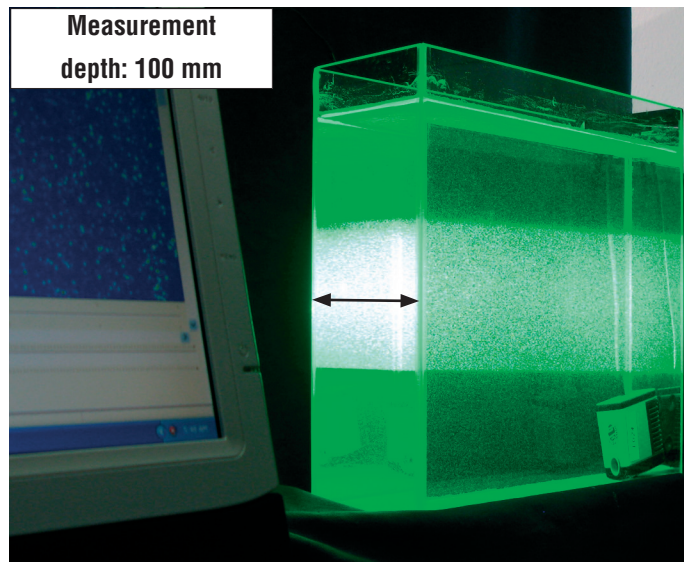
FlowMaster Tomographic PIV, Tomographic PTV and 3D-PTV

Introduction

Tomographic PIV, **Tomographic PTV** and **3D-PTV** from **LaVision**, share some features that are hardly found in other **volumetric imaging systems**:

Unmatched flexibility in space:

Fit the measurement system to your measurement volume, not the other way round! LaVision's Volumetric Flow Measurement systems cover the whole range of measurement volumes: from **cubes to thin volumes**, from small volumes of only a **few cubic millimeters to large volumes of several liters**. The possibilities are easy to understand: If one can illuminate a volume with sufficient light intensity and the particles are in focus in the camera images, then you can do volumetric flow measurement with the LaVision FlowMaster systems, no matter if the volume is thick or thin, no matter if it is small or large.



Unmatched flexibility in time:

Use low speed cameras for instantaneous **high resolution** measurements or high-speed cameras to do **time resolved full volume** measurements. Upgrade your current planar measurement system

to a full volume system. (Please ask LaVision about the upgrade options for your existing planar setup).

Unmatched flexibility in analysis:

LaVision provides **different volumetric analysis methods: Tomographic PIV, Tomographic PTV and 3D-PTV**, all based on identical hardware and experimental setup. **Tomographic PIV** allows the measurement **at particle densities surpassing** all other volumetric flow measurement techniques, giving the maximum amount of information from a single recording[1]. After the tomographic reconstruction one is free to do Eulerian vector calculation on a regular grid (**Tomographic PIV**) or Lagrangian tracking of individual particles (**Tomographic PTV** [2]).

Direct particle tracking, with **3D-PTV**, delivers individual particle velocities from ten thousands of particles in only a few minutes of analysis time.

Unmatched ease of calibration:

LaVision's unique **Volume Self Calibration** [3] allows the usage of a **single view** of our 3D calibration targets to calibrate the complete volume at once.

Unmatched flexibility in illumination:

With LaVision's **adjustable Volume Optics** it is easy to illuminate exactly the desired measurement volume. It covers the whole range from thin volumes to large measurement cubes.



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LaVision Inc.

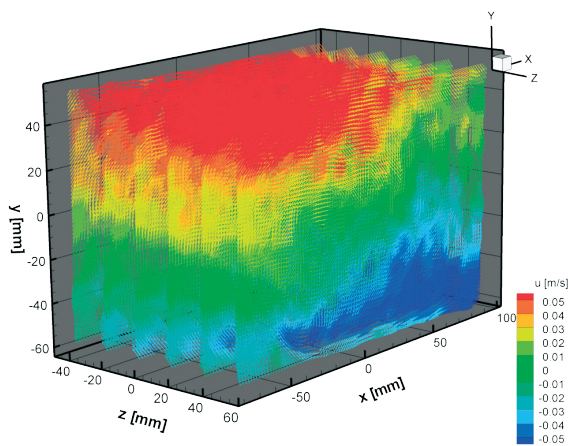
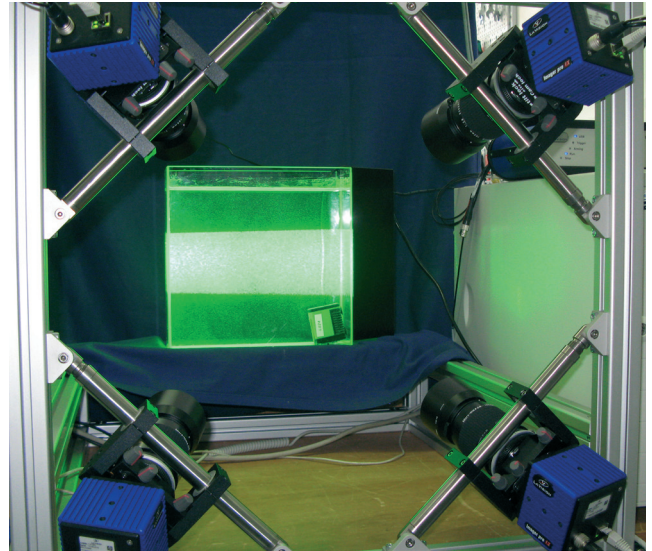
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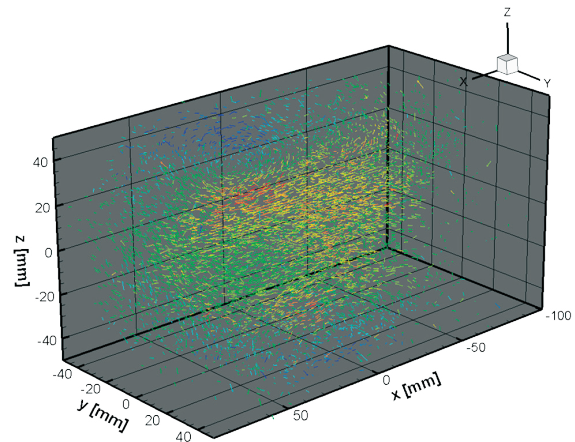
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Experimental setup

- **64 Megapixel Sensor:** four Imager Pro LX 16M cameras (sensor: 4.9 k x 3.2 k) on a rigid rig with Scheimpflug adapters, 105 mm lenses, working distance: 500 mm
- **Laser:** 2 x 200 mJ Nd:YAG, double pulse laser
- **Programmable Timing Unit** for synchronization of cameras and laser
- **Adjustable Volume Optics**
- **Measurement volume: 170 x 110 x 100 mm³** in a 300 x 300 x 100 mm³ water basin
- **Calibration:** Single view of calibration target (200 x 200 mm²), Volume Self Calibration applied, to correct for remaining calibration disparities
- **Seeding:** 100 μ m particles
- **Recorded volume images:**
300.000 particles (Tomographic PIV)
30.000 matched particles (3D-PTV)



Results Tomographic PIV: dense vector grid. Displayed are six vector planes out of 55 planes. The values of the u-component are color coded. **300.000 particles** per illumination were recorded in each camera image (circular flow from a pump at the bottom of the basin).



Results PTV: single-particle vectors with color coded u-vector component: **30.000 matched particles** per illumination (free convective flow).

References:

- [1] Elsinga G.E., Scarano F., Wieneke B. & van Oudheusden B.W., **Tomographic particle image velocimetry**, *Experiments in Fluids* 41, 933-947, 2006
- [2] Schröder A., Geisler R., Staack K., Wieneke B., Elsinga G.E., Scarano F., Henning A., **Lagrangian and Eulerian views into a turbulent boundary layer flow using time-resolved tomographic PIV**, *14th Int Symp on Applications of Laser Techniques to Fluid Mechanics*, Lisbon, Portugal, 7-10 July, 2008
- [3] Wieneke B., **Volume Self-Calibration for 3D Particle Image Velocimetry**. *Experiments in Fluids*, 45, 549-556, 2008

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