Calibration of Plenoptic 2.0 Cameras and use in 3DPTV Investigations

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HIGHLIGHTS
- Investigation of single-camera plenoptic 2.0 imaging for use in 3DPTV experiments
- Depth detection methods overviewed
- Testing conducted on known particle field displacements
- Key issues with depth detection and image-to-object space scaling identified
- Calibration method identified and outlined

ABSTRACT
Plenoptic 1.0 cameras have already been investigated as a means for performing 3DPIV. Plenoptic 2.0 cameras have an enhanced in-plane resolution, but are limited to less dense particle fields by their depth-detection method, and are thus less appropriate for 3DPIV. A technique more suited to less dense particle fields is 3DPTV. Time-resolved 3DPTV will be possible due to the high frame rate available with these cameras. Experiments to quantify the performance of the cameras for 3DPTV are being undertaken (Fig. 1). These experiments involve the use of fixed 3D particle fields, termed ‘phantoms’. Preliminary results indicate that plenoptic 2.0 cameras show some promise in 3DPTV applications. Reasonable agreement between applied out-of-plane displacements and camera-measured displacements was observed (Fig. 2). Issues with the current depth detection method have been noted, and possible improvements have been identified. General distortions and their effects on imaging with plenoptic 2.0 cameras have been identified. To correct the issues with depth detection and distortions, a calibration method has been identified. Two-frame particle tracking has been used to obtain preliminary results. Implementing the calibration method and a time-resolved tracking approach are the next steps to improving the camera’s performance in 3DPTV.

Fig. 1 A schematic of the experimental setup

Fig. 2 Particle displacements corresponding to 3mm movement towards camera; vectors amplified by 5 for clarity.