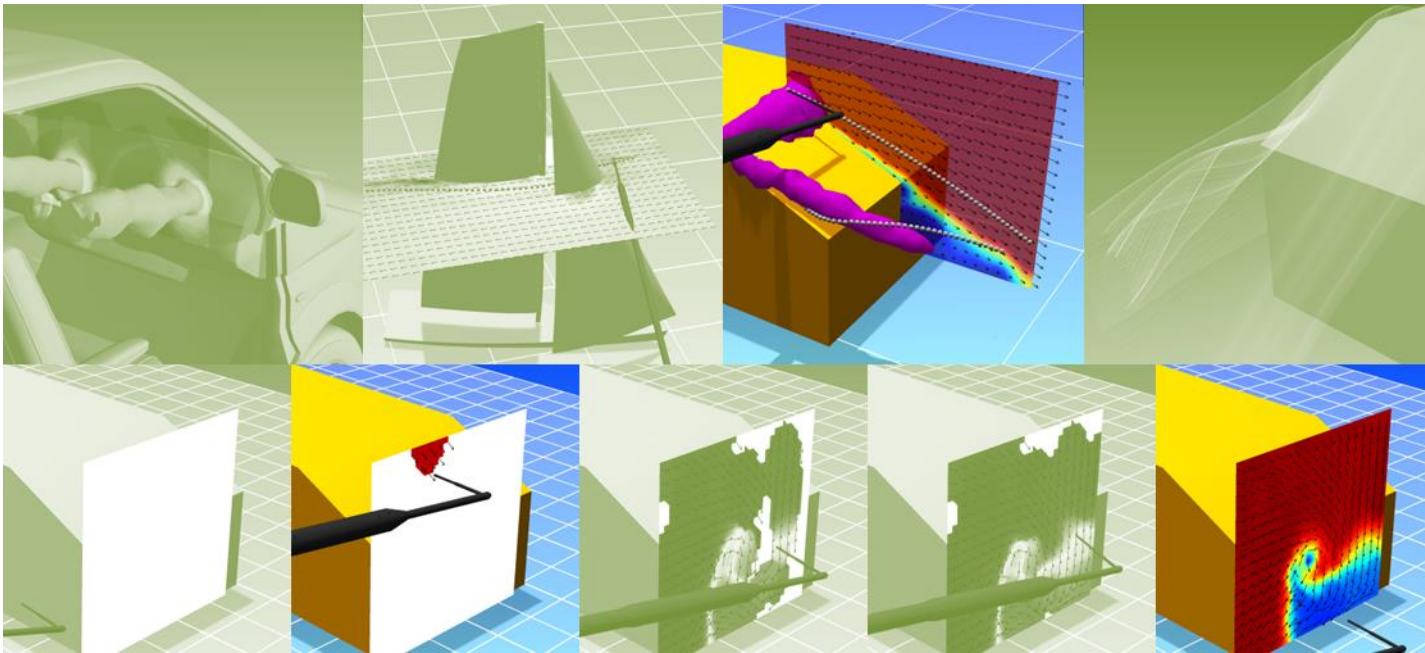


# STREAMWISE

## ProCap quantitative flow visualization system

Data sheet



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# Content

<b>1.</b>	<b>ProCap</b>	<b>3</b>
<b>2.</b>	<b>Working principle</b>	<b>3</b>
<b>3.</b>	<b>Applications</b>	<b>3</b>
<b>4.</b>	<b>Versions of ProCap</b>	<b>3</b>
<b>5.</b>	<b>Features</b>	<b>5</b>
<b>6.</b>	<b>System specifications</b>	<b>6</b>
6.1	Compact package components	6
6.2	Professional options	8
6.3	Additional items	10

## 1. ProCap

ProCap (Probe Capture) is a new and unique tool for flow visualization and measurement that combines the intuitive and simple handling of a smoke probe with the data content and quality of a 3D-point measurement scan. In the compact version ProCap offers very flexible measurement possibilities for smaller wind-tunnel applications.

## 2. Working principle

The region of interest is manually scanned by the operator using a hand-held probe while the system records the measurement data, optically tracks the probe's instantaneous position and processes and visualizes the flow field in real-time. This human-based scanning approach is very efficient as in regions of large gradients the scanning is refined and no machine-teaching even for complex geometries is necessary. The measured 3D data is accessible in real-time, typically on a large screen or projected to a wall with good visibility during testing. For later analysis, the data is also available offline using either the ProCap software or standard CFD visualization and analysis tools.

## 3. Applications

### Motorsport

- Reduce wind tunnel setup and turnaround times
- Obtain precision 3D velocity and pressure data in areas that are optically-inaccessible
- Provide a powerful, quantitative alternative to classical smoke-wand visualization

### Wind tunnel

- Get real-time, independent feedback from your traverse system
- Digital visualization of both your model and the probe, reducing the risk of probe crashes
- True three-component, three-dimensional velocity fields without the need for flow seeding, and reduce aerodynamic testing time

### HVAC and clean-room

- Very low speed ultrasonic flow probe available
- Scanning of problematic areas to visualize real flow situation
- Flow probe movement compensated

### Education

- Provide students with a real-time, quantitative visual representation of complex, three-dimensional flow fields
- For internal or external flows
- Robust, hands-on measurement system ideally-suited for laboratory demonstrations

## 4. Versions of ProCap

Customers can choose out of two software versions:

### ▪ ProCap Compact

A one-stop flow measurement solution, easy to use and quick to setup.

### ▪ ProCap Professional

Offering full features and flexibility for adaptation to customer specifications and facility. We offer a basic upgrade package as described below that can further be adapted to the application specific requirements.

Table 1 shows the capabilities of these two versions.

		<b>ProCap Version</b>	
		<b>Compact</b>	<b>Professional</b>
<b>Software features</b>	Real-time data visualization	✓	✓
	GPU 3D processing	✓	✓
	Raw data export	✓	✓
	Interpolated data export	✓	✓
	Model export in data coordinate system	✓	✓
<b>Data acquisition</b>	Working distance	0.5-3m	1-10m
	Number of cameras	1 (3 sensors)	Unlimited
	Acquisition rate	120 Hz	Adjustable
<b>Supported probes</b>	Vectoflow digital 5-hole probe: iProbe	✓	✓
	Surrey digital 7-hole probe	✓	✓
	Anemoment: Trisonica Mini/Sphere	✓	✓
	Analog 5 hole-probe	-	✓
	Analog 14 hole omniprobe	-	✓
	Integration of custom probes	-	✓
<b>Measured quantities</b>	Flow direction & magnitude	✓	✓
	Static pressure	✓	✓
	Interpolation kernel size	✓	✓
	Other quantities (probe related)	✓	✓
<b>Standard visualization</b>	Current state of probe	✓	✓
	Actual measured velocity	✓	✓
	Measurement domain	✓	✓
	No. of visualization planes	5	10
<b>Advanced visualization</b>	Streamline visualisation	-	✓
	Iso-surface visualization	-	✓
	Probe-fixed-planes	-	✓
	Voxel-eraser	-	✓
<b>Model geometry</b>	CAD file import (.stl)	✓	✓
	Number of displayed models	✓	✓
	Model geometry trackable	-	✓
<b>Tracking systems</b>	Optitrack	✓	✓
	Qualisys	-	✓
	Vicon	-	✓

Table 1: Comparison ProCap Professional and ProCap Compact

## 5. Features

### Plug-and-play

- Easy and intuitive to set up and use
- Digital probes with USB connector

### Digital multi-hole flow probes

- Velocity and pressure from a precision digital multi-hole probes

### Data processing

- Intuitive data processing and visualization software pre-installed on included computer

### Optical motion tracking

- Three-dimensional motion capture for precision, independent relative position tracking

### Easy visualization

- Clear, simple, and powerful real-time graphics and post-processing tools for volumetric flow visualization
- Immediate visualization during measurement

### Application specific probes (Pro)

- Wide range of flow probes with up to 320° of acceptance angle

### Wide operating range

- pressure sensitivities available down to 160 Pa full-scale, and temperature-rated between 5° and 60° C

### Fast response

- System bandwidth up to 120 Hz (Compact) and 200 Hz (Pro)

### Complete package

- Carefully selected hardware components for seamless operation
- rugged transport casing holds all components

### Versatile application

- Wide range of possible application including teaching experiments for seamless operation

### Modular system (Pro)

- Flexible and scalable system for a wide range of applications and facilities

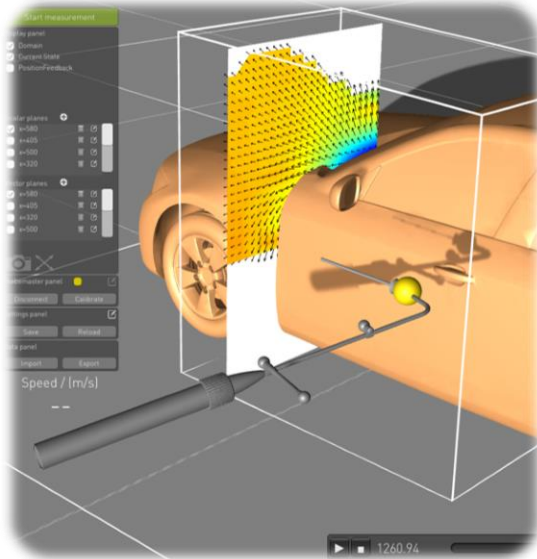
### Customizable components (Pro)

- Non-standard components can be integrated according to the customer's specifications

## 6. System specifications

### 6.1 Compact package components

#### 1 ProCap Compact software suite preinstalled on a powerful laptop



##### Software

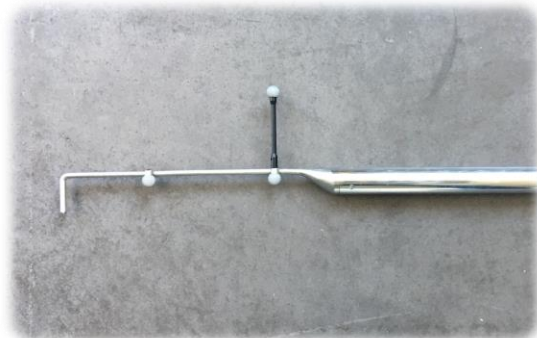
- Real-time data interpolation with adaptive spatial resolution
- Visual probe position and measurement point density feedback
- Real-time adjustment of viewing angle and zoom, positioning
- Visualization features: vectors, contour planes
- Selectable quantities, colormaps and scaling
- Probe velocity correction
- CAD model import (stl file format, e.g. available from 3D scanners)
- Fusion of different measurements to one dataset (offline)
- Data-export to Paraview (vtk file-format)

##### Laptop

- Powerful mobile workstation with pre-installed ProCap software (currently based on Lenovo)

#### 2 The following digital probes can be used:

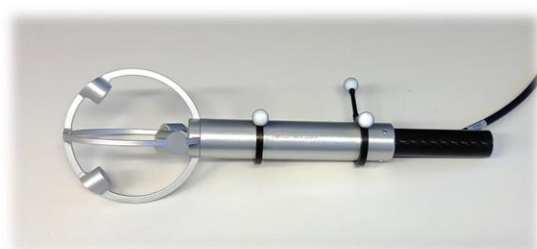
##### 5-hole digital probe, fully integrated with USB connector from Vectroflow



##### iProbe

- Digital 5-hole flow probe
- USB data and power connector
- Flow direction, velocity, static and dynamic pressure output
- Passive optical markers
- Left- or righthanded operation
- stl file for position feedback included
- Multiple pressure range options
- Metal housing
- Individually calibrated

##### Three Component Ultrasonic Probe TriSonica™ from Anemoment



##### TriSonica™ Sphere

- Digital 3D ultrasound probe
- Aluminum housing
- USB data and power connector
- Flow range (0-30 m/s):  $\pm 0.1$  m/s
- $\pm 60^\circ$  out-of-plane flow acceptance angle
- Temperature
  - Range:  $-40^\circ$  C to  $85^\circ$  C
  - Resolution:  $0.01^\circ$  C
  - Accuracy:  $\pm 2.0^\circ$  C



#### **TriSonica™ Mini**

- Digital 3D ultrasound probe
- USB data and power connector
- Flow range (0-10 m/s):  $\pm 0.1$  m/s
- $\pm 15^\circ$  out-of-plane flow acceptance angle
- Temperature
  - Range:  $-40^\circ\text{C}$  to  $85^\circ\text{C}$
  - Resolution:  $0.01^\circ\text{C}$
  - Accuracy:  $\pm 2.0^\circ\text{C}$
- Humidity, static pressure, dew point, magnetometer, and air density sensors

### **3 3D camera system Optitrack V120 trio, incl. dongle license for tracking software**



#### **Optitrack Camera**

- V120 Trio Camera bar incl. dongle license of the tracking software and cabling
- USB data connection
- Frame Rate: 120 FPS
- Latency: 8.333 ms
- Accuracy: Sub-millimeter
- Working distance: 0.6 to 5 m

(Please visit the OptiTrack website for the details regarding hardware specification and software license and updates.)

### **4 Custom transport casing**



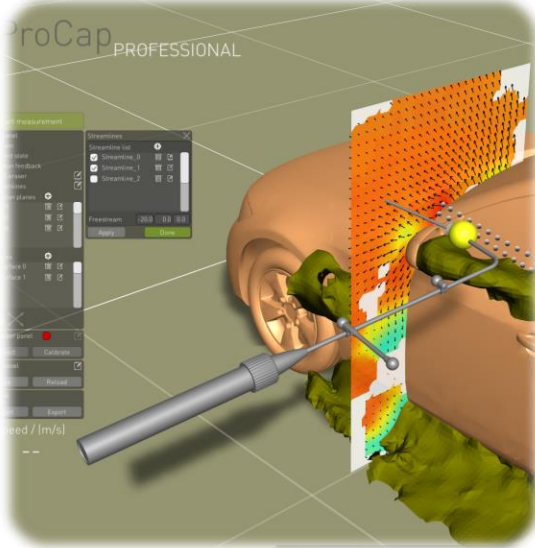
#### **Industrial casing**

- Custom made casing
- Fit to customer specific probe shape
- Holds all components but laptop



## 6.2 Professional options

### 1 ProCap Professional software suite preinstalled on powerful laptop



#### Professional software features

- Increased number of visualization planes
- Visualization plane can move with probe
- Iso-surfaces of selectable quantities
- Streamline visualization
- Enhanced spatial reference with Voxel eraser
- Display and tracking of multiple model geometries
- Support of customized and analogue probes up to 14 holes
- Acquisition of user-defined analogue channels
- Support of customizable Optitrack, Qualisys and Vicon tracking systems

### 2 In addition to the digital probes of the compact system, the following analog probes can be used:

#### 5 or 14-hole probe (requires pressure sensor module and data acquisition box)



#### Probe heads

- Custom made 5 or 14-hole probe
- Flow direction, velocity, static and dynamic pressure output
- 50°/320° acceptance angle
- Pre-calibrated
- Passive, exchangeable markers
- Left- or righthanded operation
- Quick connector to pressure sensor module
- Attachment points for mounting hardware
- stl file for position feedback included
- VRPN driver for multi-functional use of the probe included

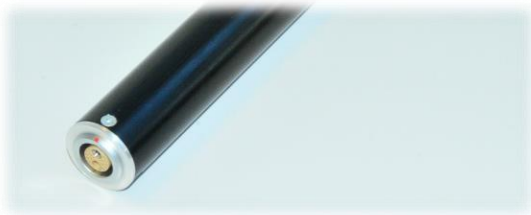


### 3 Data acquisition box with cabling



- Up to 1 kHz acquisition rate
- Optional input and trigger channels
- Integration of 3<sup>rd</sup> party sensors
- Power source for the pressure sensors and on-board electronics
- USB connectivity to the ProCap laptop
- 5 m connector cable to pressure sensor module with reference pressure tube

### 4 Pressure sensor module



- Pressure sensor module for 18, 35 or 50 m/s measurement range
- Integrated electronics with pressure sensors
- Quick connector to accept different (custom) probe heads
- 5 or 14-hole probe ready

### 5 Custom optical tracking system



- Optitrack or Qualisys tracking systems
- Tracking for large volumes with sub-millimetre accuracy
- Up to 1 kHz tracking rate
- Wide range camera options
- Permanently installed systems
- Working distance up to 8 m
- Outdoor (daylight) and underwater capability
- Model position and deformation measurement
- High-speed video output

### 6.3 Additional items

Description	Applies to	
	Compact	Professional
1 Software maintenance contracts for one or three years	<b>x</b>	<b>x</b>
2 On-site installation and training	<b>x</b>	<b>x</b>
3 Light-weight telescopic probe stick with articulated joint	<b>x</b>	<b>x</b>
4 Rugged telescopic pole for probe with different lengths	<b>x</b>	<b>x</b>
5 Tripods and magic arms	<b>x</b>	<b>x</b>
6 Custom tracking setup		<b>x</b>
7 Camera mounting hardware for fixed installations		<b>x</b>
8 Customized transport casing	<b>x</b>	<b>x</b>
9 Camera calibration hardware		<b>x</b>
10 Extra marker kits	<b>x</b>	<b>x</b>
11 Customized sensor modules for low and high-speed range		<b>x</b>
12 Customized probe types and shapes		
13 Customized probe and mounting hardware (e.g. mechanical support for high velocities)	<b>x</b>	<b>x</b>
14 Additional digital or analogue measurement channels		<b>x</b>

(All content subject to change without prior notice).

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