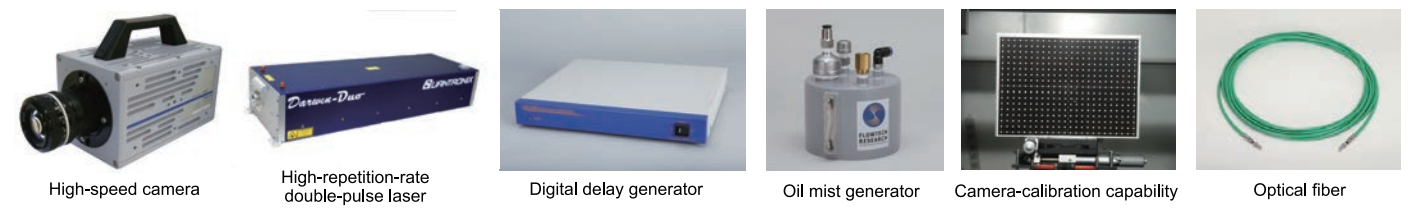


Hardware configuration example (Standard System) *

High-speed camera	C-MOS image sensor (1024×1024 pixel) , Lens Mount Interchangeable: F-mount and C-mount using supplied adapters, Monochrome 12 bit, for the record , Memory: 8GB/16GB/32GB/64GB , Partitioning: Up to 64 memory segments for multiple recording in memory , Frame rate: 50~7,000fps@1024×1024 pixel, 10,000fps@1024×744 pixel, 20,000fps@832×448 pixel , Electronic shutter: Minimum 369ns , Video Outputs: NTSC/ PAL/ HD-SDI , Triggering: Selectable positive or negative TTL 5Vp-p or switch closure , Digital Interface: Gigabit Ethernet Size / Weight: H165×W153×D242.5mm/7.15kg *excluding protrusions Power Requirements: Single-phase, 100~240VAC/50・60Hz/100VA
High-repetition-rate pulse laser **	Double-pulse Nd:YLF laser for PIV , Wavelength: 527nm , Beam property: Multi mode , Pulse per Oscillator: 30mJ/ 25mJ/ 20mJ/ 15mJ , Pulse Repetition Rate: 0.1-10kHz , Average Power@3kHz: 100W/80W/60W/40W , Pulse Width: 170ns/ 190ns/ 210ns/ 230ns , Pulse-to-Pulse Stability (%RMS): 0.5 , Beam Pointing Stability: 25μrad , Beam Diameter: 3.0mm , Beam Quality (M): 20 , Beam Divergence: 8mrad , Polarization: Circular Size / Weight: [Laser] H145×W254×D812mm/31.5kg, [Control unit] H221×W483×D509mm/27kg, [Chiller] H492×W483×D700mm/65kg , Electrical Service: [Control unit] Single-phase, 208~240VAC/50・60Hz/2.0kW, [Chiller] Single-phase, 208-240VAC/50・60Hz/2.5kW ** Performance at 1kHz unless otherwise noted.
Digital delay generator	Channels: 8ch (BNC Connectors) , Transition time : 5ns , Rate of Internal Rate Generator: 100kHz , Interface: Ethernet Size / Weight: H51×W350×D300mm/3.6kg * Allows flexible system construction that takes advantage of existing hardware.

Software specifications 《 FtrPIV 》

Function	Specification (Selectable menu item)
Input images file	BMP, JPEG, PNG, GIF, TIFF, AVI
Basic PIV operations	Direct Cross Correlation method (DCC), Optical flow method, Multi-correlation method, Multi-grid method
Advanced PIV operations	Window deformation method
Erroneous vector inspection	Maximum light intensity difference, Light intensity standard deviation, Correlation value, Vector length, Comparison with neighborhood median vector, Comparison with neighborhood mean vector, Relationship with neighborhood statistic, The number of valid neighborhood vectors
Specify calculation region mark	Specify GUI tool, Mask file, Auto generate mask image
Background reduction	Simple statistics background (Mean, etc.), Multiple backgrounds (Moving averages), Optimization
Image processing	Fixed kernel filter (Low pass, High-pass, Gaussian, Laplacian, Cross Sobel, Sharpening, Arbitrary kernel), Median filter, Brightness and contrast
Geometrical conversion	Perspective projection transformation, Affine transformation, Mirroring
Interpolation for removed erroneous vectors	Gaussian interpolation (Spatial)
Statistical calculation from time series data	Minimum - Maximum, Arithmetic mean, Median, Standard deviation, Reynolds stress, Turbulence energy, Mean vorticity, Mean flow rate
Statistical calculation from spatial data	Arithmetic mean, Standard deviation, Variance , Area, Instantaneous Flow rate, Vorticity
Filtering	Arithmetic operation of fixed values, Arithmetic operation of statistical values, Band-pass filter (Spatial), Band-pass filter (Temporal)
Alert inspection	Search range, Valid vector number, Mean correlation value, Image quality
Analysis	Vector distribution, Search range
Output of results	Text (plt, fld, p3d, csv), Still images, Motion images foreground image, dynamic image
Visualization	Erroneous vector marking, Display legend.
Batch processing	Back projection, Background reduction, Statistical calculation, DOS command processing, etc.
Customization	Flexible customization (Optional)



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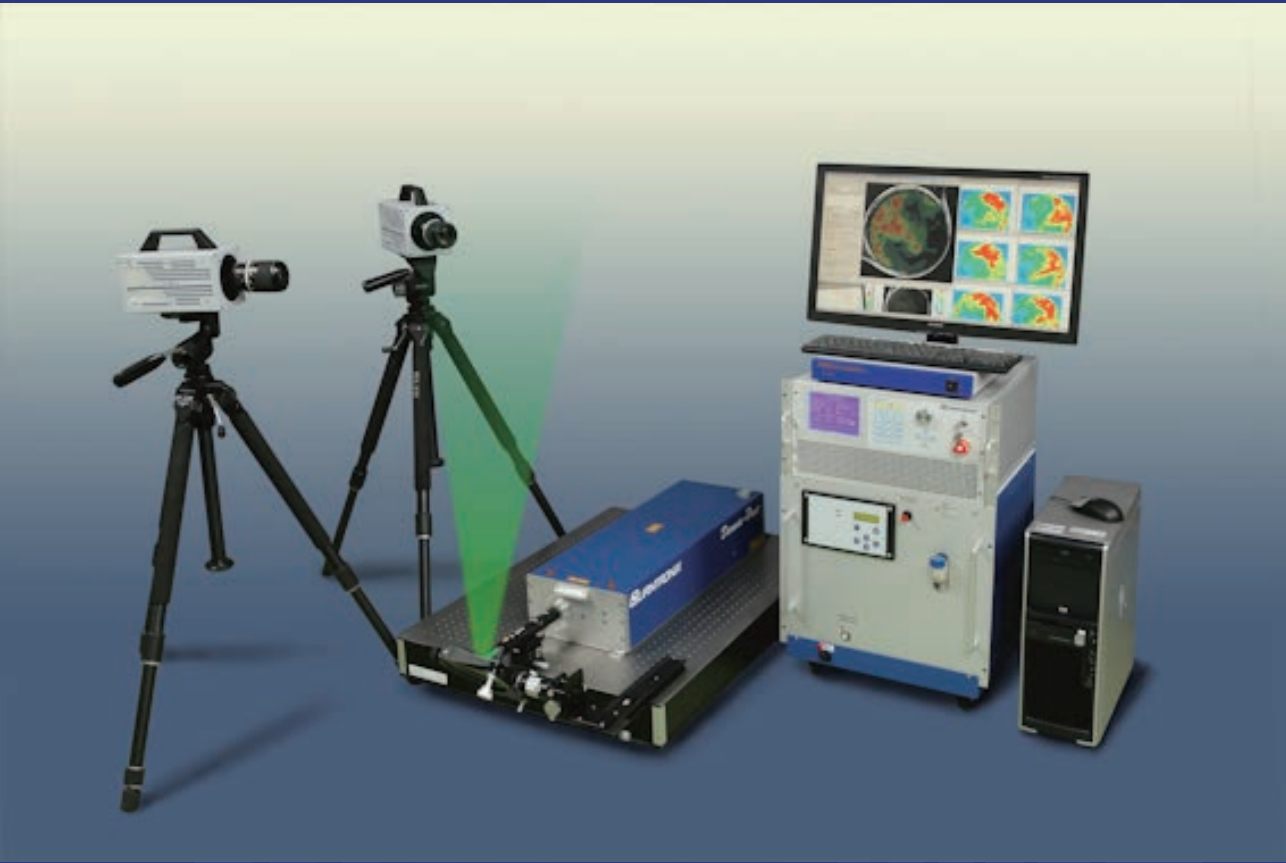
FtrPIV Dynamic

FtrPIV-Dynamic (Two-component/Stereo)



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Combining reliability and expandability,
FtrPIV-Dynamic achieves high temporal resolution
Flexible customization opens up new possibilities for flow measurement



Features

- Employs a reputed high-repetition-rate double-pulsed laser
- High-speed calculation using our proprietary PIV analysis engine
- Highly efficient PIV data analysis with unrestricted batch processing
- Equipped with time-series filtering and 2D filtering functions
- Fully synchronized data sampling of various analog signals
- Extensively customizable hardware and software
- Flexible system configurations possible using existing devices
- Seamless expansion possible from standard two-component to stereo (three-component) measurement
- Full-scale measurement consultation service available, guaranteeing high measurement accuracy and reliability
- Consultation service and technical support, with experts (optional)
- Measurement/analysis service available (optional)

Dynamic PIV Revolutionizes Flow Measurement

This device quantifies unsteady flow using temporal resolution of up to 10 kHz. It is powerful enough to determine flows surrounding high speed objects and flows involving fluid noise.

Extensive measurement example library

- Airflow around a moving printer head
- Stereo measurement of the flow inside a torque converter model
- Synchronized measurement of the flow around a rotating impeller inside a pump
- Airflow behind a high speed valve
- Liquid flow around a precision machine part in reciprocating motion
- Simultaneous measurement of airflows and fluid noise in an air-cooling duct
- Stereo measurement of the flow inside an engine for flow visualization

FtrPIV-Dynamic allows seamless expansion from the standard two-component measurement to stereo measurement. It can utilize the extensive functions available in our FtrPIV-Stereo.

FtrPIV-Stereo functions

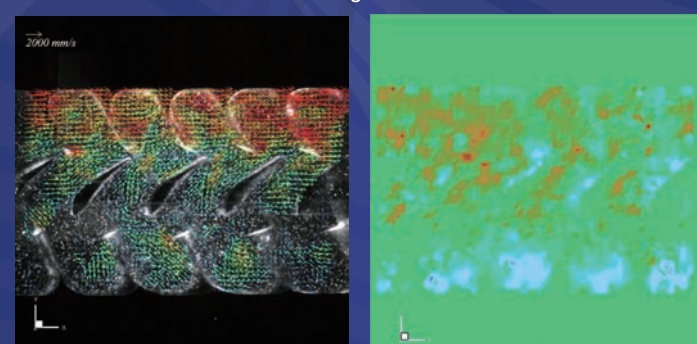
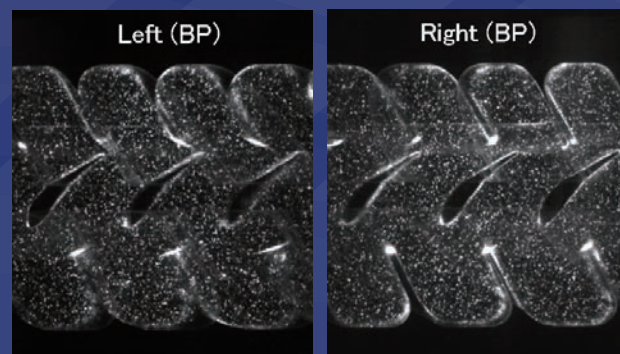
- Intuitive camera calibration with integrated camera calibration software
- Equipped with both geometric camera model and direct-mapping function
- Efficient stereo analysis using high-speed back-projection
- Easy-to-understand stereo PIV analysis procedure, similar to standard two-component measurement
- Auto batch processing function, from PIV image input to statistical operations
- Customized camera calibration tools (optional)

The standard system configured with recognized hardware can be flexibly customized using existing equipment or other desired hardware.

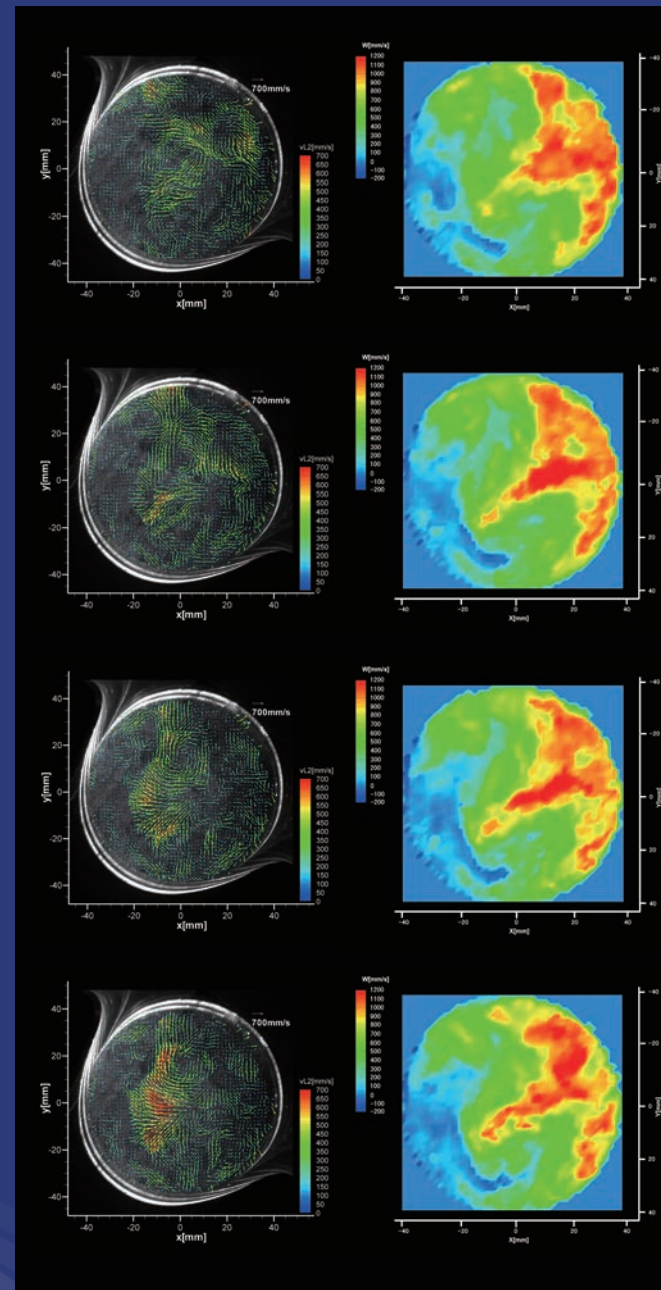
Standard system configuration

- High-repetition-rate double-pulsed Nd:YLF laser
- High-speed black and white C-MOS sensor camera (two cameras for Stereo PIV)
- Digital delay generator
- Host computer and dedicated software

This device allows synchronized capture of all types of analog signals and high-speed images. Unsteady flow phenomenon can be determined and understood through combined measurement.



Dynamic stereo PIV allows rotation-synchronized measurement of the flow inside the torque converter model.
Left: Particle images after back-projection (stereo pair) Right: In-plane vector map and color contour of out-of-plane velocity component



Examples of analog signals

- Sound pressure signal from a microphone
- Fixed-point velocity signal from hot-wire anemometer and LDV
- Pressure signal from a high-response pressure pickup
- External events signal

State-of-the-art PIV Software – FtrPIV Ver.3.1

Advanced PIV analysis software developed from our extensive measurement consultation, gaining user trust for its outstanding performance.

- Versatile functions and smooth operation
- High scalability and outstanding performance
- Designed for maximum ease of use

Feature 1: User-friendly operation

• Full support for time-series images

Analysis of a large number of time-series images acquired experimentally is fully supported.

All images are processed in a simple operation – no need to write complicated scripts.

• Interactive GUI

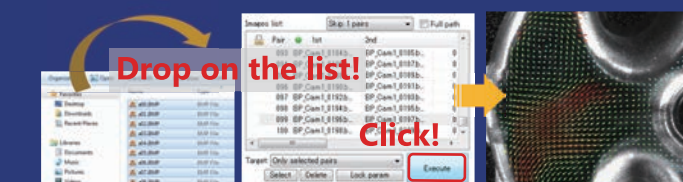
Intuitive operation, and quick verification of what has been done.

• Two-click operation

Only two clicks to time-series analysis from application start-up.

• Support for parameter setting

Easy comparison of operation results from different parameters, significantly reducing the time needed to define parameters.



Feature 2: High-speed and stable operation

• Large quantity of images

Stably processes even several thousand images.

• High-speed parallel processing

Uses parallel processing in processes with high operational load.

Achieves high-speed response with a multi-CPU and multi-core processor.

Feature 3: Hyper-sonic PIV

• Newly-developed PIV algorithm for $\Delta t < 100\text{ns}$

• Hyper-sonic PIV camera available (optional)

Feature 4: Check and re-analysis of the results

• Copying and pasting data lists

All operation results are displayed as a list. You can selectively copy a part of the data or the entire data, and paste it onto the spreadsheet software. Based on the idea of “all data belonging to the end user,” methods are optimized for convenience, enabling users to re-use data from operation results.

• Link data list and vector display

Data selected from a list can be simultaneously checked as a vector diagram, or vice versa. Items selected in a data list and those selected in a vector diagram are linked, meaning that vectors can be readily used to identify a position in an image.

• Display data tip in vector diagrams

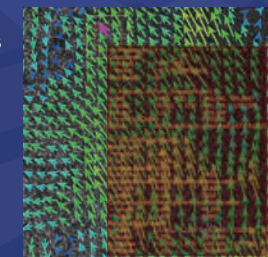
Detailed information related to the vector will be displayed as a data tip by hovering the mouse on the vector diagram. You can immediately check various information such as physical coordinates, correlation value, adopted rank, and neighborhood mean.

• Time-series statistical data

Statistical operations can be performed with one click based on the instantaneous data in the time-series. Results will be displayed in a different window. Compare statistics and instantaneous diagrams side by side.

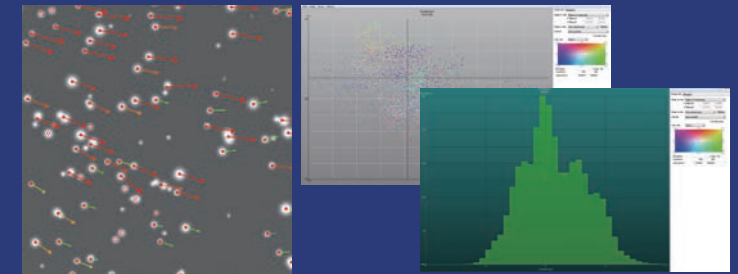
• Annotation

You can freely insert arrows and text comments in the vector diagram. The ruler is displayed on the image and the scale is displayed around the view. You can use the captured image in a presentation as it is.



Feature 5: Integratoin of PTV & PIA functions

- More versatile particle image analysis.



Feature 6: Flexible batch processing

• Free combination of processes

Enables batch processing according to function.

Freely combine process details to meet your goals.

• Parameter setting using GUI

No need to write complicated scripts.

Flexible and easy operation of the processing details and of determining processing order using GUI.

[Example] 15,625dots for 0.25 Pair/sec.

Feature 7: Jitter-corrected Δt

• Time-jitter correction to every PIV illumination

• Photodetector system with easy installation

Feature 8: Extensive image pre-processing

Universal filter kernel settings

This device is equipped with several standard kernels and enables you to freely change the kernel values. You can use a customized kernel based on your experience.

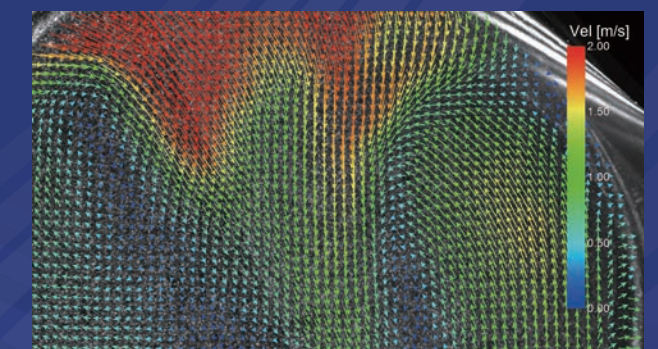
Free combination of processes

Enables composite application of extensive pre-processing functions.

You can freely define the process order and details, and implement your own pre-processing.

Sample display for pre-processing

Supports complex pre-processing. You can immediately check the applied image and the operation results.



Feature 9: Time-series filtering

You can use the FIR (finite impulse response) filter through the user-specified tap. This feature will enable you to perform a multifaceted sequential analysis. Application results are immediately displayed using arrows, enabling you to spatially recognize the application results of the time-series filter.

Feature 10: Comprehensive support

This software is designed to “grow with the user” and accurately meet various customer demands. We reply on your suggestions for prompt customization and upgrading of this software. Our experts are on hand to provide you with comprehensive support for every process. (Technical support requires a separate maintenance contract)