

# FLOW FIELD DIAGNOSTICS

## Particle Image Velocimetry solutions



Time-Resolved PIV measurement in a turbulent flame



Time-Resolved PIV measurement of wake flow behind a car. Courtesy of PSA, France

Combining our know-how of fast, accurate synchronization and rapid digital image capture, we offer complete measurement solutions for PIV applications with all the required elements integrated into turnkey systems

## Particle Image Velocimetry (PIV)

PIV is an intuitive measurement technique for measuring two or three components of velocity in a variety of flows.

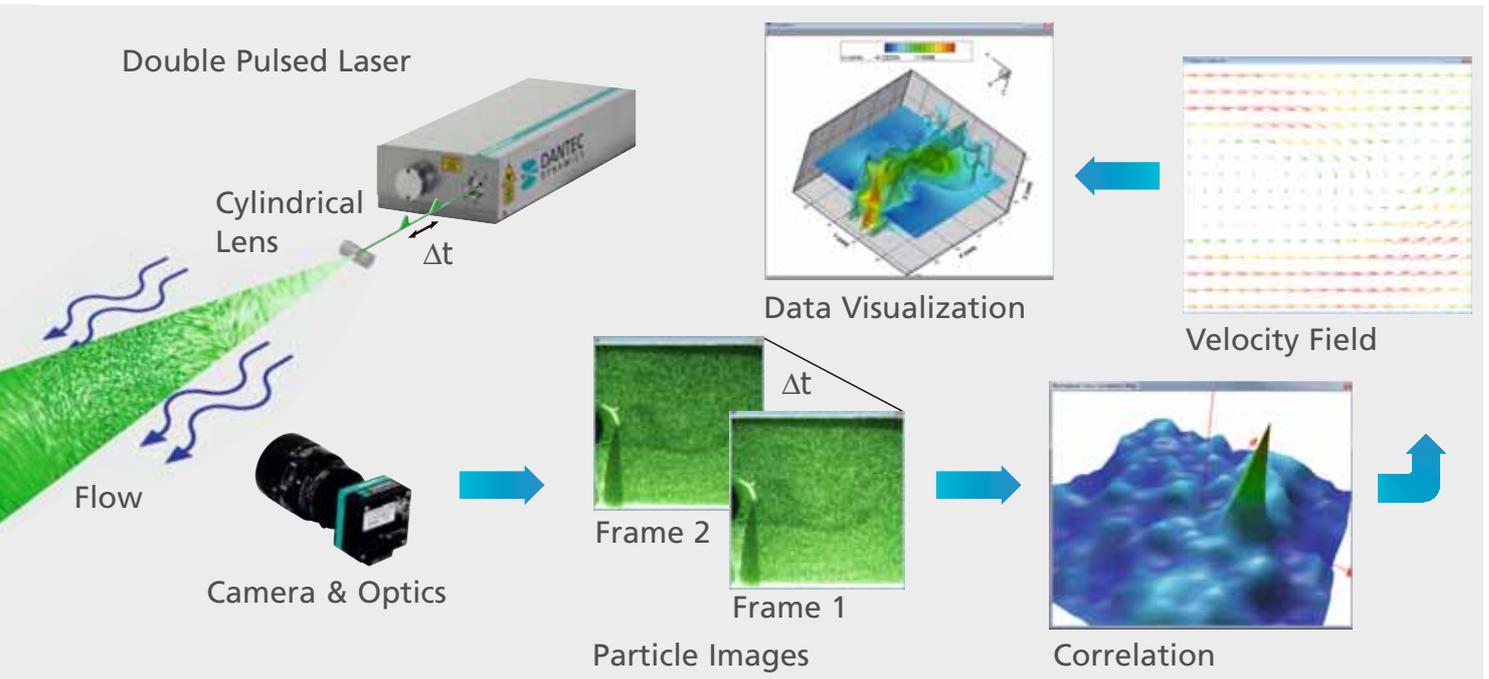
The application of PIV in research and industry is widespread, due to its ease of use and accurate data representation. As easy and intuitive as PIV is, it involves many cross-disciplinary challenges, from classical optics and imaging to the use of dedicated state-of-the-art digital electronics and lasers.

Partnering with Dantec Dynamics brings you a wide range of products to select from and expert application knowledge to assist in configuring the PIV systems that meet your needs.

We offer:

- Planar PIV as well as Volumetric Velocimetry
- Classical and Time-Resolved PIV solutions
- The widest range of CCD, sCMOS and CMOS cameras
- Lasers for any application
- Advanced timing and analog input devices
- Scalable data processing power including PC clusters and GPU solutions
- A complete software package meeting all your needs from acquisition to publishing high quality data, visualizations and animations

# The Principle of PIV



An overview showing the principle of Dantec Dynamics' 2D PIV systems

Two consecutive laser pulses illuminate a slice or volume of a flow field with particles suspended in the flow. The scattered light from the particles is recorded in two consecutive images on one or several digital cameras.

The images are sub-divided into smaller areas for calculating the mean particle displacement between two corresponding sub-areas.

The particle displacement is calculated using cross-correlation or Least Squares Matching techniques. Since the time between the laser pulses is known, the particle velocity can be determined.

Taking into account the magnification of the optical setup, the absolute velocity field can be derived. The velocities calculated from an image pair are an instantaneous snapshot of the flow viewed by the cameras.

PIV results are an accurate representation of the flow presented to the user and viewers in an easy to understand and visual manner. The presentation is aided by advanced software post-processing.

PIV data for all three velocity components can be presented volumetrically. These capabilities have made PIV a popular and yet accurate research tool.



The world's highest image quality with HiSense Neo



The world's fastest camera - SpeedSense 1610



FlowSense EO 4M - one out of five models - mounted on a Scheimpflug adapter

# A Unique Selection of Equipment



Customized Stereoscopic underwater PIV systems for towing tanks. Courtesy of CEHPAR, Spain

## Lasers for any application

- Pulsed lasers from mJ up to several Joule
- Continuous wave lasers up to 5+ W
- Best match of repetition rate to all CCD, sCMOS and CMOS cameras
- Rugged design and user-friendly

## The market's widest range of CCD and sCMOS cameras

- High sensitivity, low noise
- CCD-Sensors from 1.3 MPixel up to 16+ MPixel
- Direct data stream to disk or RAM

## Wide range of CMOS cameras

- Up to tens of kHz at full frame size
- CMOS-Sensors from 1 MPixel resolution up to 4+ MPixel
- Fast dedicated data transfer

## Advanced analog and synchronization devices

- Independent triggers at nanosecond resolution
- Analogue sampling up to 2+ GHz
- Advanced Waveform Analysis

## Customized PIV solutions

- Streamlined probes for water and wind tunnel applications
- Fully automated and remote controlled traverse systems
- Camera and light sheet endoscopes

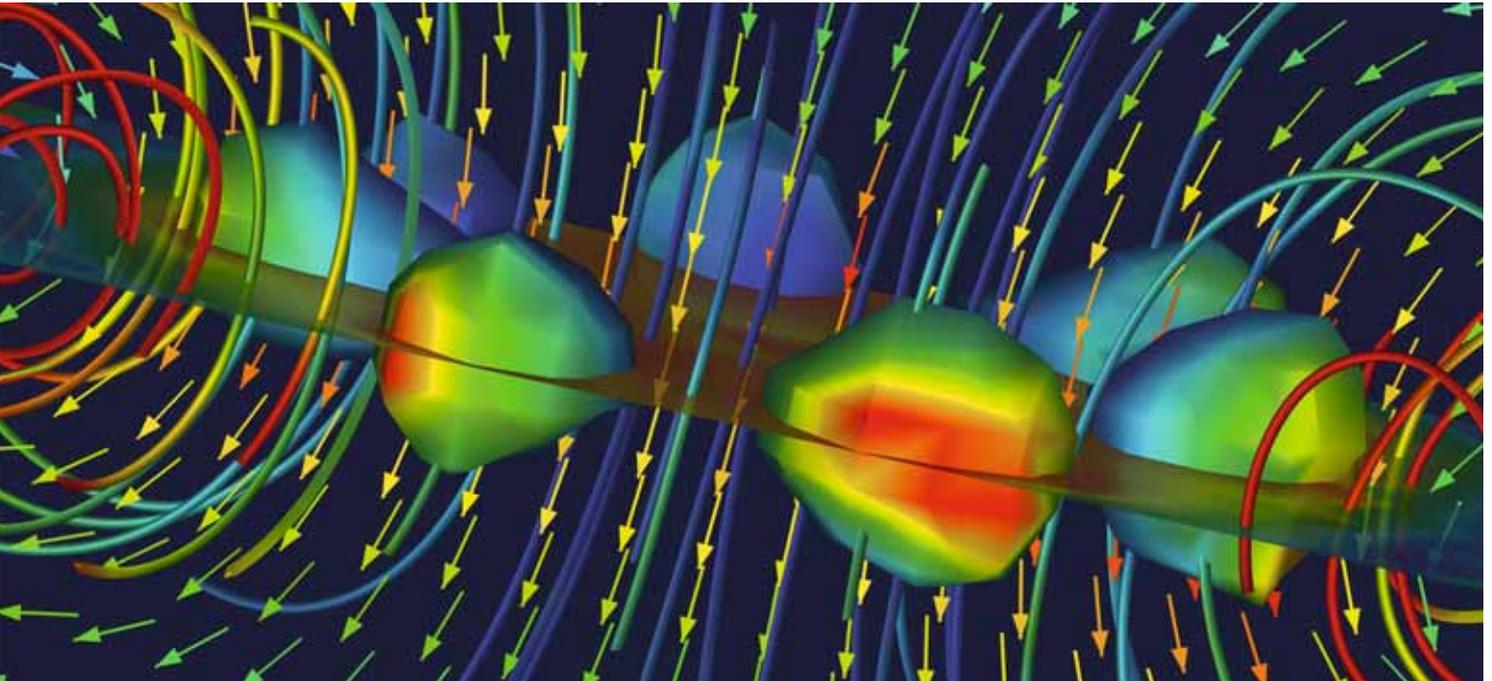


Modular high power light sheet optics mounted on a DualPower laser



Camera endoscopes for measurement in areas otherwise difficult to access

# DynamicStudio - The Unique PIV Software Platform



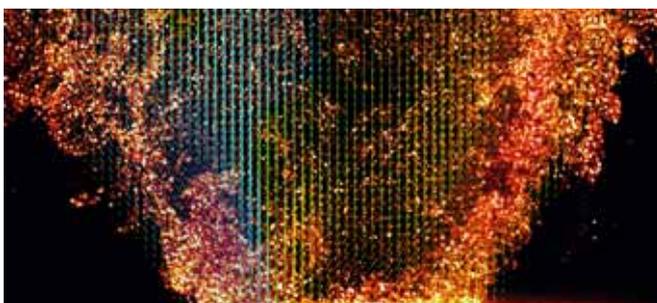
3D visualization of ring vortex instability measured by 3D LSM. Courtesy of Technical University Freiberg, Germany

## Key elements that makes our software dynamic

- Hardware auto-recognition and interconnection diagram
- Ensemble database structure
- Distributed acquisition, storage and analysis including GPU support
- Analysis sequences and batch processing
- Unmatched flexibility in auto-processing – works on multiple projects
- Batch exporting

## Volumetric Velocimetry

- Unique single camera solutions: Plenoptics camera with volume illumination and scanning light sheet with standard camera
- Three different processing methods: Volumetric Particle Tracking Velocimetry, Tomographic PTV



TR-PIV results from a swirling gas burner for turbine engines. Courtesy of Lund University, Sweden

and 3D Least Squares Matching

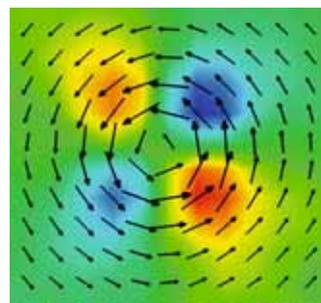
- Support for CUDA based GPU boards

## 2D Least Squares Matching

- A unique Dantec Dynamics product
- Highly increased accuracy in situations with velocity gradients
- Direct velocity gradient calculation
- No raw image manipulation needed for windows deformation

## FlexPIV

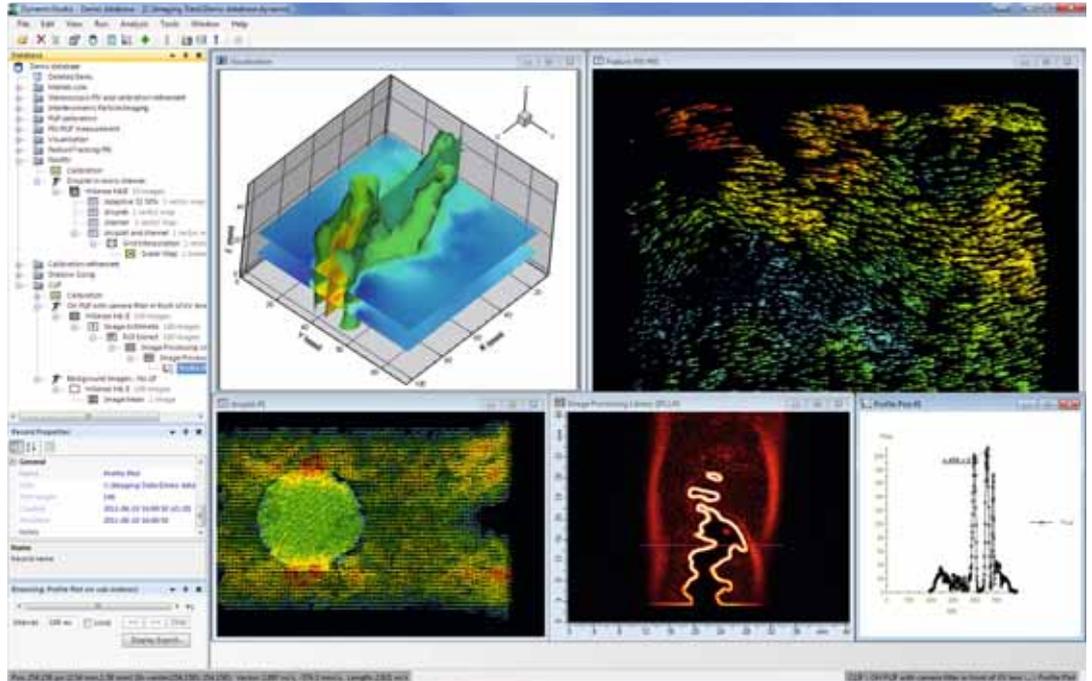
- A unique Dantec Dynamics product
- Variable vector calculation in different domains
- Closely matches PIV processing nodes to CFD nodes for data comparison
- Local refinement of velocity vectors



Velocity field of a vortex and  $dv/dx$  directly computed by 2D LSM



Velocity field and iso velocity surfaces calculated by 3D LSM



The intuitive and flexible user interface of DynamicStudio showing several different processing results

### Feature PIV

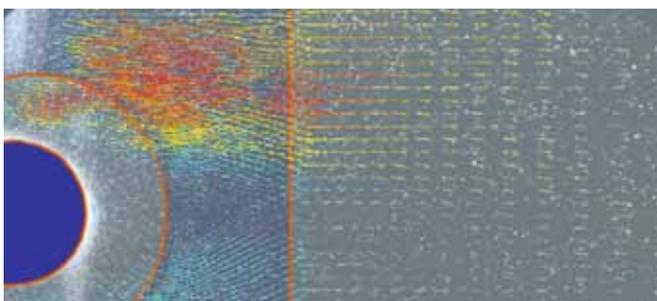
- A unique Lagrangian approach for velocity calculations, based on feature detection and tracking
- Vectors are only calculated where features or particles can be detected
- Features can be scaled down to single particles
- Provides Lagrangian history of particle movement

### Data Visualization

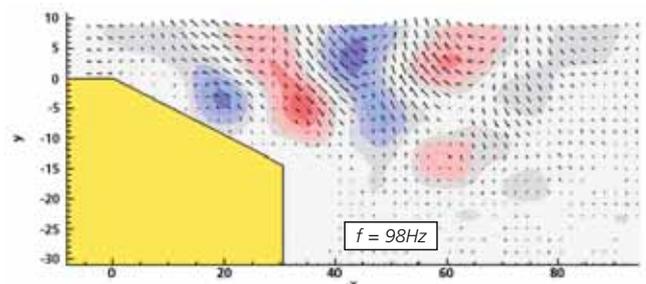
- New integrated Visualization module with advanced capabilities
- Create publishing quality 2D and 3D graphics and animations from your measured data
- No need for third party graphics programs
- No exporting and re-importing of data; all data are retained in DynamicStudio

### Oscillating Pattern Decomposition (OPD)

- An innovative method for analysis of energy modes in spatio-temporal data
- Based on well-proven methods developed for flow pattern prediction in climatology
- Uncovers the dynamically dominant mechanisms, while using efficient noise removal by sophisticated POD filtering
- Identifies the stability, receptivity and sensitivity of velocity fluctuation modes
- Direct applicability in wind engineering
- Works with PIV, PLIF, CTA rakes data as well as other spatio-temporally resolved data



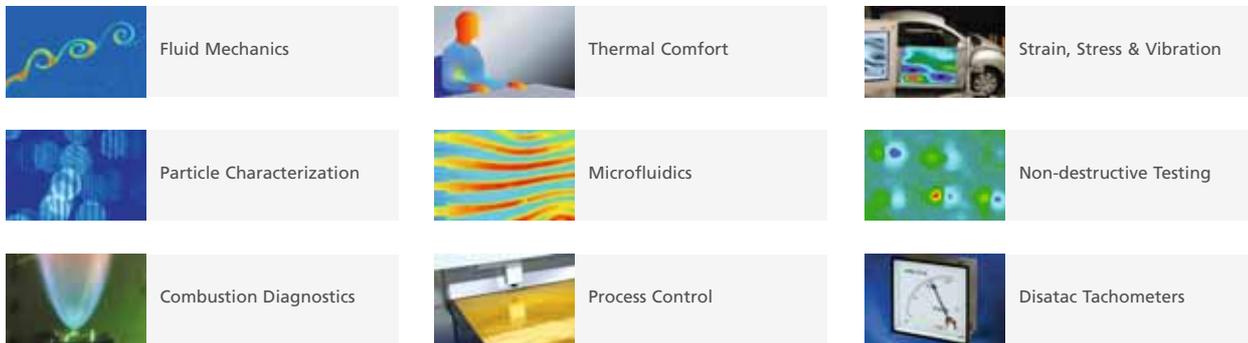
Flow and geometry adaptive PIV processing with FlexPIV



Data and analysis method courtesy of Prof. Vaclav Uruba, Institute of Thermomechanics, Prague, Czech Republic

# About Dantec Dynamics

Dantec Dynamics is the leading provider of laser optical measurement systems and sensors for fluid flow characterization and materials testing. Since 1947 we have provided solutions for customers to optimize their product and component testing. Dantec Dynamics provides quality solutions for an extensive list of customers in the areas of:



## Worldwide representation

From our six offices and more than 30 distributors worldwide we approach our customers individually. We examine the specific needs and find the best solution for you. For us you are a long-term partner in improving efficiency, safety and quality of life. A list of representatives is available at our website.

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