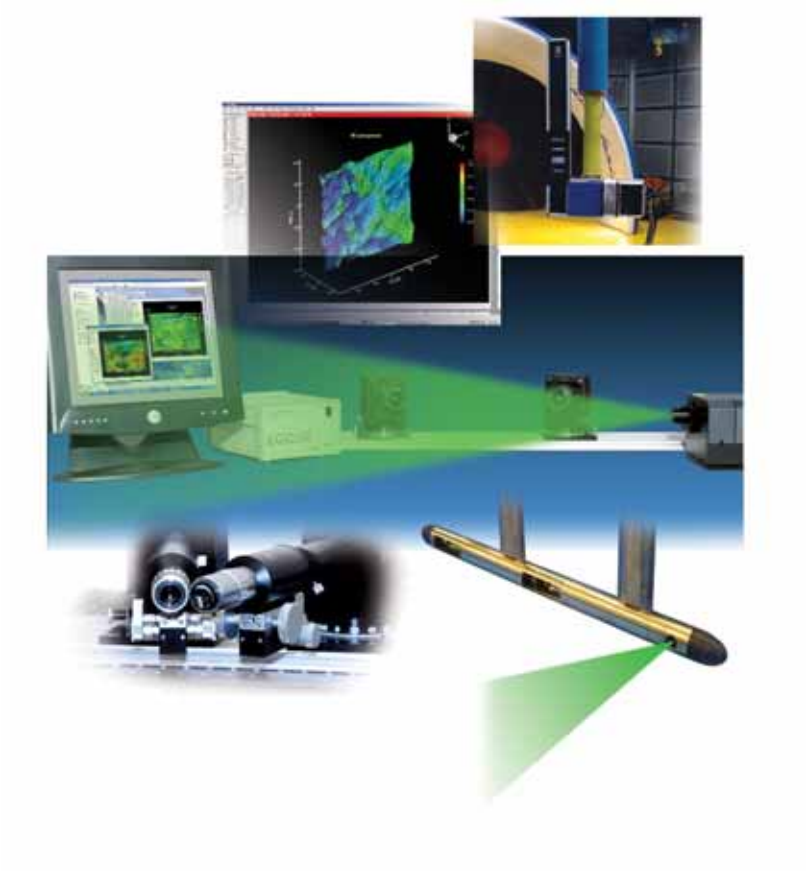
Fluid Mechanics

PowerView™
Stereoscopic PIV System



The Latest Advancement In PIV Technology for Three-Component Velocity Measurements

TSI®

Since introducing the first commercial PIV system in 1988, TSI has led in hardware and software innovation. By exploitng new CCD cameras, CMOS cameras, and frame grabber technology, TSI routinely develops and implements patented hardware and data analysis concepts. In addition, TSI regularly exploits advances in computer system developments and capabilities. Stereoscopic PIV systems from TSI provide global measurement of the three orthogonal velocity components. Two cameras are positioned to view the light sheet obliquely, and the captured particle image displacements contain the influence of all three velocity components. Innovative data analysis employed in the INSIGHT 3G™ package then identifies the true image displacements and extracts the 3-D velocity field. Stereoscopic systems for Time-Resolved PIV, microPIV and standard PIV are available. Many of the system components can be shared making it easy to upgrade from one to another.

Innovation keeps TSI PIV systems unsurpassed in performance and flexibility.

TSI Stereoscopic PIV systems offer unsurpassed capability:

- On-line measurement/display of three velocity components
- On-line PIV image display
- PowerView Plus family cameras with short frame-straddling time for high-speed flows
- PowerView family of high-speed cameras for Time-Resolved PIV measurements
- On-line mapping function to eliminate the need to measure camera angles
- Optimum Scheimpflug camera configuration to get the largest measurement region
- DPDS target for generating mapping functions to remove the need to traverse the target
- Stereo AutoMapping tool to automatically correct for misalignment between the calibration target and the laser light sheet
- Stereo AutoMapping tool adjusts the calibration function for wind tunnel measurement when calibration is performed outside the tunnel
- Calibration based on camera configuration without the use of a target
- Back-forward or side-scatter camera positioning
- Special and compact stereoscopic systems arrangement for wind tunnels and underwater measurements

PowerView Plus Family of CCD Cameras and CMOS Cameras

There are a wide range of PIV cameras offered by TSI for stereoscopic measurements, ranging from high speed CMOS cameras with frame rates up to 250,000 fps to the standard CCD cameras with frame rates of 30 fps. These cameras offer high spatial resolution, short frame straddling times, programmable camera parameters, and other innovations vital to accurate flow measurements. The cameras are also equipped with a unique mask to protect the sensor output circuitry from direct exposure, which may result in fatal damage to the camera. When a large amount of data capture is needed, the stereoscopic system can be used together with the unique *HyperStreaming* system from TSI.

PowerView Plus 4MP Camera

PowerView Plus 11MP Camera

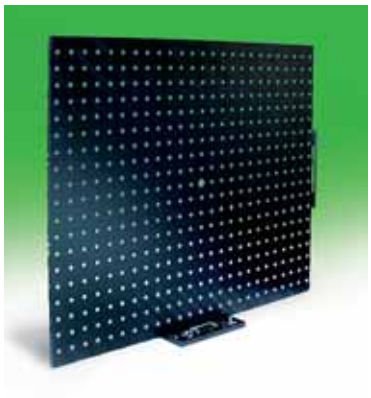
PowerView Plus HS-2000 Camera

Optimized Scheimpflug Arrangement

A Scheimpflug camera configuration ensures that all points in the illumination plane (plane of measurement) are brought into focus in the camera image plane, making it adaptable to the widest range of flow measurement applications. The Scheimpflug condition is achieved when the object plane, the image plane, and the lens plane intersect at a common point. To achieve the optimum configuration, a unique camera mounting arrangement that allows rotation of the detector plane with respect to the lens system is employed. Because the cameras rotate about their detector planes, the field of view does not change when the Scheimpflug angle is adjusted, greatly simplifying system alignment. The cameras can be set up in back-, forward- or side-scatter positions with respect to the light sheet. Remote adjustment of the Scheimpflug arrangement is also available.

Mapping Function Generation and DPDS Target

Since the cameras in the Scheimpflug configuration are generally not normal to the light sheet, angular viewing must be accounted for. A rectangular grid structure imaged in such an arrangement appears as a trapezoid, a situation easily compensated for using a comprehensive mapping function. The influences of refraction through walls and similar optical influences are also overcome.

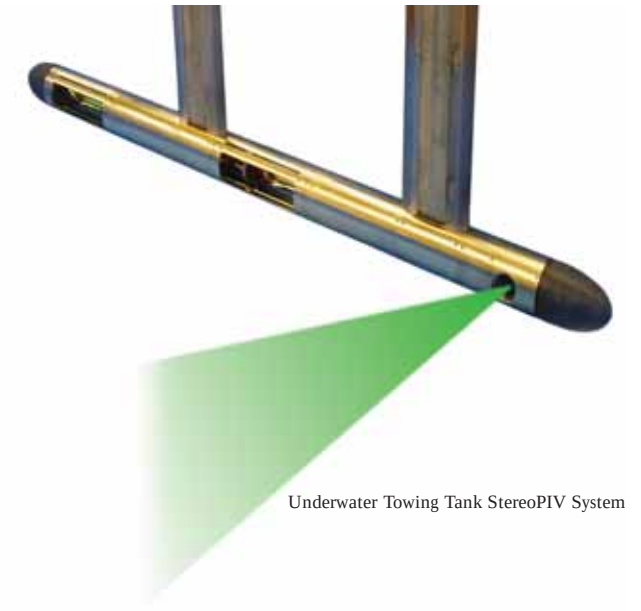


In TSI systems, the mapping function that establishes the unique relationship between the object plane, or the measurement plane in the flow, and the image planes in the cameras is generated using a target. TSI pioneered the dual plane dual side (DPDS) target that has multiple planes of markers on both sides. It allows mapping function generation without traversing the target. Further, it allows the two cameras in a stereoscopic system to be set up in any desired fashion. They can be placed on either side of the light sheet or both on the same side to suit the experimental facility geometry. The target has a built-in mirror to position it in the light sheet plane. Unique algorithms, developed as part of the image capture and analysis portion of TSI's ***INSIGHT 3G*** PIV software, make mapping function generation accurate and easy to accomplish. A distinctive advantage of this on-line calibration approach is that camera angles and other parameters need not be measured, even for an asymmetrical camera arrangement.

The Stereo AutoMapping tool in the ***INSIGHT 3G*** package offers the best automatic scheme to correct for any misalignment of the calibration target and the light sheet. The same tool can also be used to reduce the need to perform calibration with the target inside a wind tunnel. The calibration can be performed outside of the tunnel and the AutoMapping tool will correct for the calibration automatically.

Special Stereoscopic PIV Systems

TSI has designed and built special StereoPIV systems to make measurements in different flow facilities around the world. In many instances, the system needs to be configured to suit the test conditions, type of flow model used, access limitations, and other practical aspects of the application of interest. In many cases, the StereoPIV system is put together as a probe that is often in the flow. The small size of the TSI PowerView Plus cameras makes them perfect for compact packaging. This combined with remote adjustment of aperture, focusing, and Scheimpflug setting make these StereoPIV systems ideal to setup and operate, remotely. Further, these modular StereoPIV systems can be reconfigured to have the desired layout of the imaging camera modules and the light sheet module to suit the measurement needs.



Underwater Towing Tank StereoPIV System

INSIGHT 3G™ Global Imaging, Analysis, and Display Software Platform

The *INSIGHT* 3G package features all of the tools needed for even the most advanced global imaging measurements, from our patented processing algorithms to the most elaborate data analysis features available. And now, equipped with the *HyperStreaming* Module, the power of the *INSIGHT* 3G Platform can be unleashed on enormous amounts of data, using features such as the POD Analysis Toolbox and distributed processing capability over a network of computers to quantify the flow properties of interest with the desired detail.

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