

Particle Volume Reconstruction: Plenoptic Camera and Scanning Laser

Valerie Troutman <vtrout@stanford.edu>

EE367 (Winter 2016) – Stanford University

Motivation

Develop a single camera, volumetric, and portable imaging diagnostic to fully capture the 3D components of various fluid flow phenomenon

Project Scope

- Capabilities of technology
 - Resolution (x, y, z)
 - Calibration
 - Computational Time
- Feasibility of using the Lytro Illum
 - Resolution (x, y, z)

Related Work

- 3D Plenoptic PIV (67 x 39 x 45 mm³) [Thurow 2013]
- Volumetric Reconstruction [Fahringer 2012 & 2013]
- Multiple-plane light-field PIV [Brucker 2013]
- Calibration of a Plenoptic Camera [Bierasinski 2014]
- Scanning Laser 3D PIV [Hori 2004]

Future Work

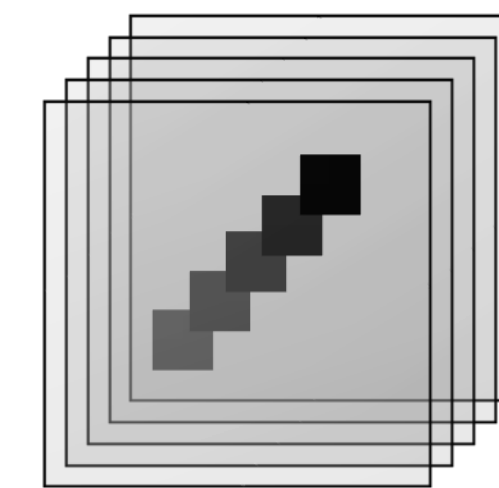
- Computational speed (shift in Fourier space)
- Robust calibration (larger depth, patterned square)
- Particle tracking

Plenoptic Camera

$$\frac{1}{f} = \frac{1}{S_{\text{sensor}}} + \frac{1}{S_{\text{object}}}$$

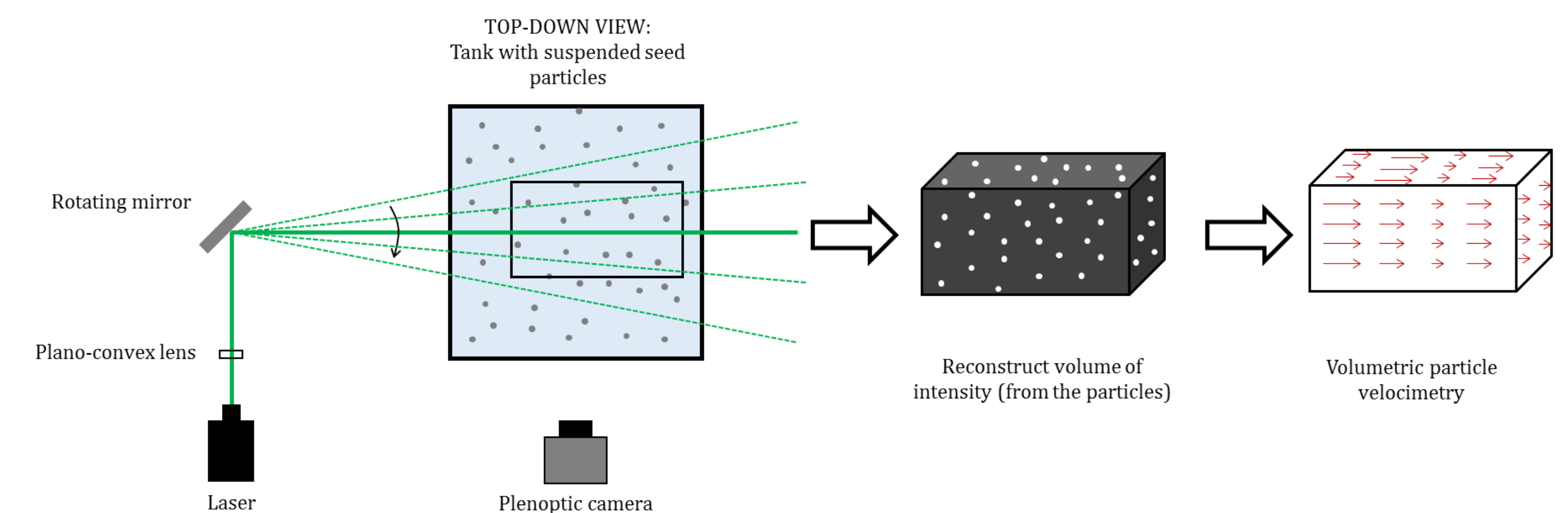
Computationally Adjust

Calibration

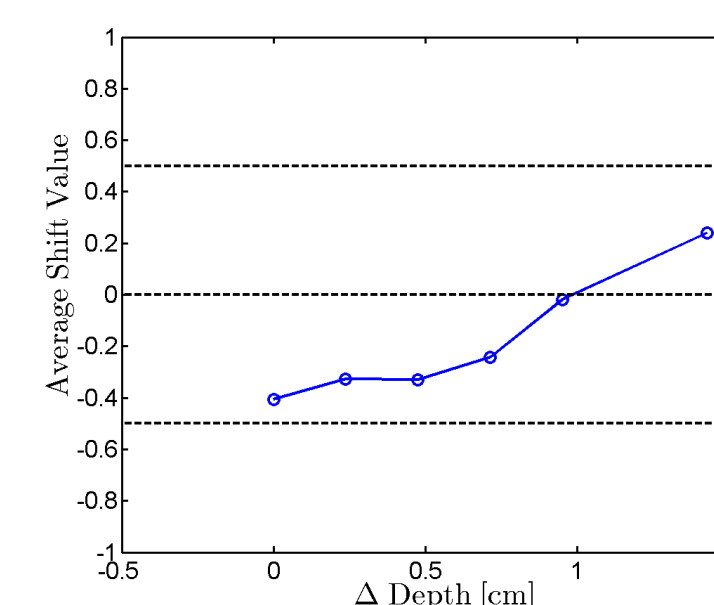


New Technique

Particle Volume Reconstruction



Calibration



Experimental Results

Resolution

X-Y: 540 x 375 pixels
Δ Depth: ~0.25 cm

Projected X-Y:
~36 pixels/cm

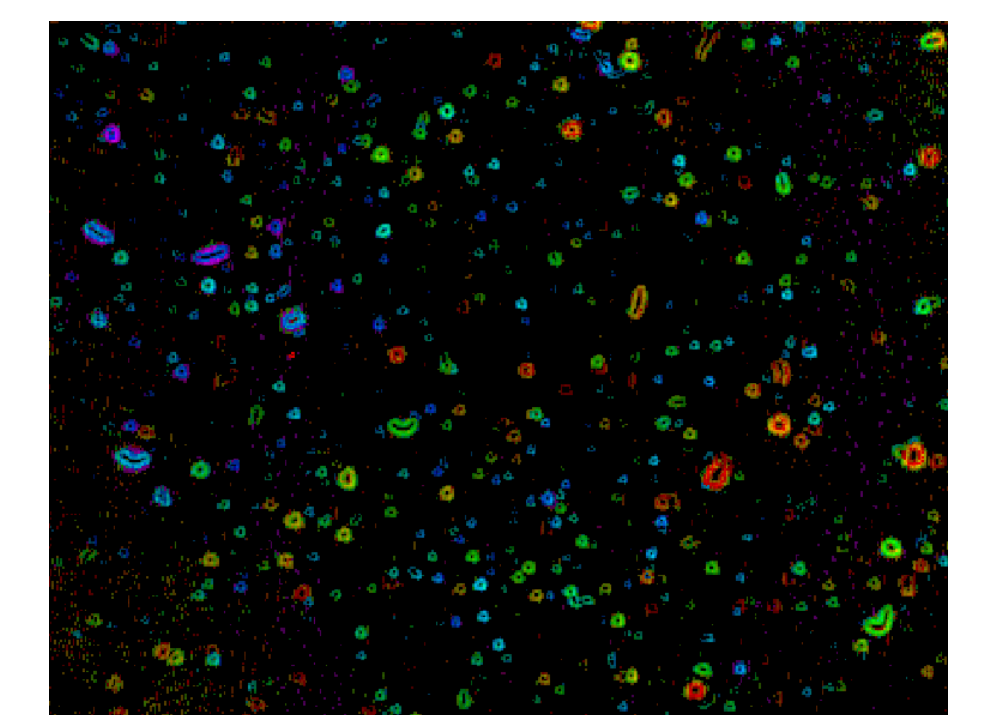
Computational Time

1 image ~15 minutes
1 second @ 30 Hz
~7 hrs

Particle Volume Reconstruction



~15 x 10 x 30 cm³



~ 300 particles