**Piv**: There are many ways to measure fluid motion, one of which is particle image velocimetry (PIV). This is a non-intrusive optical measurement method, which gives velocity fields resolved in both time and space.

1. A visual representation of fluid motion.

2. An imaging system for capturing the visual representation.

3. A method for processing the images to quantify the fluid motion

To visualize the flow, we add trace particles in the fluid. If the particles are small then they are deemed passive and will follow the fluid motion. Using the setup with camera to get two images we want to use to find an Eulerian description of the velocity field. Dividing the images into regular grid of subwindows, with overlap.

For each subwindow in the first frame, we try to match its pattern with a similar pattern in the second frame, following the motion . Dividing the optimal match displacement of the pattern by ∆t we find an ensemble averaged velocity, then using cross-correlation to tell how different the pattern is. To improve the quality of the PIV result is to detect and replace outliers, where the missing vectors are evaluated using the fitted B-spline aka spline.

**Coordinate system**: To get the physical quanteties we need convert from the camera coordinate system x in pixel to the real world coordinates x, using a picture of real coordinates and with help of coordinate transformation

**Masking**: In some cases it is useful to mask part of the image, for instance when the image contains a dynamic free surface.

**Single pass**: This is the basic when we use 2 picture with a time difference and normalpass() on them. The result is returned using a structure, which among other things contains the positions (x,y) and the velocities (U,V).

**Multipass**: Further improvements in accuracy and resolution can be obtained by using multiple PIV passes, using for instance window shifting or window distortion.

**Window shifting**: to improve the resolution while retaining the maximum displacement is to first use a pass with large subwindows, followed by a pass with smaller subwindows shifted by the displacement found in the previous pass.

**Window distortion**: Subwindow based methods like PIV with correlation/difference measure only gives translation, assuming the velocity field within the subwindow is uniform. To improve accuracy for shear flows, subwindow distortion can be used. HydrolabPIV finds the distortion of the image pair by integrating the B-splines fitted to the displacements using Runge-Kutta. The displacement is then used to interpolate a new image pair tending toward zero/uniform displacement. Processing this image pair in the regular way gives a correction to the displacements.

**Initpass:** If the experiment is time resolved it is possible to save computation time by using previous found velocity fields as an initial guess to the next image pair using initpass(. . . ).