FLOW CHARACTERIZATION OF BIO-MEDICAL DEVICES

APPLICATION NOTE PIV-026 (A4)

Laser based diagnostic instrumentation is the most ideal tool for flow characterization of bio-medical devices. Two of the common systems are Particle Image Velocimetry system (PIV) and Phase Doppler Particle Analyzer (PDPA). Shown throughout this application note are examples of applications conducted by PIV and PDPA systems.

PIV is an excellent diagnostic tool that can be used to obtain instantaneous fluid velocity data relevant to the flow measurement in your investigation of bio-medical devices. PIV provides insight into the fluid mechanics at work and their interplay with relevant subjects of interest in heart valve design and flow diagnostic of aneurysm. Due to its non-invasive optical nature, PIV can be used in any fluid medium, without disturbing or influencing the subject of interest. As a technique already long in use within engineering and mechanics communities, PIV is an established diagnostic providing high-quality and precise measurements within fluid flows.

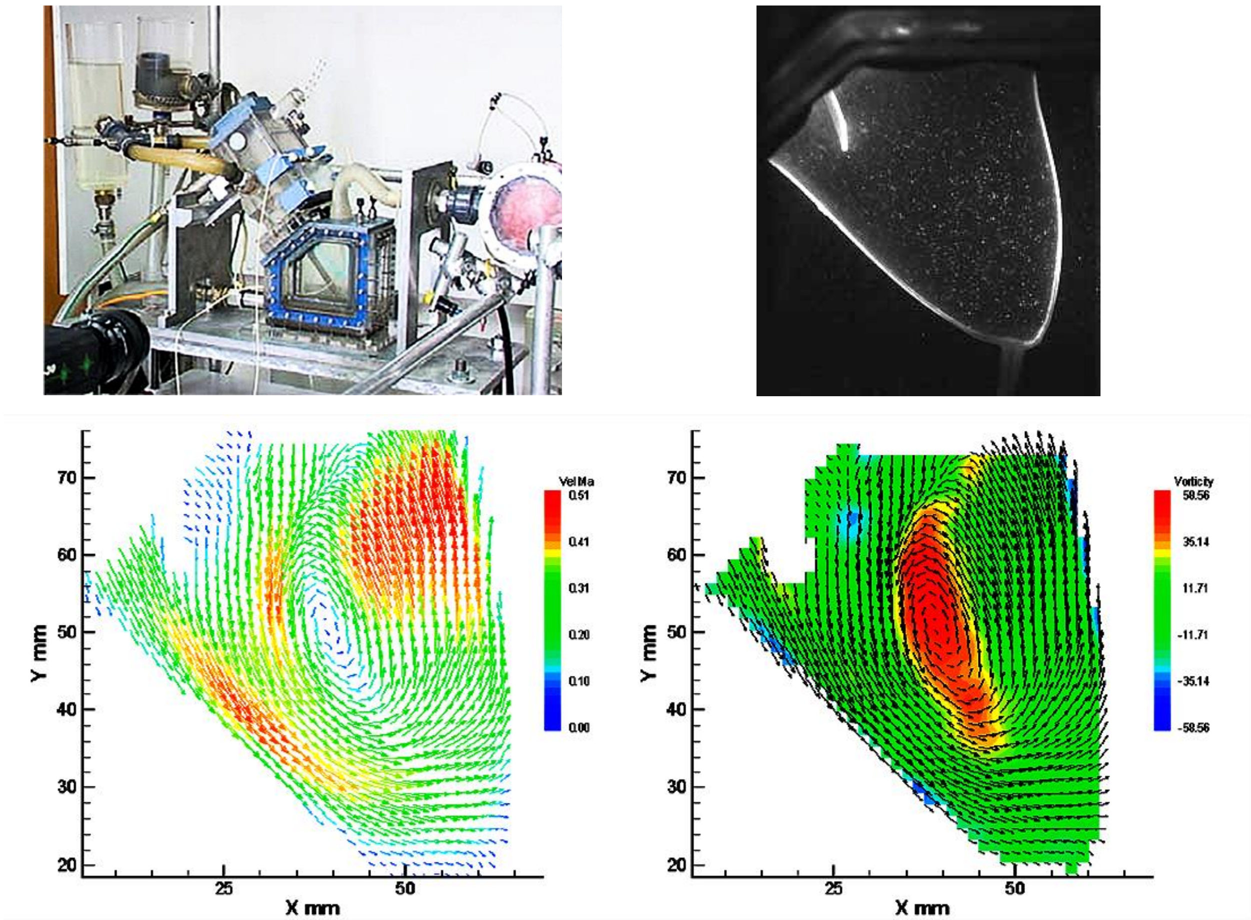

Figure 1: Flow structure characterization behind mitral valves in a double activated heart simulator using planar PIV (Universite d' Avignon)

By customizing the configuration of your PIV system, the results required for your research can be easily obtained: including two-component or three-component measurements on a plane, and three-component measurements in volumes. Variations of each of these systems allow for both low-repetition and time-resolved data acquisition rates. All PIV systems provide instantaneous vector maps of flow-field velocity, and access to resulting derived measurements and parameters such as turbulence characteristics, vorticity, and coherent structure identification and tracking.

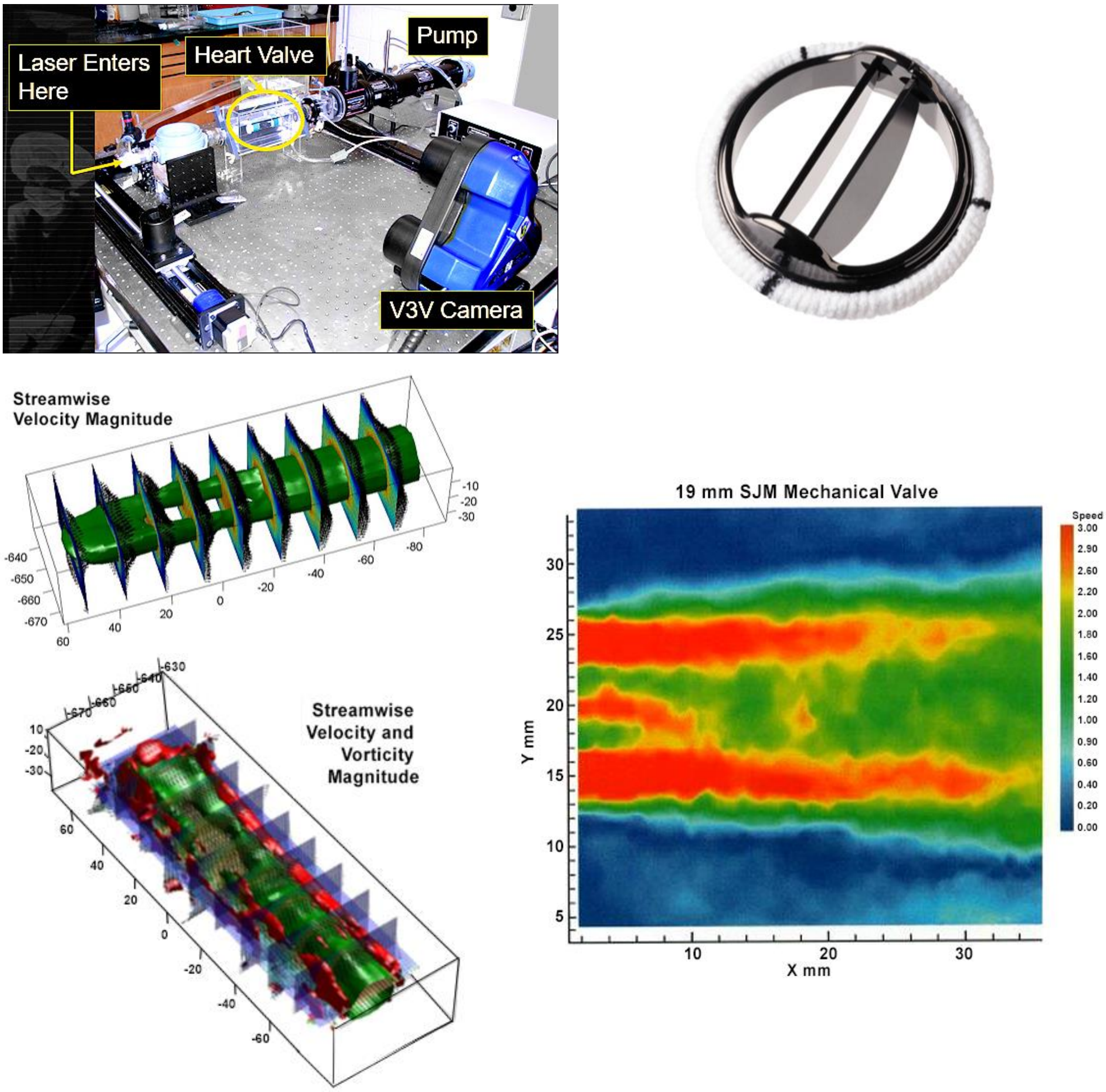

Figure 2: Measurement of mechanical heart Valve using volumetric PIV system (University of Minnesota and St. Jude Medical)

For instance, time-resolved PIV systems commonly allow for data capture rates in excess of 1000 Hz, providing detailed insight into the temporal and spatial evolution of fluid structures. This allows the researchers the investigation of the temporal fluid mechanics in the pulsating nature of the heart valve.

A volumetric PIV system further extends the usefulness of the diagnostic, as data for all three velocity components everywhere within a three-dimensional space are measured directly and simultaneously. This allows you to visualize and quantify the instantaneous flow structure, such as the linked-chain vortex structure. Further, volumetric PIV systems operating at time-resolved rates provide even more complete spatial and temporal understanding fluid dynamics at work within the medical device.

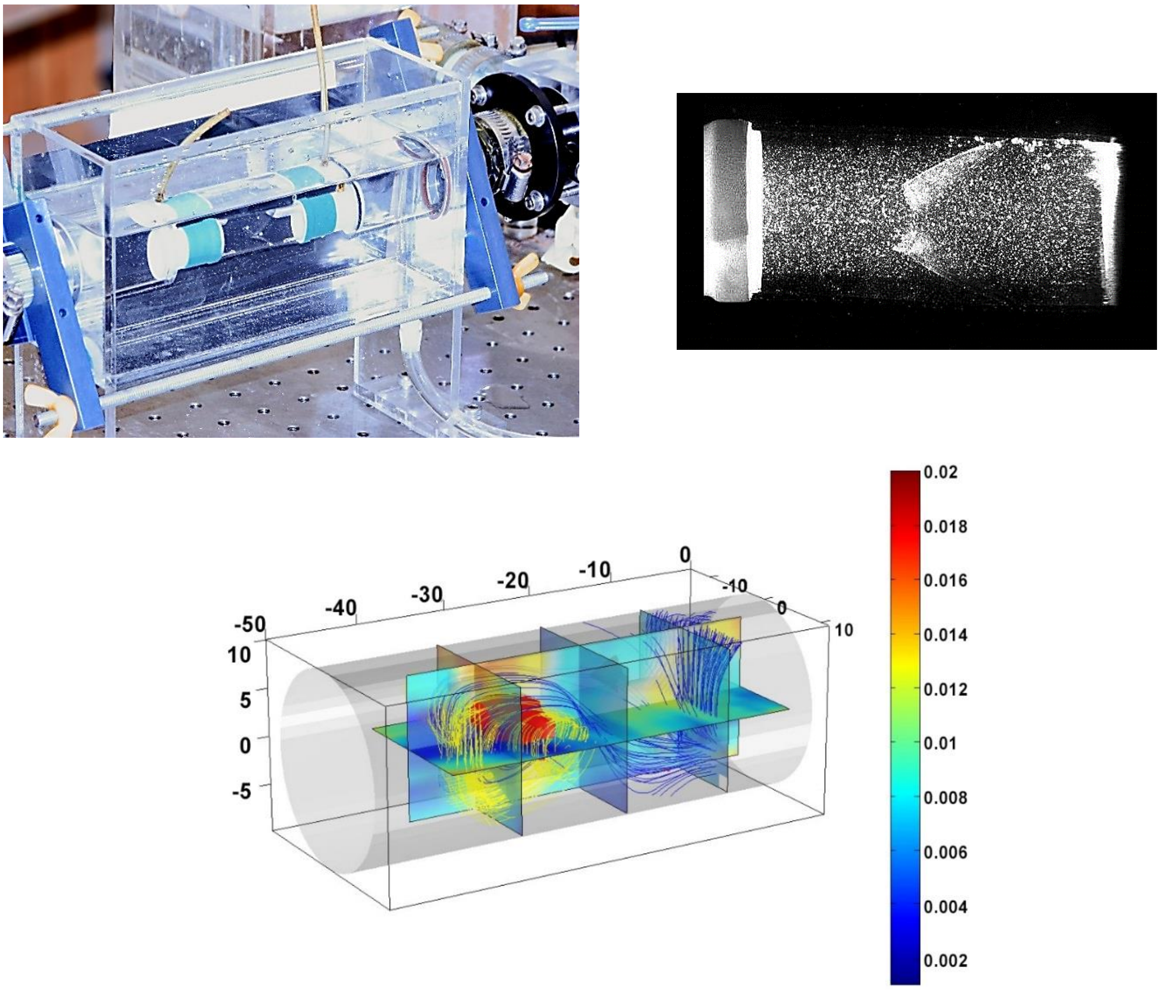

Figure 3: Investigation of deformable Silicon heart valve using volumetric PIV (University of Minnesota)

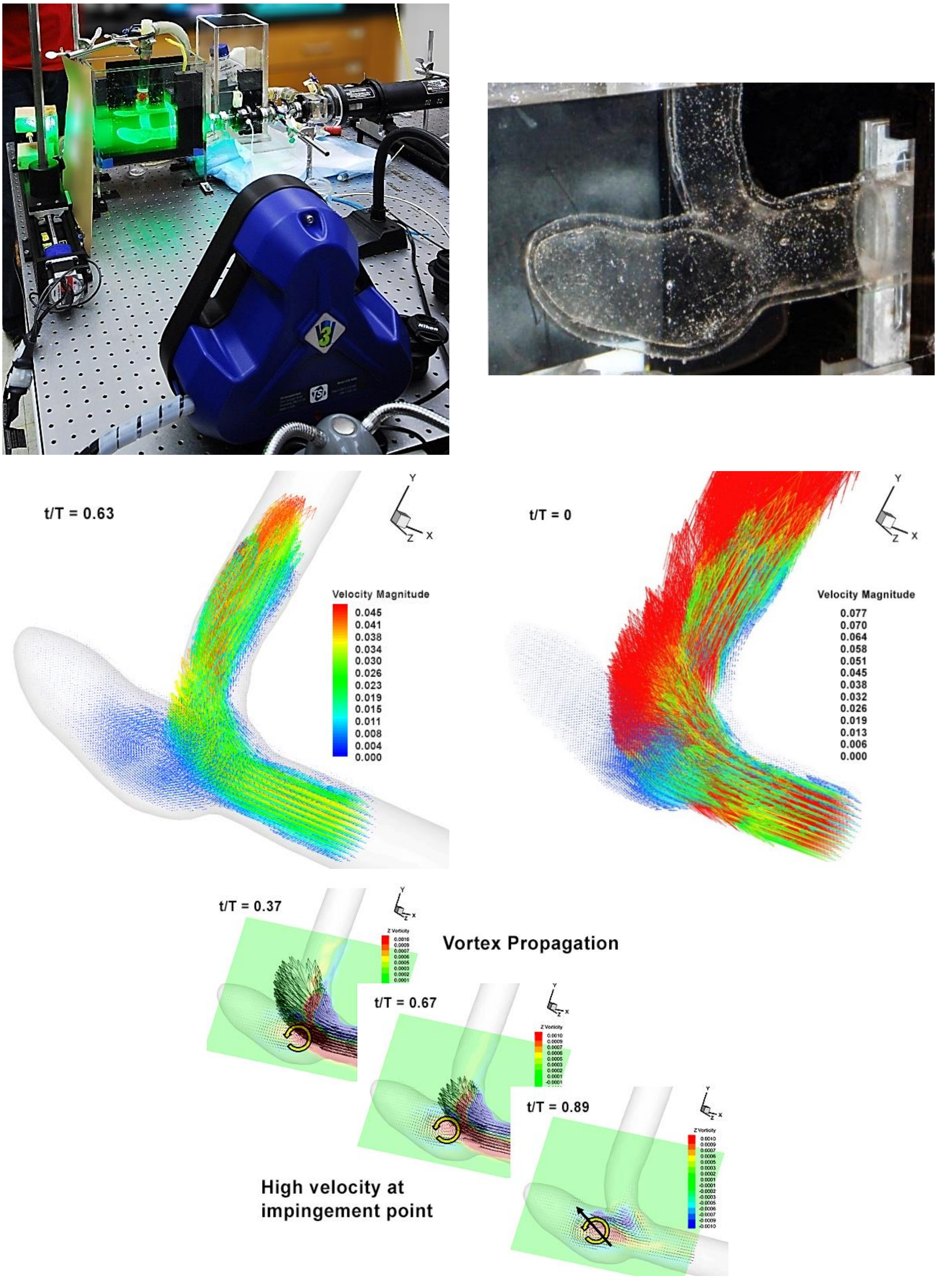

Figure 4: Flow diagnostics in aneurysm using volumetric PIV (University of Minnesota)

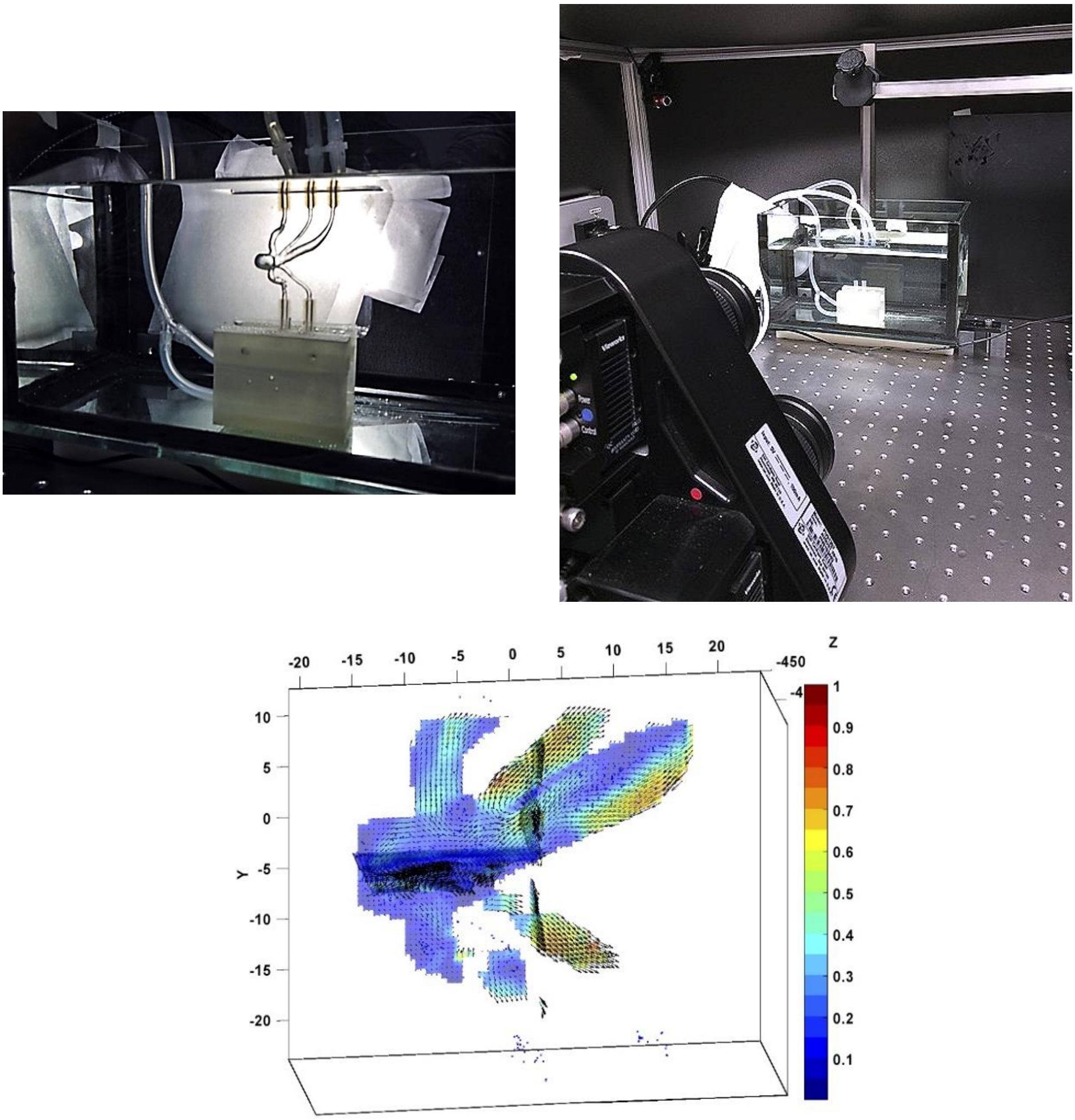

Figure 5: Diagnostic of aneurysm under pulsating condition using volumetric PIV (Medical College of Wisconsin)

PDPA is another non-invasive technique to provide instantaneous measurement of velocity and droplet size simultaneously. PDPA is particularly applicable for the diagnostics of medical inhaler to determine whether the droplets emitting from the inhaler have the proper size and speed entrained to the patient. The results from the PDPA measurement can help to modify the design of the inhaler to ensure the right droplet size with the correct exiting speed to get to the patient efficiently.

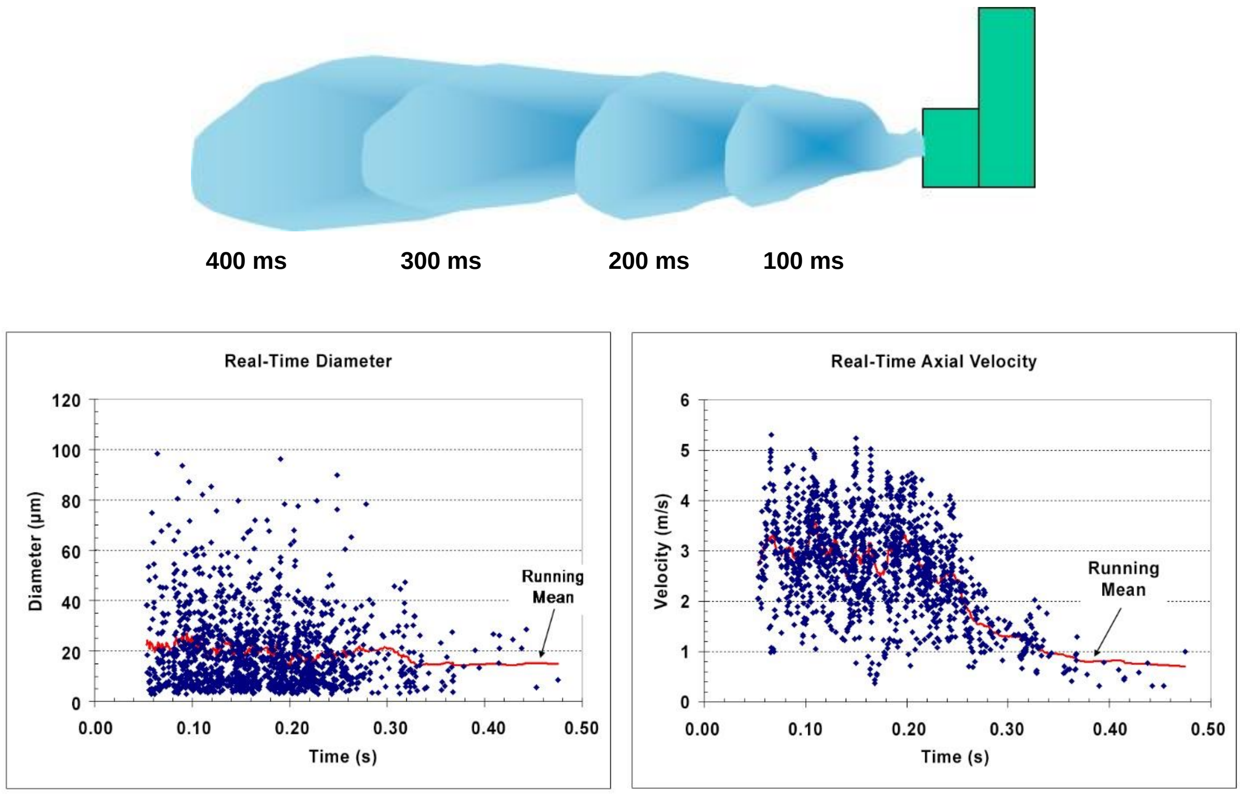

Figure 6: Droplet size and velocity measurement from Inhaler using PDPA (3M)

Contact TSI for more detail of the applications and also of the systems of interest to you.

UNDERSTANDING, ACCELERATED

TSI Incorporated – Visit our website www.tsi.com for more information.

USA	**Tel:** +1 800 680-1220	**India**	**Tel:** +91 80 67877200
UK	**Tel:** +44 149 4 459200	**China**	**Tel:** +86 10 8219 7688
France	**Tel:** +33 1 41 19 21 99	**Singapore**	**Tel:** +65 6595 6388
Germany	**Tel:** +49 241 523030		

