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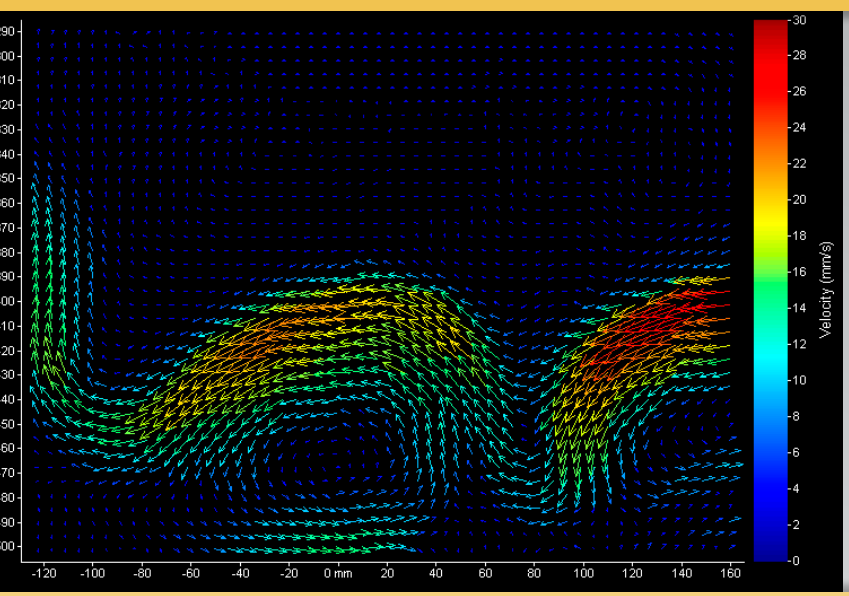
H SERIES: HYDRAULIC RESEARCH INSTRUMENTS

LASER PIV SYSTEM – H41



Armfield/Etalon Research

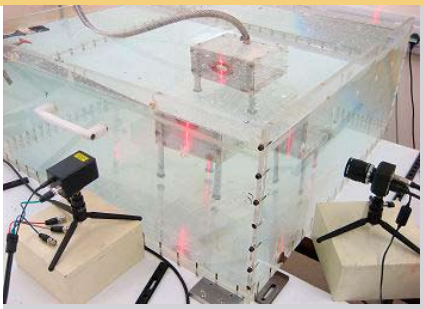
FEATURES

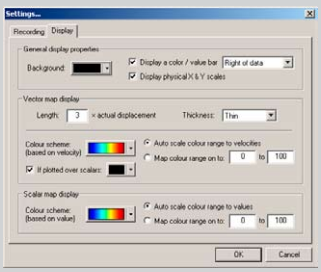
The H41 uses particle image velocimetry (PIV) to measure, non-intrusively, fluid velocities at multiple points in a flow, at a rate of up to 16Hz.

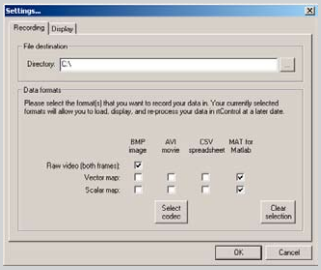
The compact and portable hardware (which uses a safe, non-pulsed, Class 3b laser) and the extremely easy to use software with real time display, make this an ideal tool for undergraduate teaching and demonstration.

With its sophisticated multi-pass processing, the H41 matches the performance of higher power PIV systems costing several times more. It is therefore also an ideal, cost-effective tool for experimental fluid dynamics research.

The intuitive software provides a wide range of processing, display and recording functions for both velocity and derived statistical data, using a standard PC.







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Etalon RESEARCH

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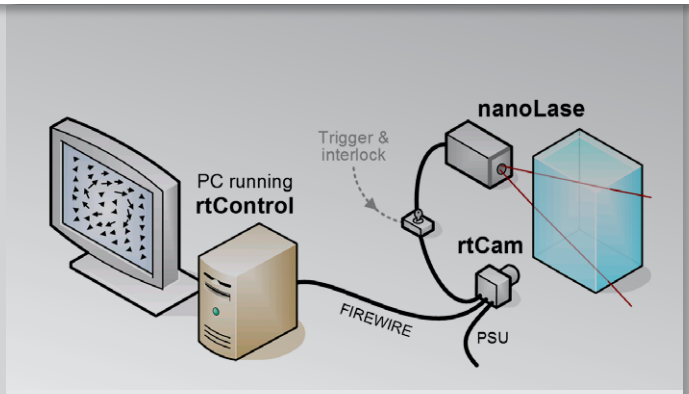
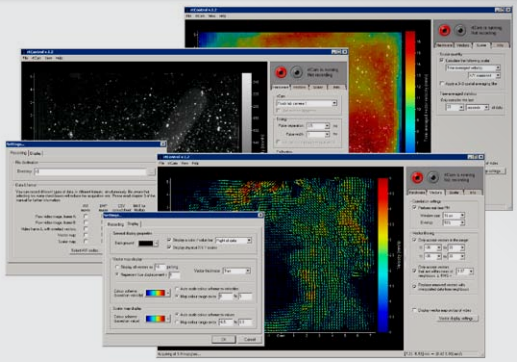
<EXTENDED> WARRANTY 2 years 2YR WARRANTY ON ALL ARMFIELD PRODUCTS



H41 Laser PIV System set-up diagram



DESCRIPTION

The H41 consists of two main assemblies: the nanoLase light sheet projector and the rtCam camera, with built-in timing synchroniser. The rtCam interfaces to the rtControl software package, which runs on a standard PC under Windows XP (not supplied by Armfield).

The nanoLase consists of a low-power solid-state laser, together with optics to form the beam into a ~3mm thick, 45° wide light sheet. The laser is modulated to produce pairs of pulses, with an adjustable delay (known as Δt) of between 100 µs – 5 s. Both the pulse separation and pulse width can be set directly from the rtControl software.

The nanoLase and rtCam are arranged orthogonally around the flow to be measured, with the laser being used to illuminate flow-following "seeding" particles that have been mixed into the water. The system is supplied with 100 g of 100 µm polyamide particles, which are suitable for the majority of water-based flows. These particles scatter light towards the rtCam, which acquires a pair of images every time the laser emits a pulse pair.

Each pair of particle images are immediately sent to the control PC using a standard FireWire (IEEE 1394) connection. The rtControl software then subdivides the images into "tiles" which are cross-correlated in order to measure the displacement of the seeding particles in that area. Because the delay between the images is known, a velocity map can be calculated for the whole of the camera's field of view. While most PIV systems take several minutes to get to this point, rtCam and rtControl can repeat the entire process up to 16 times a second.

In addition to the real-time velocity vector maps, rtControl can calculate and display derived statistical data (such as vorticity or time-averaged velocity) with options to superimpose vectors, scalars, and video on top of each other. Similarly, there are options to record data as either raw images (in BMP format), or as processed vectors or scalars (in AVI movie, CSV spreadsheet, or Matlab® archive format). Previously recorded datasets can be loaded into rtControl for subsequent display and analysis.

Both the rtCam and the nanoLase are fitted with standard mountings suitable for a selection of different mounting mechanisms. The system is supplied with two small desktop tripods; larger tripods and various snake-arm mounts are available as accessories. Also available are purpose designed mounts designed for use with Armfield flow channels.

The system is provided complete with all cables and packed into an aluminium flight case for safe storage and easy transport.

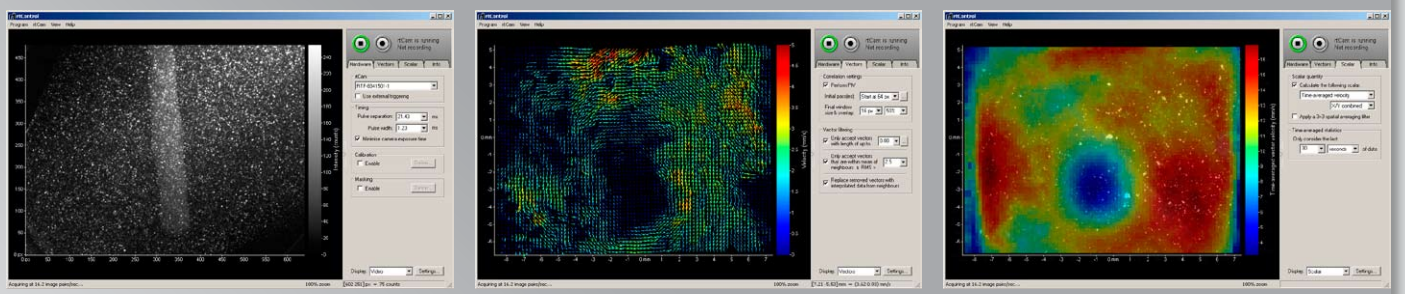
SPECIFICATION

Laser:

- *Solid-state air-cooled 200 mW, 660 nm laser diode (Class 3b).*
- *Standard optics produce a c. 3 mm thick, 45° light sheet (c. 200 mm wide at 250 mm).*
- *Interchangeable 22° light sheet optic available (item H41-3).*
- *Pulse separation (Δt) of between 100 µs - 5 s (in steps of 10 µs).*
- *Pulse width of between 10 µs - 32 ms (in steps of 10 µs).*

Camera:

- *Super-sensitive VGA CMOS sensor: 640 × 480, 6.0 µm pixels (1/3" format); ~50% quantum efficiency at 660 nm; 75 - 110 dB dynamic range; 4.8 V/lux·sec sensitivity.*
- *Trigger input enables image pair acquisition to be synchronised with external events.*



Typical software screenshots

> *Accepts standard CS- or C-mount lenses (12.5mm f/1.4 lens supplied).*

> *Camera exposure can be linked to the laser's pulsing, thereby enabling operation in a lit room.*

Software Processing:

> *Data refresh and recording rate up to 16Hz (dependent on the computer speed, the selected acquisition and PIV analysis parameters and the recording taking place)*

> *Real-time, or offline, 2-component vector calculation.*

> *Single pass or adaptive multi-pass cross-correlation with 8, 12, 16, 24, 32 or 64 pixel window sizes.*

> *0% or 50% window overlap (i.e. maps of up to 19,000 vectors).*

> *Optional vector interpolation and filtering based on:*

User-supplied velocity limits;
RMS of neighbouring vectors' values.

> *Calculation of the following derived scalars:*
Vector angle and magnitude;
Vorticity and swirl;
Time-averaged mean velocity;
RMS and turbulence intensity.
Where applicable, vector component and statistical sample number are user-defined.

OPTIONAL ACCESSORIES

H41-3 22° Light sheet Optics for nanoLase.

The standard 45° light sheet optics can be replaced with item H41-3 in order to produce a narrower 22° fan angle. This can be useful in cases where the nanoLase needs to be placed further away from the measurement area.

H41-5 1.5 m tripod for rtCam

H41-6 Snakearm with magnetic base for nanoLase

H41-7 Snakearm with G-Clamp base for nanoLase

H41-10 Mounting system for Armfield C4-MkII flume
(Requires H41-2 submersible nanoLase and H41-3 optics option)

H41-11 Mounting system for Armfield S6-MkII flume
Including lateral adjustment for nanoLase. (Requires H41-2 submersible nanoLase and H41-3 optics option)

CONSUMABLES

H41-4 Seeding particles
Suitable for water flows (200g)

OPTIONS

A range of further options are available to suit specific user applications, including:

- *Waterproof enclosure for the rtCam, to allow complete submersion in water,*

E.g. for use with a large towing tank

- *Flashlamps can be supplied in place of the nanoLase, for surface velocimetry measurements.*
- *Higher power versions of the nanoLase are available for measuring larger areas or faster flows.*
- *The rtCam can be supplied with macro or telephoto lenses.*
- *A light-sheet thickness adjuster is available for micro-PIV measurements.*

Please contact Armfield for further details of these options

ORDERING DETAILS

H41-1 Laser PIV System for Flow measurement and Visualisation

H41-2 Laser PIV System for Flow measurement and Visualisation with submersible nanoLase light sheet projector.

VOLTAGE VARIANTS

H41-1-A, H41-2-A 220-240V, 50Hz
H41-1-B, H41-2-B 115V, 60Hz

REQUIREMENTS

Electrical supply:
H41-1-A, H41-2-A 220-240V, 50Hz
H41-1-B, H41-2-B 115V, 60Hz.

Personal Computer (PC) running Windows XP, with IEEE 1394 (A or B) interface.

It is recommended that the PC has at least 2GB RAM with a processing speed of at least 2GHz. The display resolution should be at least 1024 × 768, true colour.

The data refresh rate achievable is dependent on the specification of this computer. For example, to achieve 16Hz data refresh and recording rate, a 2.66GHz Intel dual core processor or better is required, and the hard drive must support sustained writes at 9.5 Mb/s.

OVERALL DIMENSIONS

nanoLase
Length: 0.050m
Width: 0.050m
Height: 0.085m

Submersible nanoLase
Length: 0.050m
Width: 0.050m
Height: 0.095m

rtCam
Length: 0.050m
Width: 0.050m
Height: 0.090m

SHIPPING SPECIFICATION

Volume: $0.1m^3$
Gross weight: *6kg*

ORDERING SPECIFICATION

- *Particle Image Velocimetry System, comprising a laser light sheet projector, a camera system and processing software*
- *200 mW (Class 3b) 660 nm laser, with variable pulse width and pulse spacing*
- *45° light sheet optics as standard with optional optics to produce a 22° sheet*
- *Real-time 2D display of flow velocity vectors updated at up to 16 Hz*
- *Data can be recorded in video (avi), bitmap (bmp), text (csv) and Matlab (mat) formats*
- *Option of submersible light sheet projector*

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