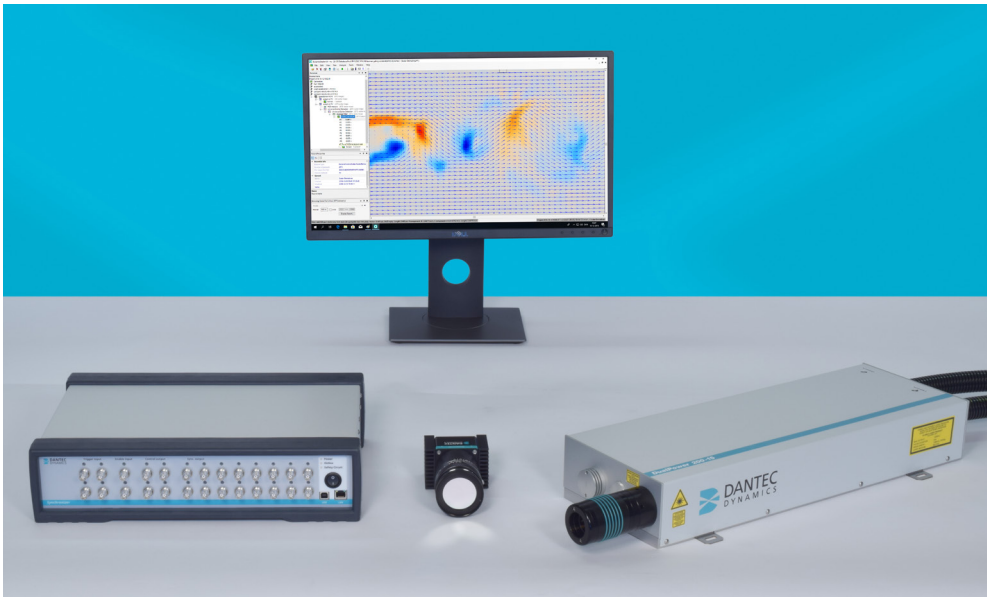
SOLUTION SHEET

PIV systems - planar measurements

Flexible, easy-to-use and high-performance PIV solutions



Solutions focused on flow-field measurements in space and time

Particle Imaging Velocimetry (PIV) systems allow non-intrusive measurements of two or three velocity components for a planar cross-section in gas or liquid flows.
A system consists of one or two cameras, a light source, optics to create a light sheet, a synchronizer, a PC and software for analysis.
With a modular and flexible platform design combined with our wide range of components, systems can be tailored to fit many different applications. A single-camera system can measure two velocity components (2C) in a plane (2D). A 2D-2C PIV system can be upgraded to a Stereo PIV (2D-3C) system and even to a Volumetric Velocimetry (3D-3C) system by adding components. For data acquisition and advanced flow analysis, we have developed the most comprehensive imaging software for optical velocity measurements - DynamicStudio.

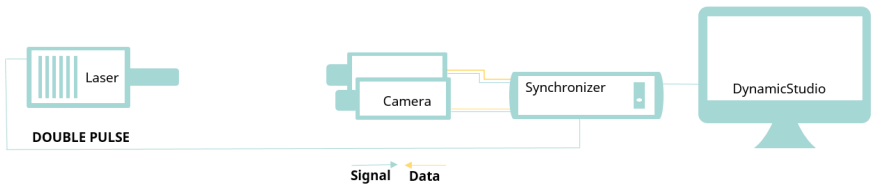
Key benefits

- Non-intrusive imaging technique for measurements of flow fields in gases and liquids
- 2 or 3 velocity components in a plane can be measured
- DynamicStudio has built-in tools and guides to simplify planning, set up and data processing
- The widest range of CCD, sCMOS and CMOS cameras. Up to 29MP and up to 25,600 fps full resolution
- Laser and camera combinations for repetition rates from 10 Hz up to 10KHz
- Light-guide solution for flexible positioning of the light-sheet, even in space-limited setups
- Programmable, automated data acquisition and traverse motion
- Automated data analysis
- Advanced timing and synchronization of any device in your experimental setup

High-end flow field velocity measurement solution

Particle Imaging Velocimetry (PIV) systems consist of one or two cameras (for 2D-2C or Stereo PIV respectively) with lenses, a light source (typically a laser), optics to create a light sheet, a synchronization device, a PC for recording, data storing, handling and analysis.

The light source and camera(s) are core components in a PIV system. They must be selected based on the required temporal and spatial measurement resolution. Thanks to the flexible platform-based design, a system can be combined from a wide range of components and thereby tailored to exactly match the specific needs of your application.



Overview of the different components, timing and data flow.

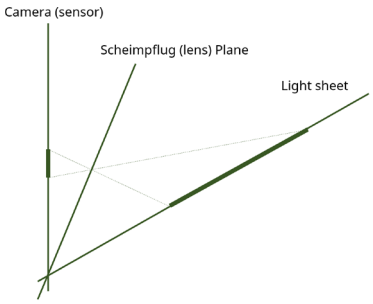
Planar PIV solutions in brief

Configuration to measure two velocity components

A 2D-2C PIV configuration is a planar imaging system for measuring two velocity components in a measurement plane defined by the light sheet. A 2D-2C PIV system is compact and very easy to set up and use. A system typically consists of a camera, a laser with light sheet optics, a synchronizer and a PC for data acquisition, storage and analysis. In order to image the flow, seeding particles are also required (flow tracers). The seeding can be small liquid droplets (for gases) or solid particles (for gases and liquids).

Configuration to measure three velocity components

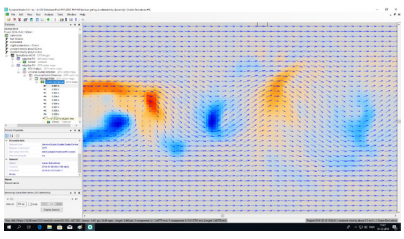
A 2D-2C configuration can easily be upgraded to a Stereo PIV (2D-3C) system to measure all three velocity components in a plane by adding a second camera. In a stereoscopic camera arrangement where the imaging is performed at an angle to the plane, the lens and image plane need to be tilted in order to keep the measurement plane in focus. This is known as the Scheimpflug condition. A typical stereoscopic camera arrangement and schematic of the imaging planes can be seen on the sidebar. Scheimpflug camera mounts are used to achieve this imaging configuration.



The Scheimpflug principle used in Stereo PIV.

DynamicStudio

The DynamicStudio software is very comprehensive and employs a number of unique features for acquisition, synchronization, data pre-processing, post-processing, analysis and visualization. With our powerful software, even online visualization of flow fields is now possible. DynamicStudio is the central element of your PIV system. To calculate the velocity fields from acquired raw images and analyze the results, the DynamicStudio Base package along with add-ons for 2D-2C and 2D-3C analysis are used. With data acquisition and analysis performed in the same software, there is no need to move data around. Interdisciplinary scientists can achieve results quickly in the lab in order to focus on the research rather than the measurements. Dedicated analysis routines and customized analysis sequences allow for quick investigation and visualization of results. The software's database structure is very easy to use and includes extensive data exchange features e.g. to MatLab and Tecplot.



von Karman vortex street, Courtesy of von Karman Institute, Brussels, Belgium.

For further details on the software, please consult separate data sheet on the "DynamicStudio base package" on our website.

Cameras, lenses and accessories

Dantec offers the widest range of CCD-, sCMOS or CMOS cameras to provide the ideal solution for every fluid mechanic application; in total you can choose from over 100 supported cameras. It is possible to “freeze” fast flows with up to 25,600 frames per second (at 1 MP), or to resolve the smallest details with the impressive resolution of a 29 MP camera. Select a lens to optimize the magnification and field-of-view (FoV) in order to fit the scope of the measurements. Narrow-band optical filters can be used to remove strong ambient light. For Stereo PIV and multi-camera systems, Scheimpflug camera mounts are required.

For further details on high-resolution and high-speed cameras, please consult our website.

A camera and lens fitted on a Scheimpflug mount.

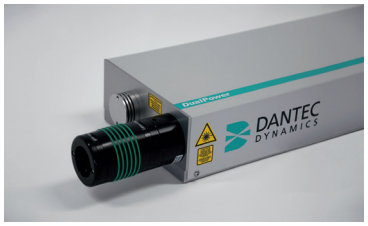
Illumination sources and accessories

To match the application requirements and camera specifications, a wide range of illumination systems are available, including high energy and/or high frequency pulsed lasers. Lasers for flow sampling rates from 10 Hz to 10 kHz can be selected to fit any application.

Our modular light sheet optics allow for focal adjustments to place the thinnest part of the light sheet where needed and set the light sheet divergence angle to match the camera FoV.

Our light guide arms offer flexible positioning of the light sheet even with large/heavy lasers.

For further details on lasers, light sheet optics and light guide arms, please consult our website.



A laser with light-sheet optics.

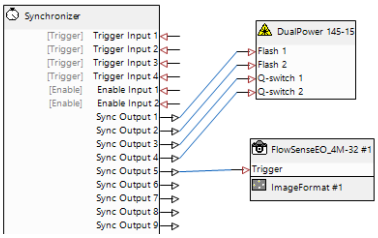
Performance Synchronizer

The Performance Synchronizer ensures that all devices perform their individual tasks at the exact right time. The device is a powerful tool for handling not only the PIV image acquisition, but also simultaneous acquisition from other sensors and/or timing of external devices in the experimental/industrial setup. Use of the ethernet interface makes it possible to place the Performance Synchronizer near the experiment and the PC in a control room at a distance.

The Performance Synchronizer is integrated into DynamicStudio for easy setup and configuration. Connected PIV devices are auto-detected, which ensures that the user will not have to enter any specific properties for the system. The connectivity diagram in the software will display the way the synchronization cables are to be connected. In DynamicStudio it is also possi-ble to create your own devices; this flexibility ensures that you can connect auxiliary devices and handle the most challenging synchronization demands.

For further details on the possibilities and performance of this unit, please consult separate data sheet “Imaging Synchronizers” on our website.

Performance Synchronizer



Guide in DynamicStudio shows how to connect synchronization cables.

Options

Traversing

A traversing mechanism for mapping different sections of the flow field can be added to the system as an option and is controlled from the software to enable fully automated experiments.
The software can construct a complete time-averaged 3D-3C flow field by combining 2D-3C data from each measurement section.

TrueTime laser pulse timing

The Performance Synchronizer can, as an option, be delivered with a special feature for “TrueTime Laser pulse time stamping”. This allows for a precise (resolution of 1ns) recording of the time-between laser pulses in PIV for increased velocity accuracy.

Encoder input for cyclic phenomena

With this option, the Performance Synchronizer can time stamp encoder pulses in rotating systems such as engine, propeller and turbomachinery applications.

Product overview

Flow sampling rate	10-15 Hz	50-200 Hz	1 kHz	10 kHz
Application	Flow analysis	Flow analysis Time resolved measurements in convection flows and water flows	Flow analysis Time resolved measurements in high speed water flows and low to medium speed air flows	Flow analysis Time resolved measurements in high speed air flows
Laser rep rate [Hz]	10, 15	50, 100, 200	1000	10000
Light Sheet Optics	Compatible with the laser beam diameter. Adjustable focus and sheet divergence angle. Compatible with Light Guide Arms.			
Camera series	FlowSense EO	FlowSense CX	SpeedSense VEO or VEO E	SpeedSense xx12 series, xx40 series
Camera accessories	Lenses, Filters, Scheimpflug mounts			
Software	DynamicStudio: Base Package, 2D PIV Add-on, Stereoscopic PIV Add-on			
Timing	Performance Synchronizer			
PC / Workstations	Performance PC for 1-camera imaging system High Performance Imaging PC for a 2-camera imaging system Performance Imaging Streaming Workstation For 2-camera image streaming			
Illumination options	Light Guide Arm, 1 m or 2 m length			
Timing options	TrueTime laser pulse time stamping Encoder input (for cyclic synchronization, phase-resolved measurements)			
Traverse options	1, 2 or 3- axis traversing mechanisms with up to 1010 mm range per axis			

DANTEC DYNAMICS Turn Measurements into Knowledge

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