Light field camera based particle tracking velocimetry

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HIGHLIGHTS

- A light field camera is optically equivalent to a bundle of parallel view stereo cameras.
- Then the recording of particles images can be converted into multiple stereo images, from which the 3D locations of particles can be obtained by using the same scheme as in the conventional 3D particle tracking velocimetry.
- A large number of parallel view stereo images in this approach facilitate the particle matching process in the stereoscopy at a cost of reduced resolution of individual stereo images.
- Computationally expensive refocus calculation or tomographic reconstruction is not required to calculate a 3D volume of particles.
- At relatively low particle density, the primary test results of this approach seemed promising as compared to the tomographic reconstruction based approach.

ABSTRACT

The light field image processing technique has been recently increasingly popular in the particle image velocimetry for 3D flow measurement. However, the potential of this approach in the 3D volumetric velocity measurement of distribution should probably be exploited more in detail. In the present work the authors propose a new basic light field imaging system that uses commercially available handheld light field camera to perform a depth recovery of recorded particles in a square cavity. The particle image recording by the light field camera is carried out by using a small square cavity (150×150×10 cm³) with an electro-magnetic stirrer, an Ar-ion laser based volumetric light source and other optical components. The main lens of the light field camera views the cavity flow with seeding particles (Mitsubishi high-porous polymer) normal to the transparent cavity wall. The distance from the camera main lens front to the two walls is about 100 to 120 mm. A sample 3D recovery result of seeding particles viewed from obliquely upward is given in Figure 1 (left) and the 3D particle coordinates, thus obtained, are tracked between two time steps as shown in Figur1 (right). In this 3D particle tracking, the particle matching is performed by using the SOM PTV algorithm.

Fig. 1 Recovery of particle locations and instantaneous velocity in a cavity flow