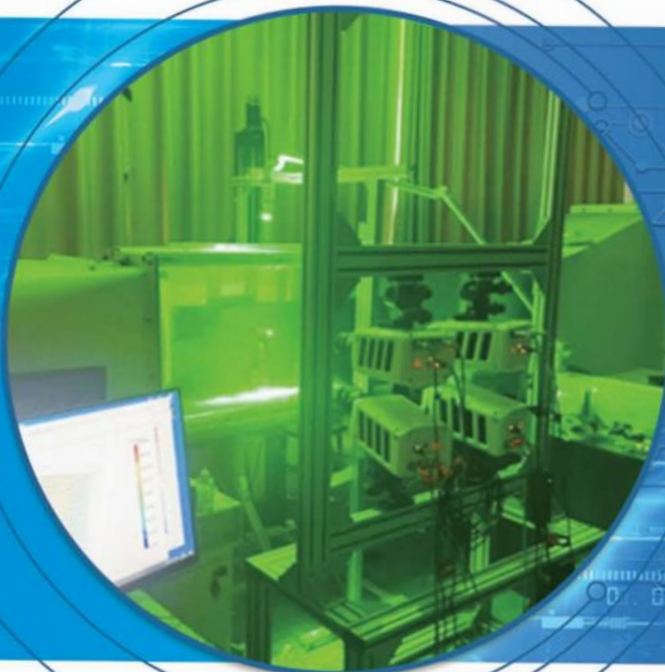# PIV flow field
measurement system
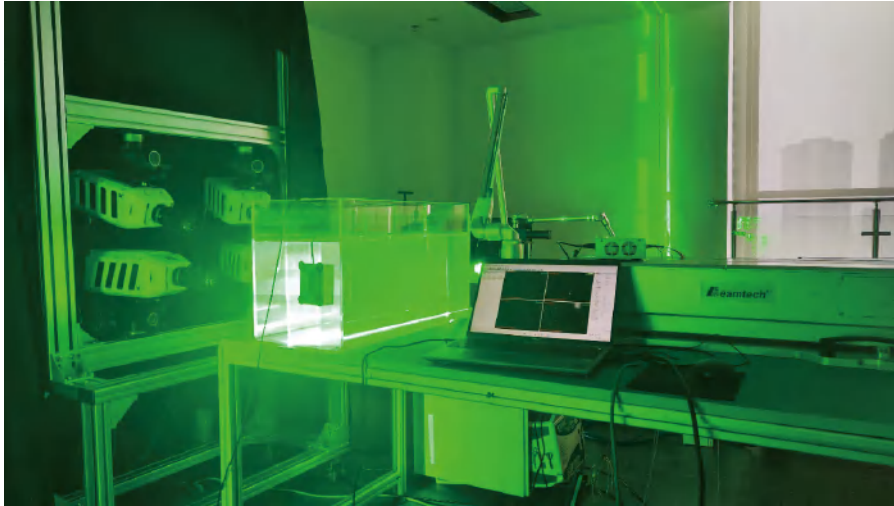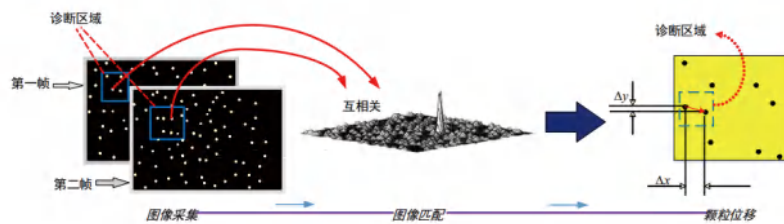
Measuring System

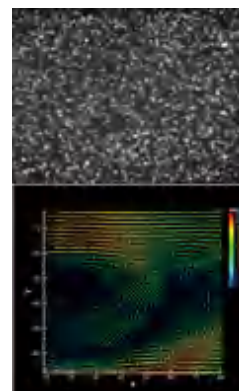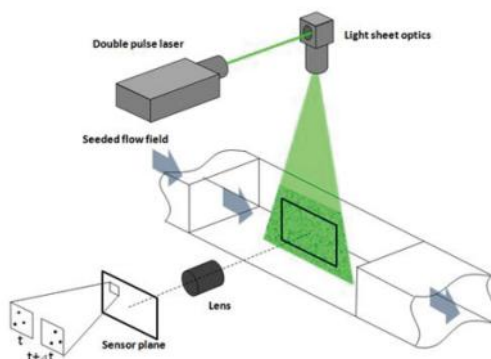# PIV Flow Field Measurement System

System Introduction

The PIV flow field measurement system is composed of PIV high-speed camera, PIV ultra HD double frame camera, RFlow particle image velocity measurement software, synchronization controller, and domestic leading PIV laser. It has differentiated advantages in high frequency, ultra-high definition, high-resolution continuous sampling, system customization, technical services, etc., and is an ideal choice to carry out experimental research on fluid mechanics, hydrodynamics, wind dynamics and two-phase flow.

Measurement Principle

PIV technology comes from the flow display technology. It mainly tracks the tiny particles scattered in the flow field through image analysis technology, and uses the movement of these particles to characterize the movement of the fluid. The specific operation process is as follows: First, the tracer particles are scattered in the flow field, using 532nm/527nm laser or other light source to illuminate the measured flow field area, through two or more consecutive exposures, the image of the particles is recorded on the negative or imaging CMOS surface; Then, autocorrelation method, cross-correlation method and particle tracking are used to process the particle image, and the velocity vector of each point in the flow field is calculated. Finally, according to the demand, other motion parameters (including flow field velocity vector diagram, velocity component diagram, flow diagram, etc.) are deduced.
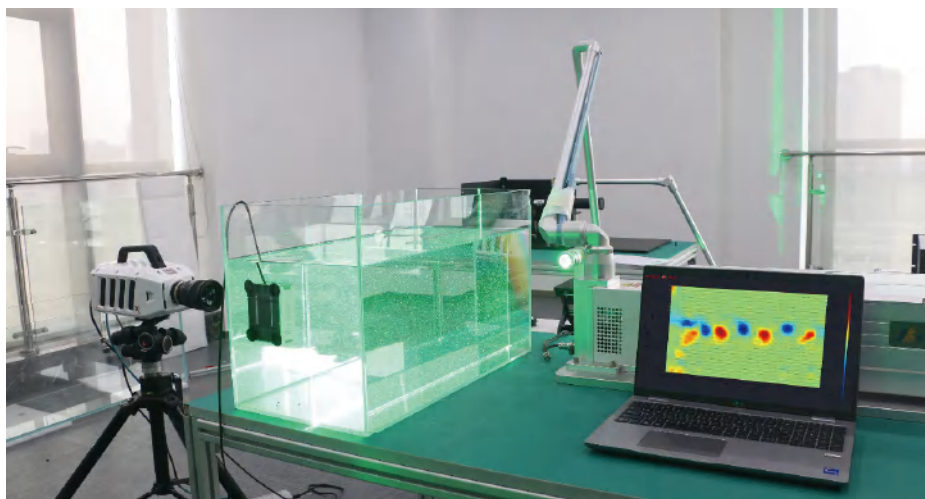
PIV Products
2D2C-PIV

Product Introduction

The 2D2C-PIV particle image velocity measurement system is composed of a single high-speed camera, laser, light guide arm, synchronization controller and RFlow particle image velocity measurement software, which supports the calculation of two-dimensional velocity field information in the measurement plane.

Key Features

- Good compatibility: compatible with a variety of Revealer PIV high-speed cameras, ultra HD double-frame cameras;
- With image pre-processing function: support the background culling method, image enhancement method, filtering method to filter the background non-particle image and relatively poor quality particle image, reduce image noise;
- Efficient calculation: Support efficient calculation of average velocity, turbulence intensity, Reynolds stress, skew coefficient and kurtosis coefficient;
- Abundant kinematic parameters are presented: In addition to the conventional flow velocity vector, two-dimensional distributions of kinematic parameters such as vorticity, rotation intensity, Q criterion variable and structured vorticity are presented in the form of color cloud images.
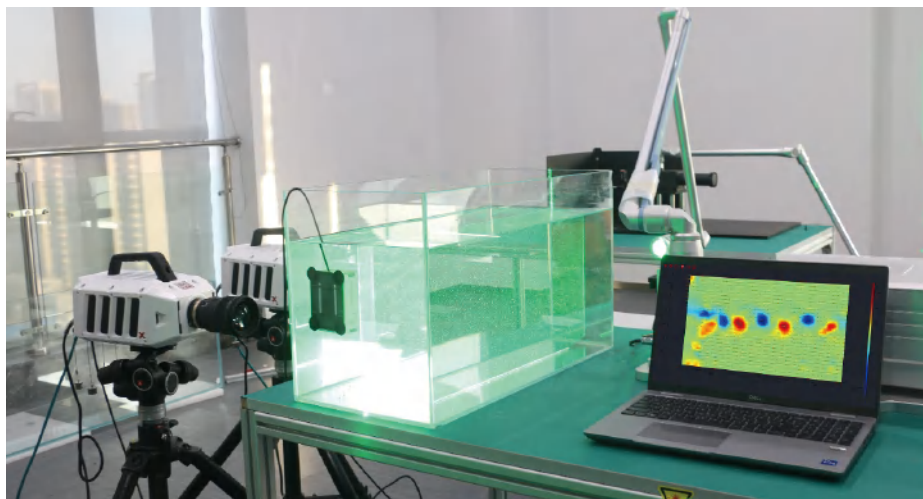
Recommended version	High-frequency version	Low-frequency version
Measuring medium	Air, Water	Air, Water
Capture resolution (recommended)	2560×1920/1280×1024	5120x4096
Capture frame rate (recommended)	2000fps/15000fps	36fps
Data transmission interface	Gigabit Ethernet / 10-Gigabit Ethernet	cxp
Laser wavelength	532nm/527nm	532nm/527nm
Laser type	High frequency pulsed laser	Low frequency pulsed laser
Laser energy	20~50mJ	100~500mJ
Software licensing	RFlow 2D2C	RFlow 2D2C
Statistical data	Average velocity, turbulence intensity, Reynolds stress, skew coefficient, kurtosis coefficient	Average velocity, turbulence intensity, Reynolds stress, skew coefficient, kurtosis coefficient

PIV Products
2D3C-PIV

Product Introduction

The 2D3C-PIV system is an extension of the 2D2C-PIV system, consisting of two high-speed cameras, lasers, light guide arms, synchronization controllers, and RFlow particle image velocity measurement software, which supports the calculation of the velocity component Z perpendicular to the measurement plane or the velocity component "out of the measurement plane".

Key Features

- Good compatibility: compatible with 2 thousand eyes Wolf PIV high-speed cameras or ultra high-definition dual-frame cameras and maintain accurate synchronization;
- High precision stereo calibration: The stereo calibration of 2D3C-PIV system is completed through three steps: calibration identification, establishment of calibration function and correction of calibration function;
- High definition imaging: the Angle arrangement of the camera sensor plane, lens plane and measurement plane conforms to Shamu's law to ensure clear images throughout the image field;
- Accurate 3D reconstruction: Using an optimized generalized method based on projection function, the 3D velocity field on the measurement plane is reconstructed.。

Recommended version	High-frequency version	Low-frequency version
Measuring medium	Air, Water	Air, Water
Capture resolution (recommended)	2560×1920/1280×1024	5120x4096
Capture frame rate (recommended)	2000fps/15000fps	36fps
Data transmission interface	Gigabit Ethernet / 10-Gigabit Ethernet	cxp
Laser wavelength	532nm/527nm	532nm/527nm
Laser type	High frequency pulsed laser	Low frequency pulsed laser
Laser energy	20~50mJ	100~500mJ
Software licensing	RFlow 2D3C	RFlow 2D3C
Statistical data	Average velocity, turbulence intensity, Reynolds stress, skew coefficient, kurtosis coefficient	Average velocity, turbulence intensity, Reynolds stress, skew coefficient, kurtosis coefficient

PIV Products
3D3C-PIV

Product Introduction

The 3D3C-PIV system is composed of four PIV high-speed cameras or ultra-clear double-frame cameras, laser, light guide arm, synchronization controller, and RFlow particle image velocity measurement software, which supports instantaneous measurement of three velocity components at each point in the three-dimensional body.

Key Features

- Good compatibility: compatible with 4 thousand eyes Wolf PIV high-speed cameras or ultra high-definition dual-frame cameras and maintain accurate synchronization;

- High-precision chromatographic calibration: the images of multiple cameras are uniformly converted into a common coordinate system with sub-pixel accuracy, and the digital calibration and correction technology is used to establish an accurate correspondence between the image space;

- High-resolution tomography: Multiple cameras meet the Shams condition, and the depth of field is greater than the thickness of the light, ensuring clear focus of the tracer particles in the measurement area;

- High definition 3D representation: Based on the transient projection of finite image space, the multi-algebraic reconstruction algorithm is called to obtain the 3D gray field representing the distribution of tracer particles;

- High precision image analysis: The method of multiple iteration and image deformation is used to improve the calculation accuracy of three-dimensional image particle velocity.

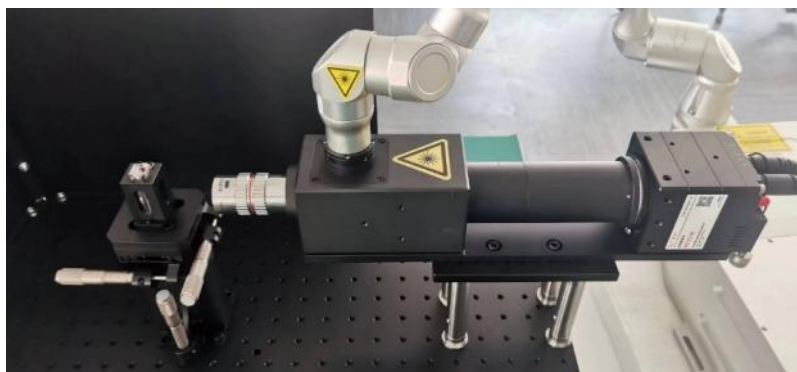| Recommended version	High-frequency version	Low-frequency version
Measuring medium	Air, Water	Air, Water
Capture resolution (recommended)	2560×1920/1280×1024	5120x4096
Capture frame rate (recommended)	2000fps/15000fps	36fps
Data transmission interface	Gigabit Ethernet / 10-Gigabit Ethernet	cxp
Laser wavelength	532nm/527nm	532nm/527nm
Laser type	High frequency pulsed laser	Low frequency pulsed laser
Laser energy	20~50mJ	100~500mJ
Software licensing	RFlow 3D3C	RFlow 3D3C
Statistical data	Average velocity, turbulence intensity, Reynolds stress, skew coefficient, kurtosis coefficient	Average velocity, turbulence intensity, Reynolds stress, skew coefficient, kurtosis coefficient

PIV Products

Microscopic PIV

Product Introduction

The PIV system consists of high-speed camera, light guide arm, laser, working platform, high magnmagnation lens (optional)/inverted fluorescence microscope (optional), RFlow particle image velocity measurement system software, which supports instantaneous measurement of microflow field in microchannels.

Key Features

- Support horizontal and vertical flexible layout of experimental model;
- Precision integrated optical path design, high-precision focusing;
- Efficient PIV data processing speed, using multi-core GPU parallel computing;
- Abundant kinematic parameters are presented: In addition to the conventional flow velocity vector, two-dimensional distributions of kinematic parameters such as vorticity, rotation intensity, Q criterion variable and structured vorticity are presented in the form of color cloud images.

Recommended version	High-frequency version	Low-frequency version
Measuring medium	Air, Water	Air, Water
Capture resolution (recommended)	2560×1920/1280×1024	5120x4096
Capture frame rate (recommended)	2000fps/15000fps	36fps
Data transmission interface	Gigabit Ethernet / 10-Gigabit Ethernet	cxp
Laser wavelength	532nm/527nm	532nm/527nm
Laser type	High frequency pulsed laser	Low frequency pulsed laser
Laser energy	20~50mJ	100~500mJ
Statistical data	Average velocity, turbulence intensity, Reynolds stress, skew coefficient, kurtosis coefficient	Average velocity, turbulence intensity, Reynolds stress, skew coefficient, kurtosis coefficient

Product Composition Introduction

PIV high speed camera

Revealer PIV high-speed camera provides capture speeds of up to 2,000 FPS at 2560×1920 resolution, or up to 15,000 FPS at 1280×1024 resolution, with 300ns high-speed cross-frame exposure capability.

PIV Ultra HD dual frame camera

The Thousand Eyes Wolf PIV Ultra HD dual frame camera provides ultra HD image quality up to 20 million pixels, with real-time transmission, flexible storage and other features.

Laser

Continuous laser: 5W, 10W, 20W
Low frequency double pulse laser: energy 100mJ-500mJ optional, frequency 0-15Hz, Jitter< 1ns, energy stability RMS<2%
High frequency double pulse laser: energy 20mJ-50mJ optional, frequency 0.2-10kHz, Jitter< 3ns, energy stability RMS<1%
High-frequency monopulse laser: energy 20mJ-50mJ optional, frequency 0.2-10kHz, Jitter< 3ns, energy stability RMS<1%
Lasers with other parameters can be customized

Light guide arm

Transmission wavelength: 532 nm; 355 nm, 266 nm Optional
optical aperture: 15 mm
Maximum transmission power: >600 mJ@532 nm
Transmission loss: <15%
Arm length: 7 knots, 1.8m
Material: Aluminum alloy

Wafer light source

Transmission wavelength: 532 nm, 527nm light Angle: optional
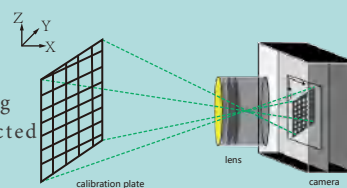Damage threshold: > 3J/cm2
Special requirements Sheet light or cone light is optional

Calibration target

Custom high precision calibration board
Even if there is no coincidence or even a large deviation between the calibration plate and the laser, the deviation can be calculated by using the recorded image, and the corresponding mapping function is corrected and the recorded image is corrected, the calibration accuracy is 0.1 pixels.
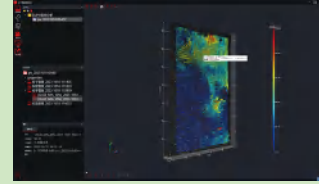
calibration plate   lens   camera

Synchronous controller

The synchronization controller independently developed by Thousand Eyes Wolf has the synchronization control ability of various lasers and multiple PIV cameras, timing or delay triggering, using 1 SYNC IN synchronization signal input, 1 IRIG_B (DC B code) signal input, 1 TRIG external trigger signal input, 8 SYNC OUT synchronization signal output design. At the same time, the phase adjustment function can be set according to the needs of the control host.

RFlow particle image velocity measurement software

The self-developed RFlow particle image velocity measurement software integrates advanced image processing algorithms and particle image interpretation technology to perform visual analysis of vector sequence diagrams collected, including transient analysis, vortex structure and statistical data. Transient analysis includes instantaneous flow field, Galileo decomposition flow field, Reynolds decomposition flow field and instantaneous velocity field. The vortex structure includes vorticity cloud map, vortex rotation intensity and Q criterion variable cloud map. The statistical data can analyze the average velocity, turbulence intensity, Reynolds stress, skew coefficient, kurtosis coefficient statistics.

Tracer particle

According to the needs of actual application scenarios, thousand Eyes Wolf provides a variety of non-toxic, harmless, non-corrosive, stable chemical properties, good flow following tracer particles, hollow glass beads HGS, titanium oxide, silver plated hollow glass beads, fluorescent particles, etc.

Introduction of PIV case

Wind Tunnel

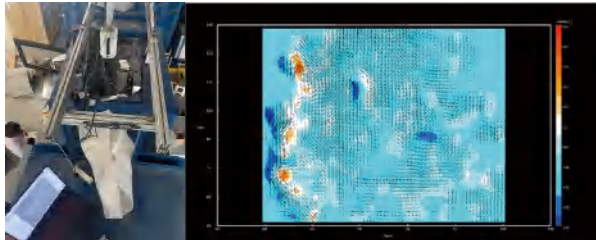Introduction: U-shaped boundary layer wind tunnel experiment
Highlights: Obtain the chromatographic particle image, calculate the flow field distribution in the volume space Recommended: 3D3C-PIV, 4 PIV ultra HD dual frame cameras 4800× 3400@20fps

Wind Tunnel

Introduction: Wind tunnel experiment
Highlights: Measure wind tunnel velocity, eddy current field, flow diagram, and capture the rapid change process of flow field
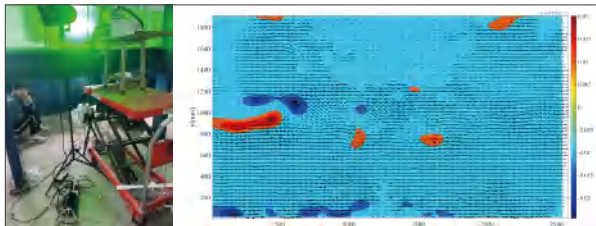Recommended: 2D2C-PIV, 1 PIV high speed camera 2560× 1920@2000fps

Water Tunnel

Introduction: Water flow field experiment
Bright spot: Clearly observe the influence of eddy current generated by different obstacles on the flow field, improve the oil pipeline transportation
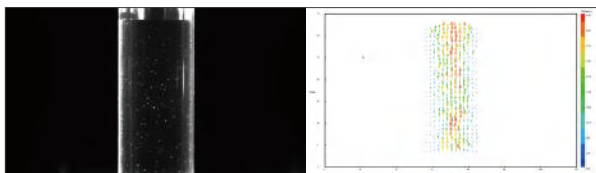Recommended: 2D2C-PIV, 1 PIV high speed camera 2560× 1920@2000fps

Water Tunnel

Introduction: Container flow field experiment
Highlight: Analysis of the fluid velocity field under pressure intolerance and different containers
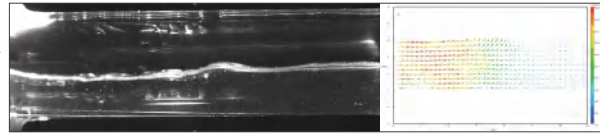Recommended: 2D2C-PIV, 1 PIV high speed camera 2560× 1920@2000fps

Water Tunnel

Introduction: Heating reflux flow field experiment

Highlight: The evolution process of flow field velocity of natural reflux and dramatic reflux under different heating coefficients is studied

Recommended: 2D2C-PIV, 1 PIV high speed camera 2560× 1920@2000fps
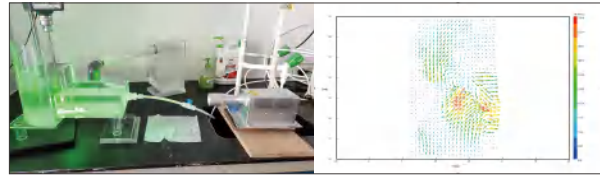

Water Tunnel

Introduction: Propeller flow field experiment

Highlight: Analysis of the flow field at the tip of the blade during propeller rotation
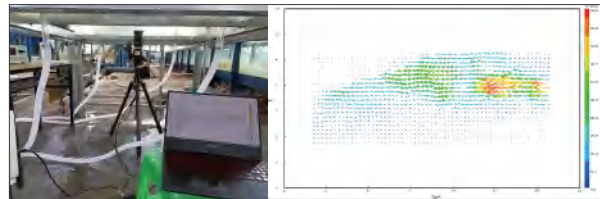
Recommended: 2D2C-PIV, 1 PIV high speed camera 2560× 1920@2000fps

Water Tunnel

Introduction: Water flow field experiment

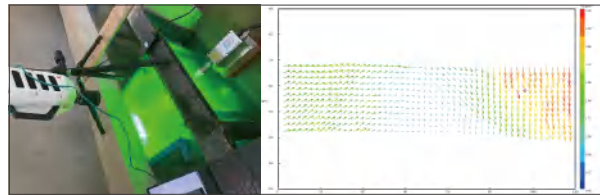Highlight: Get the vortex generated by different obstacles in the flow field

Recommended: 2D2C-PIV, 1 PIV high speed camera 2560× 1920@2000fps

Water Tunnel

Introduction: Dam fish flow field change

Highlight: Analyze the evolution process of flow velocity of flow field and study the impact of flow field on fish Recommended: 2D2C-PIV, 1 PIV high-speed camera 2560× 1920@2000fps
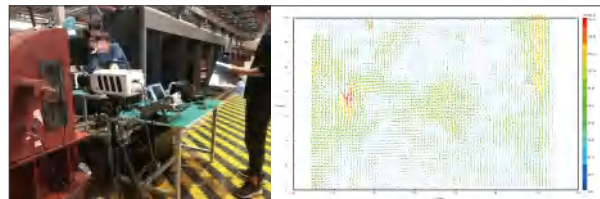

Water Tunnel

Introduction: PIV experiment of pipeline flow field

Highlight: Shoot the water flow field in the pipeline across frames, accurately set the offset time of PIV camera and laser to meet the synchronization

Recommended: 2D2C-PIV, 1 PIV high speed camera 2560× 1920@2000fps

Bubble

Introduction: Bubble tracking experiment

Highlights: Visual tracking of bubbles, measurement of dynamics indicators such as diameter, area, perimeter, velocity, acceleration

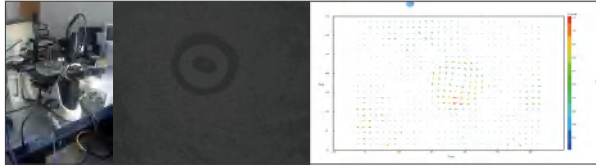Recommended: 2D2C-PIV, 1 PIV high speed camera 2560× 1920@2000fps

Microflow field

Introduction: PIV experiment of micro vortex flow field
Highlight: The whirlpool flow field formed by ultrasonic wave is observed by integrated microscope
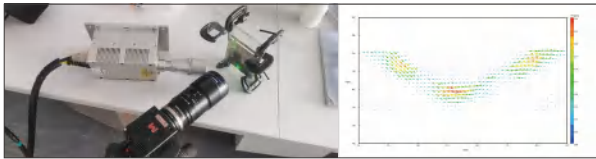Recommended: Microscopic PIV, 1 high speed camera 2560×1920@2000fps

Microflow field

Introduction: Microfluidic PIV experiment
Highlights: Precision optical path design, support high magnification lens, achieve velocity vector field measurement in microchannel
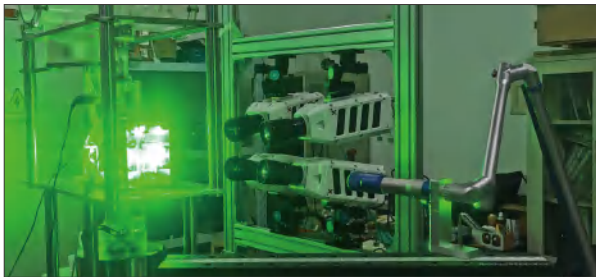Recommended: Microscopic PIV

Biomedical

Introduction: Study on the flow field in tissues and organs
Highlights: The 3D flow velocity field and vorticity in the space of tissues and organs can be measured. Recommended development: 3D3C-PIV, 4 high-speed cameras 2560×1920@2000fps

Quality Service

- The company has wind, water tunnel professional laboratory, free of charge to provide test shooting services
- Provide PIV remote technical support services
- Free training, at least once a year
- 24-hour after-sales service
- Promises 1 month fast repair within the warranty period, will provide a substitute device if can not repair it within this time
- Provide free technical design and professional hardware and software selection
- Professional technical support team