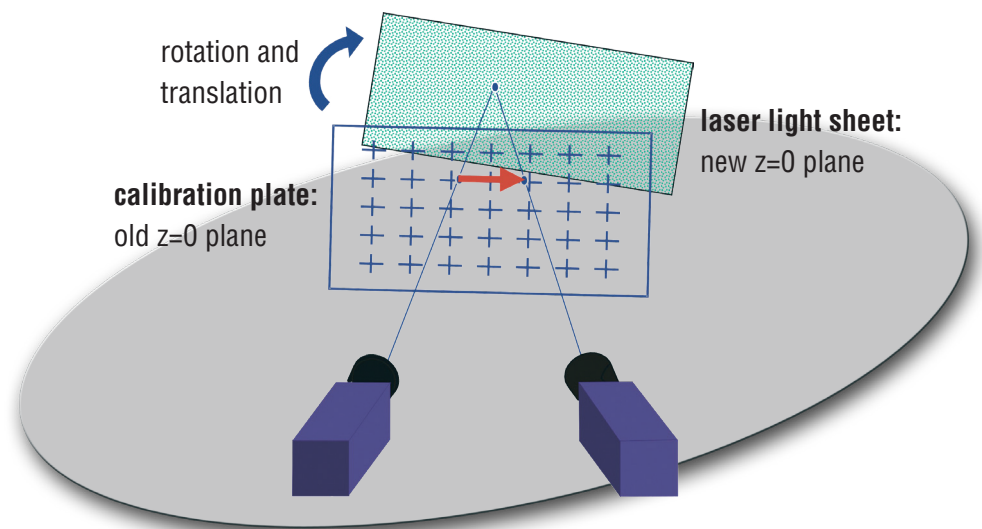


## Self-Calibration for Stereo-PIV

Anybody who has worked with a Stereo-PIV system knows the need for an accurate calibration prior to measurements and will agree that it is often a time-consuming and not very easy task to correctly align a calibration target in exactly the same plane as the light sheet. Even more of an effort is the calibration of several different planes when the z-position is scanned.

LaVision has developed new algorithms for an easier and quick calibration technique. The achieved '**Self-Calibration**' method is a unique tool to correct even large misalignments between calibration plate and laser light sheet. LaVision's **Self-Calibration** method is a standard feature of LaVision's Stereo-PIV software **DaVis**.



### Advantages

- ▶ **Higher accuracy:** Elimination of calibration errors
- ▶ **User-friendly:** Free positioning of calibration plate, no need to align calibration plate exactly with light sheet
- ▶ **Easy volume-scanning:** All scanning positions calibrated at once
- ▶ Possible to place the calibration plate outside the measurement volume
- ▶ **Time-saving:** Calibration can be prepared off-site
- ▶ **Additional benefits:** Information on relative position and thickness of both laser sheets

### Principle

First a standard Stereo-PIV calibration is done by viewing a calibration plate which does not need to be aligned exactly with the light sheet. Then the recorded particle images themselves are used to calculate the misalignment between calibration plate and light sheet. Finally the mapping function is corrected accordingly and the recorded images are evaluated. The Stereo-PIV vector fields are computed by LaVision's well-known, highly accurate correlation algorithms using deformed interrogation windows (PIV Challenge 2003).

#### LaVisionUK Ltd

2 Minton Place / Victoria Road  
Bicester, Oxon / OX26 6QB / United Kingdom  
E-Mail: [sales@lvision.com](mailto:sales@lvision.com) / [www.lvisionuk.com](http://www.lvisionuk.com)  
Phone: +44-(0)-870-997-6532 / Fax: +44-(0)-870-762-6252

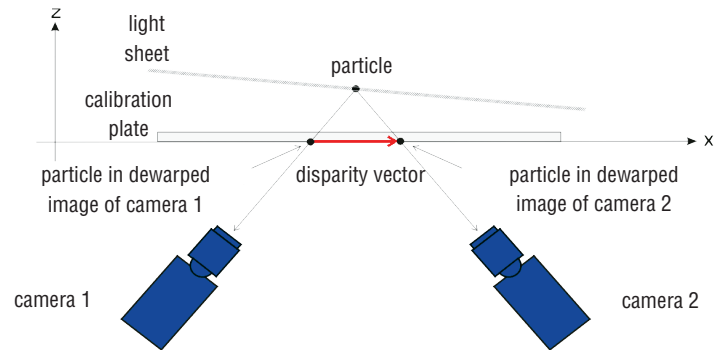
#### LaVision GmbH

Anna-Vandenhoeck-Ring 19  
D-37081 Göttingen / Germany  
E-Mail: [info@lvision.com](mailto:info@lvision.com) / [www.lvision.com](http://www.lvision.com)  
Tel. +49-(0)551-9004-0 / Fax +49-(0)551-9004-100

#### LaVision Inc.

211 W. Michigan Ave. / Suite 100  
Ypsilanti, MI 48197 / USA  
E-mail: [sales@lvisioninc.com](mailto:sales@lvisioninc.com) / [www.lvisioninc.com](http://www.lvisioninc.com)  
Phone: (734) 485 - 0913 / Fax: (240) 465 - 4306

From the correlation map between the two cameras the disparity vector is used to compute the position of the light sheet.

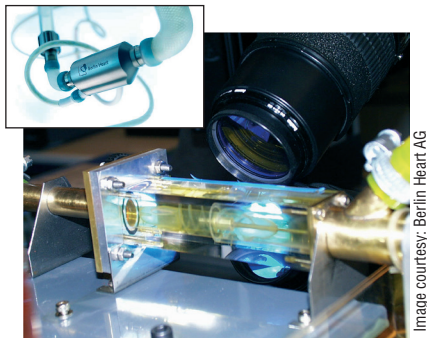


The thickness of the light sheets and their overlap can be estimated from the length of the correlation peak. Even with a careful calibration procedure typical misalignments lead to velocity errors in the range of 0.2 pixel or even higher. LaVision's newly developed **Self-Calibration** method is an ideal check of the calibration accuracy. Furthermore the **Self-Calibration** eliminates all calibration errors, because the particle images themselves are used for the final calibration.

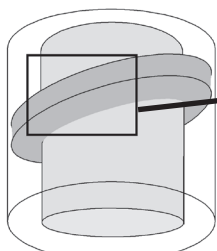
## Application

### Stereo-PIV in the model of an implantable blood pump

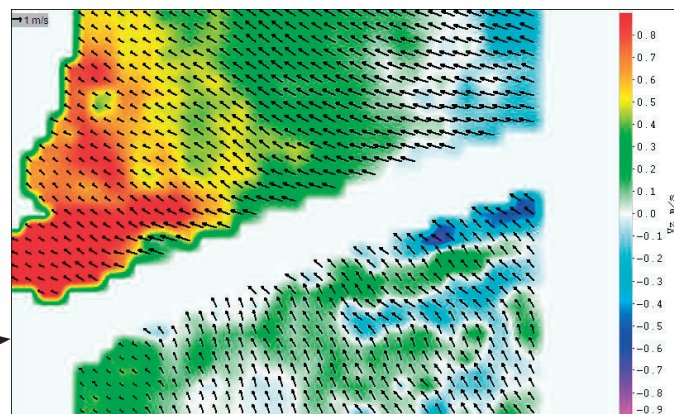
The original device (shown on the upper left inset of the picture) is designed to be implanted into a patient's body and must therefore function reliably and accurately. The flow field must be known in order to avoid conditions in which sensitive blood cells can get destroyed. A model was built to apply Stereo-PIV but the dimensions and the complex procedure of assembling the components do not allow to place a calibration target inside. Here **Self-Calibration** PIV was the only solution because it allowed to do the calibration outside of the model.



Experimental setup



Measurement area



Single vector field (color = w-component)

Data provided by LaVision are believed to be true. However, no responsibility is assumed for possible inaccuracies or omissions. All data are subject to change without notice.

Dec-23

### LaVisionUK Ltd

2 Minton Place / Victoria Road  
Bicester, Oxon / OX26 6QB / United Kingdom  
E-Mail: [sales@lavisoin.com](mailto:sales@lavisoin.com) / [www.lavisoinuk.com](http://www.lavisoinuk.com)  
Phone: +44-(0)-870-997-6532 / Fax: +44-(0)-870-762-6252

### LaVision GmbH

Anna-Vandenhoeck-Ring 19  
D-37081 Göttingen / Germany  
E-Mail: [info@lavisoin.com](mailto:info@lavisoin.com) / [www.lavisoin.com](http://www.lavisoin.com)  
Tel. +49-(0)551-9004-0 / Fax +49-(0)551-9004-100

### LaVision Inc.

211 W. Michigan Ave. / Suite 100  
Ypsilanti, MI 48197 / USA  
E-mail: [sales@lavisoininc.com](mailto:sales@lavisoininc.com) / [www.lavisoininc.com](http://www.lavisoininc.com)  
Phone: (734) 485 - 0913 / Fax: (240) 465 - 4306