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3D particle location from perspective shifted plenoptic images

PRESENTED BY

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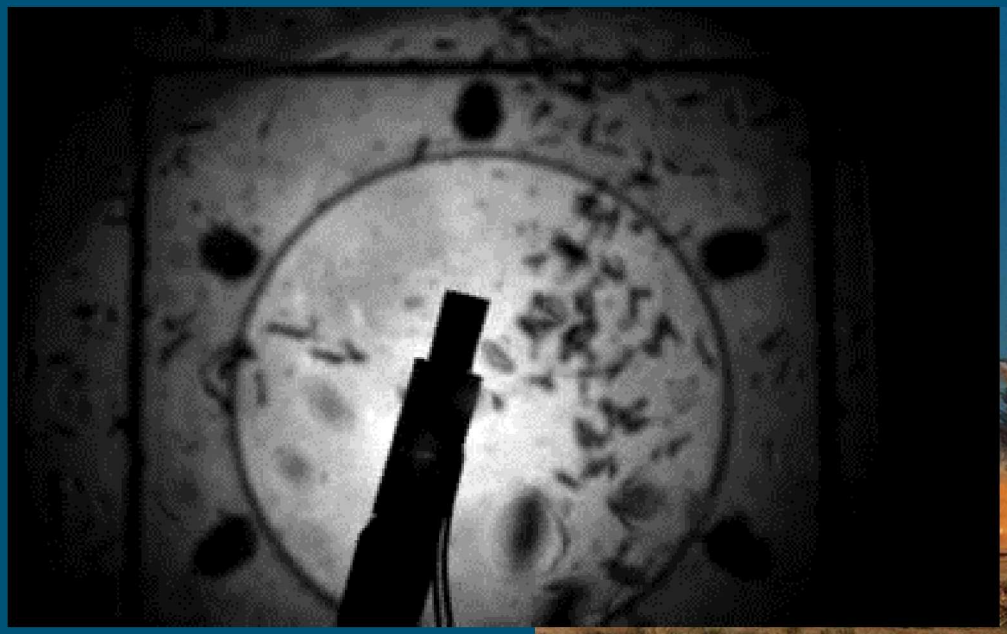
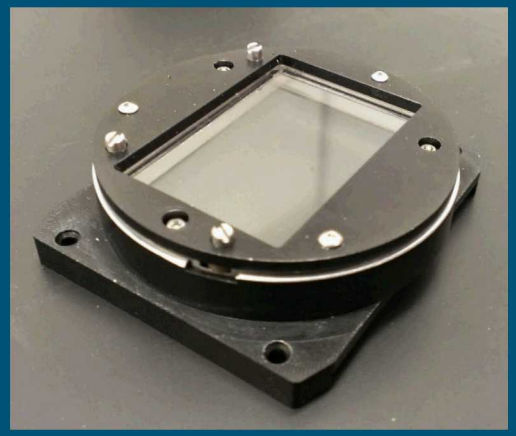


*Photo courtesy of Sandia National Labs

MOTIVATION

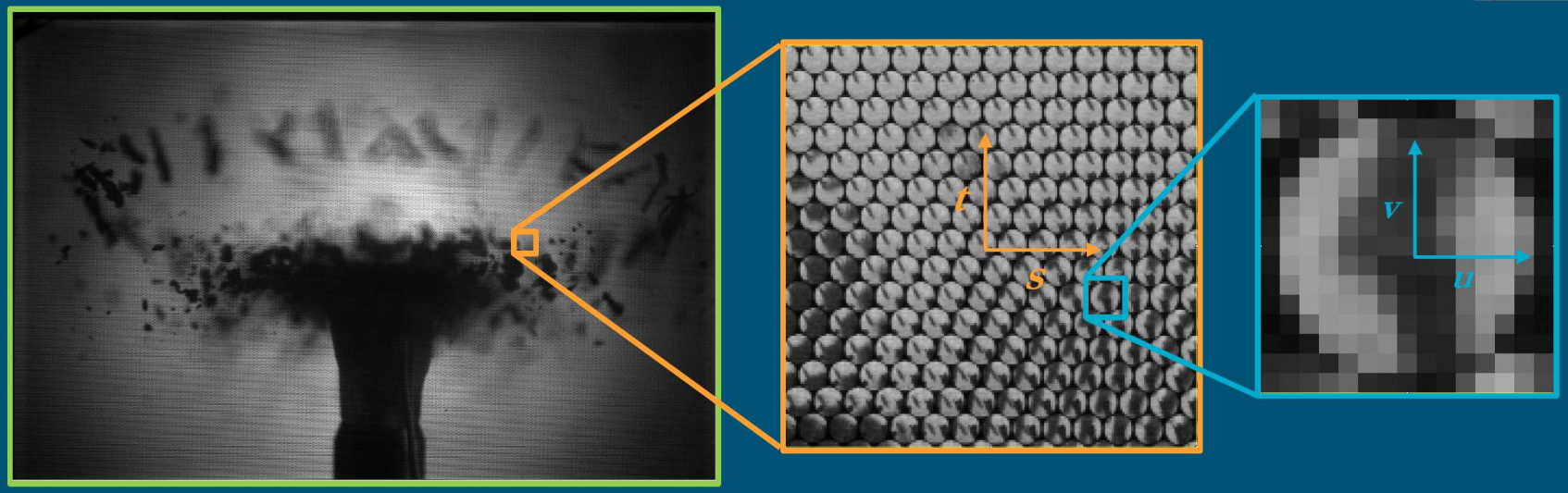
- Particle tracking for a variety of highly 3D applications
  - Explosion analysis
  - Explosion mitigation
  - Measurement of fragment size, shape, velocity

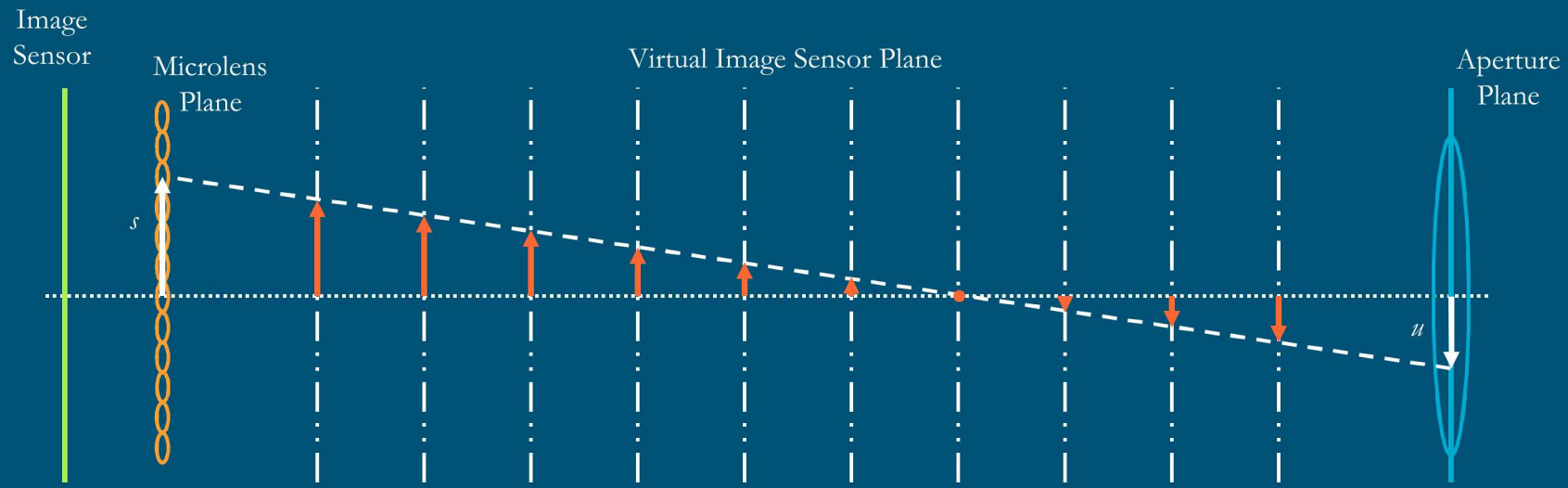
Plenoptic Imaging



- Camera modified by the insertion of a ***microlens array*** between the main lens and image sensor
- Captures ***spatial and angular*** information which can be processed to extract 3D information
- Refocus and change perspective from a ***single snapshot in post processing***
- ***Single compact camera*** allows for experimental simplification and flexibility

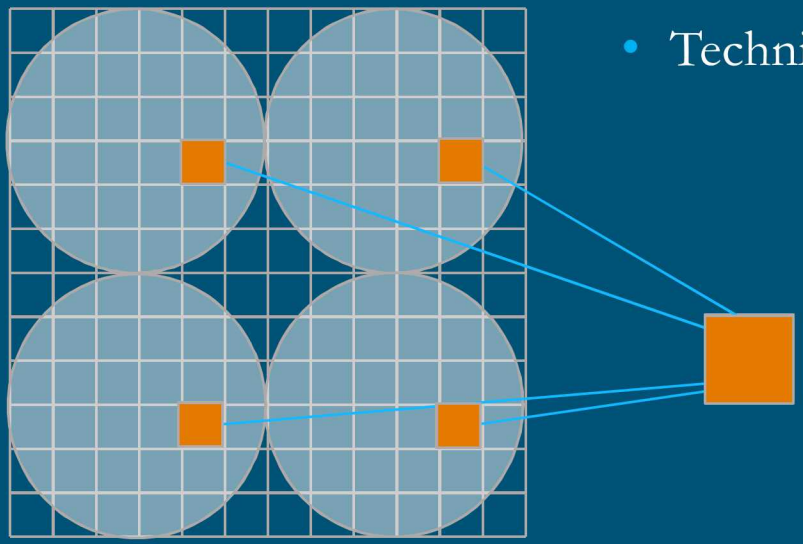
Plenoptic imaging



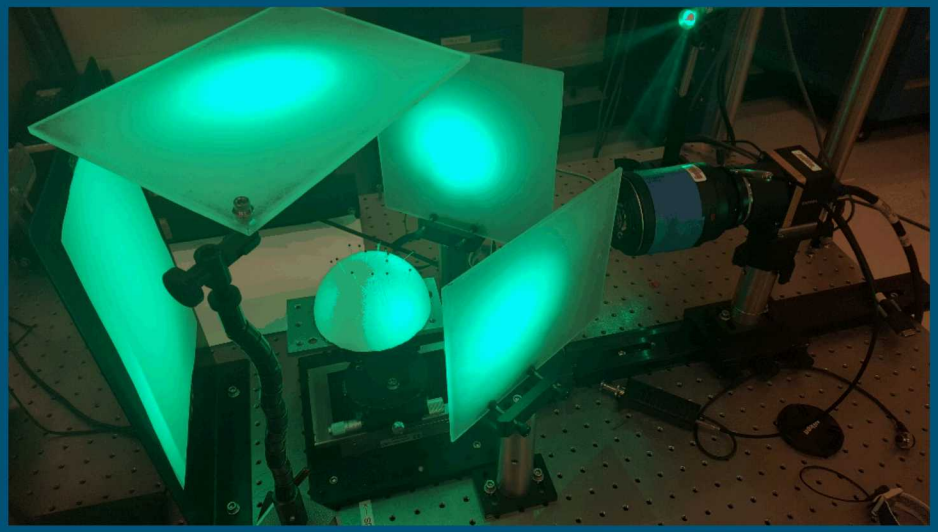


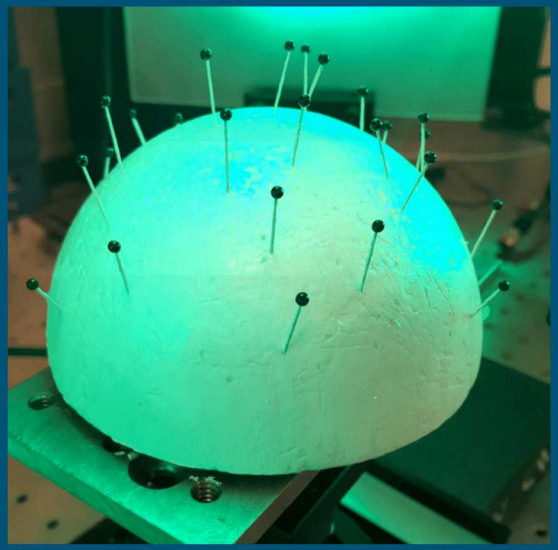
Perspective-shift

- Allows a change in perspective within the range of the aperture
- Resulting image as if from a small portion of the aperture
- Object depth can be determined based on apparent motion
- Selection of single pixels = computationally *inexpensive*
- Technique of choice in this work

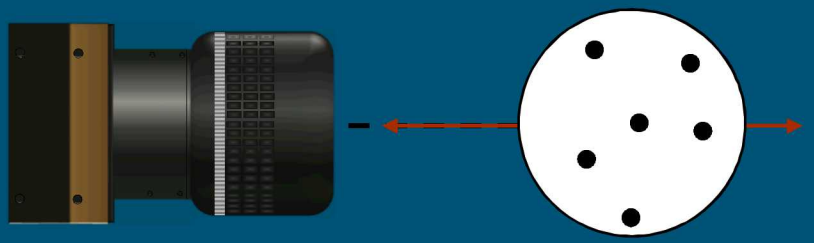


Experimental configuration



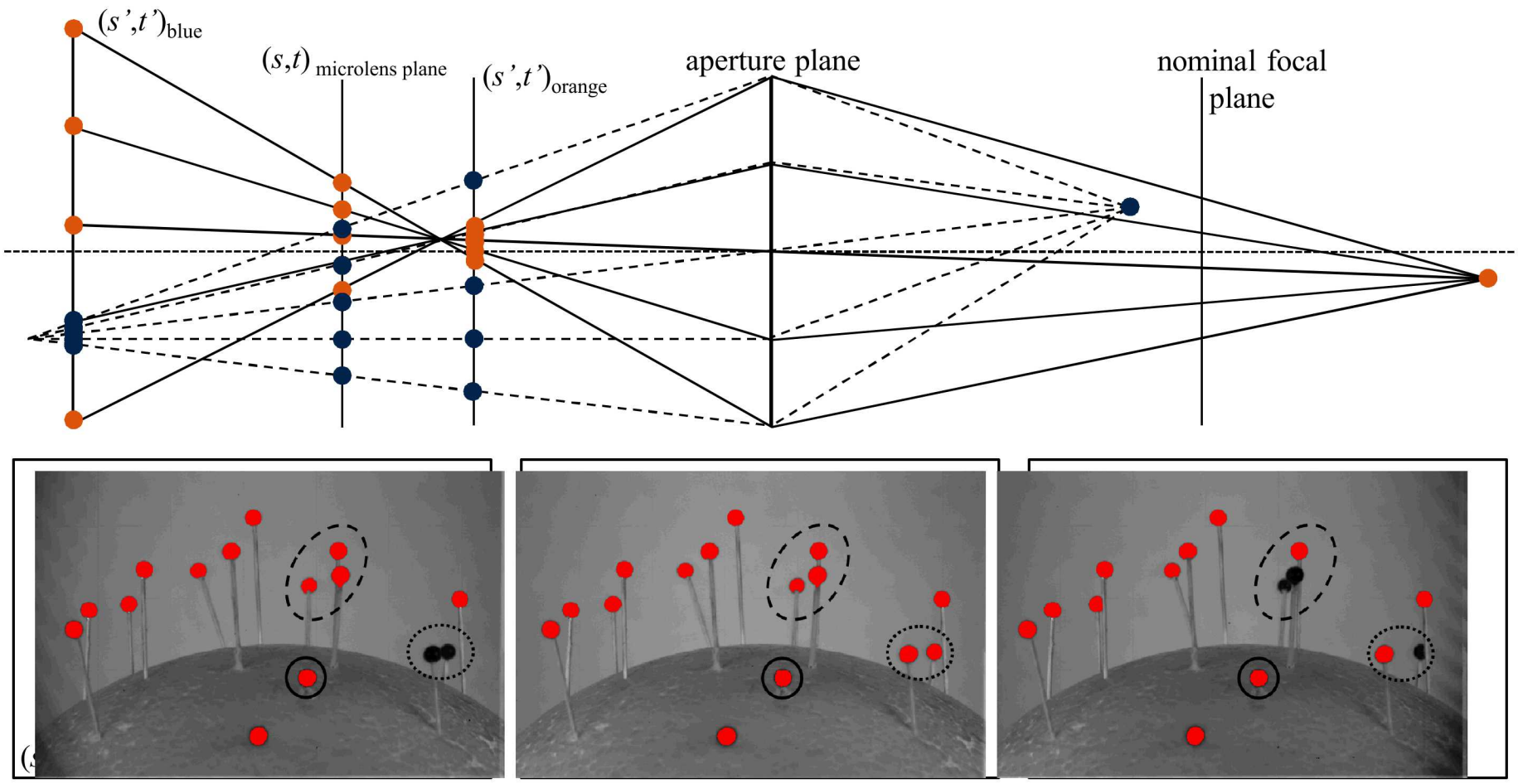


- Simulated static particle field
- Translated to provide known displacement
- Varied nominal magnification
- Large data set allows statistically significant quantitative measurements
- Same data set used in previous depth from focus study

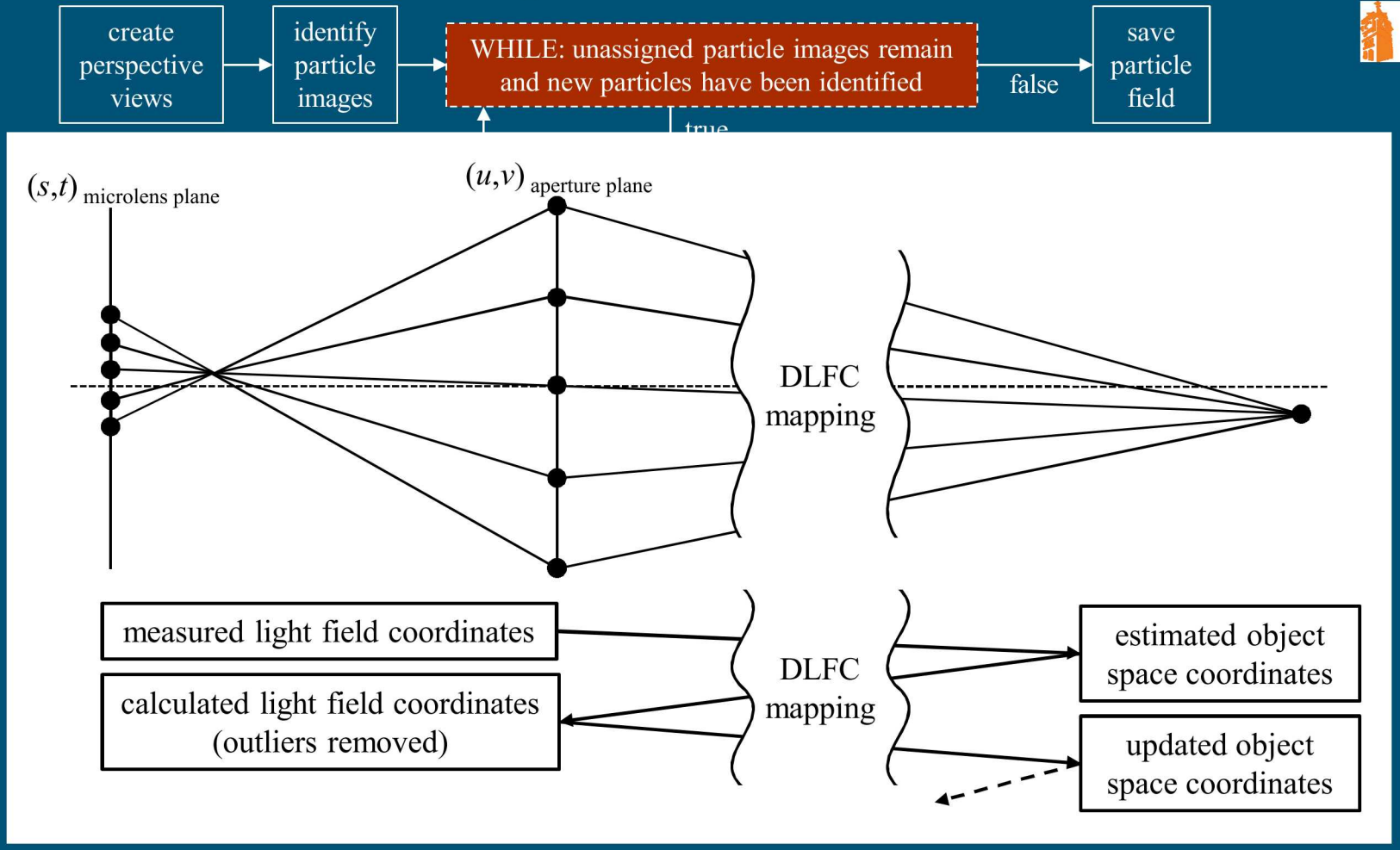


Perspective-shift algorithm

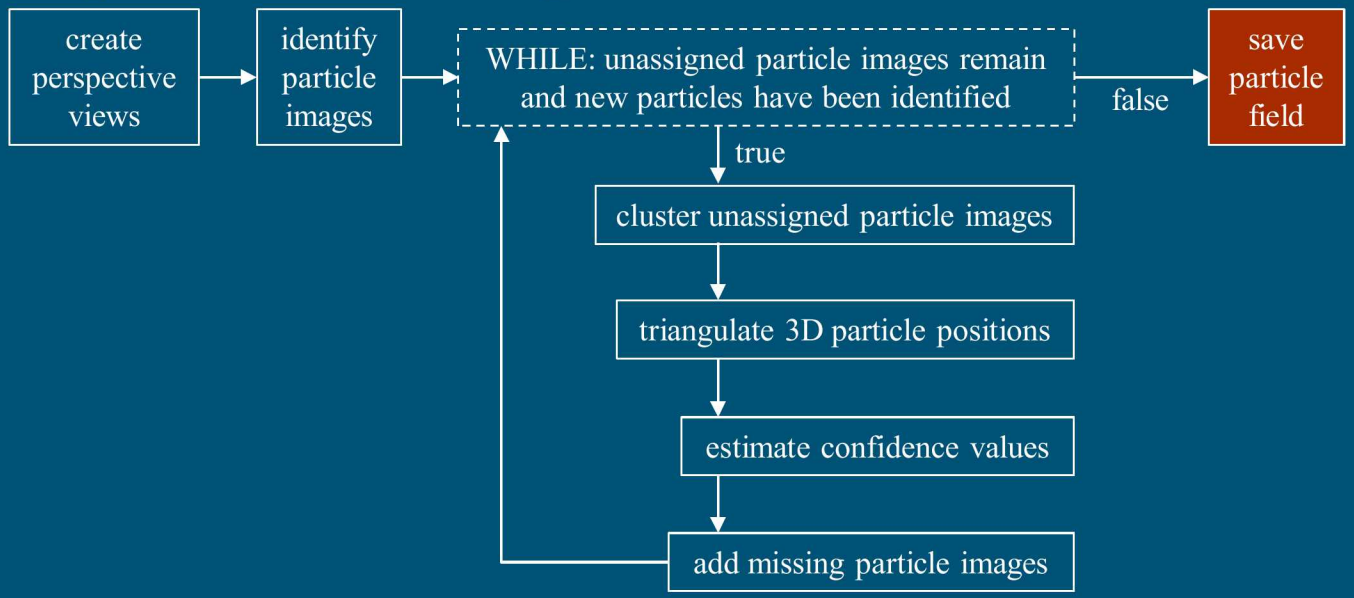
create perspective → identify particle → WHILE: unassigned particle images remain and new particles have been identified → false → save particle

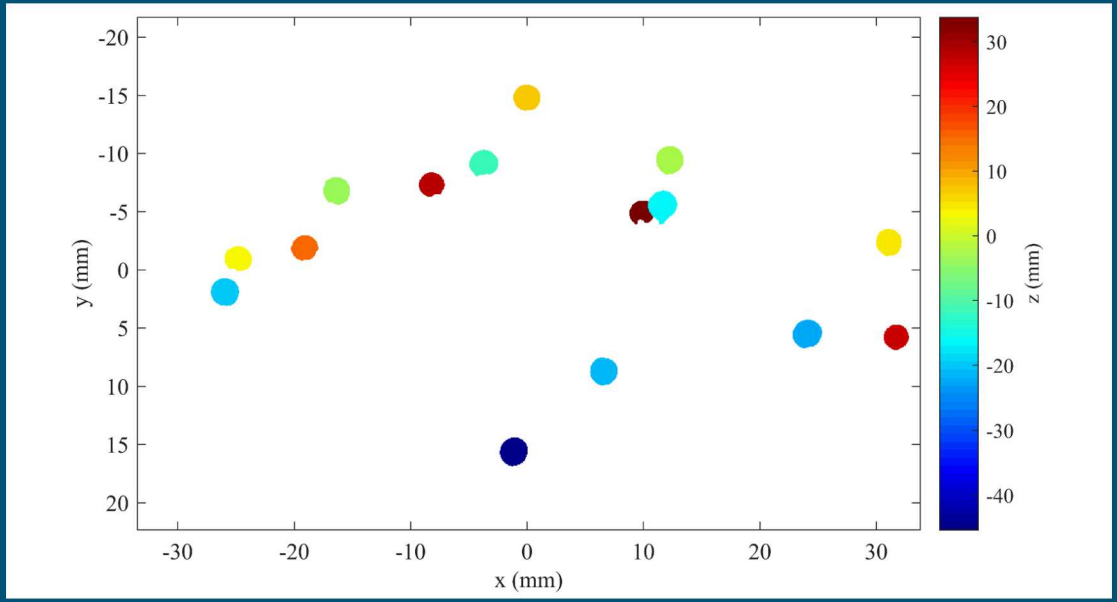


Perspective-shift algorithm

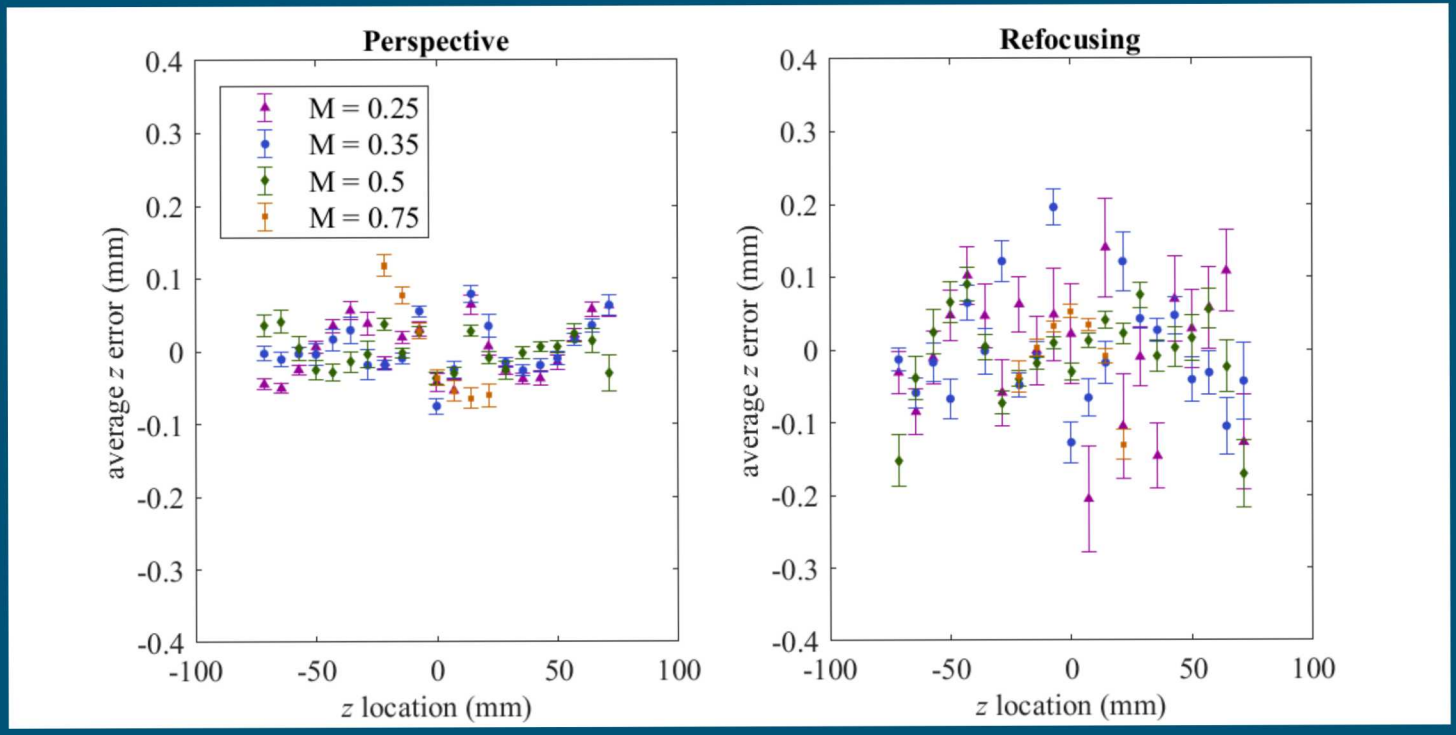


Perspective-shift algorithm



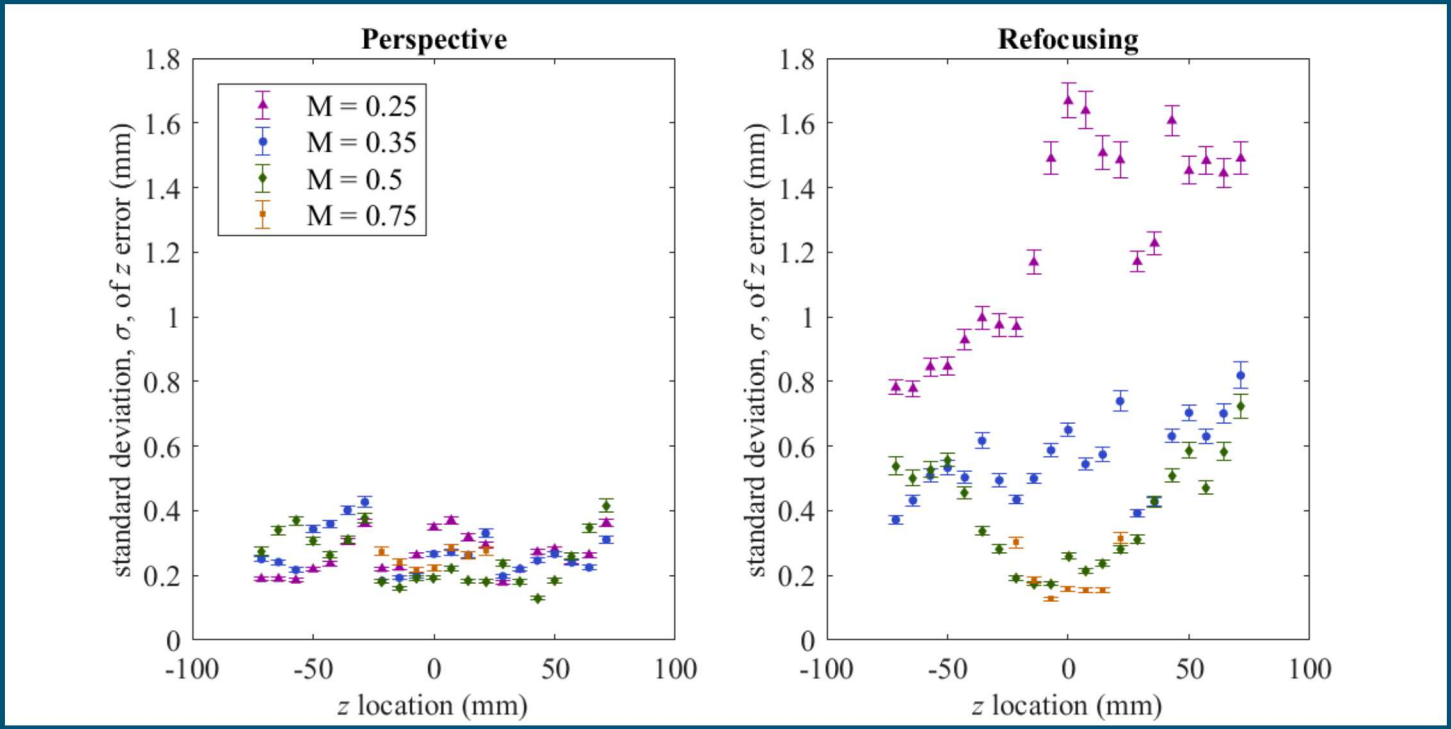


Accuracy



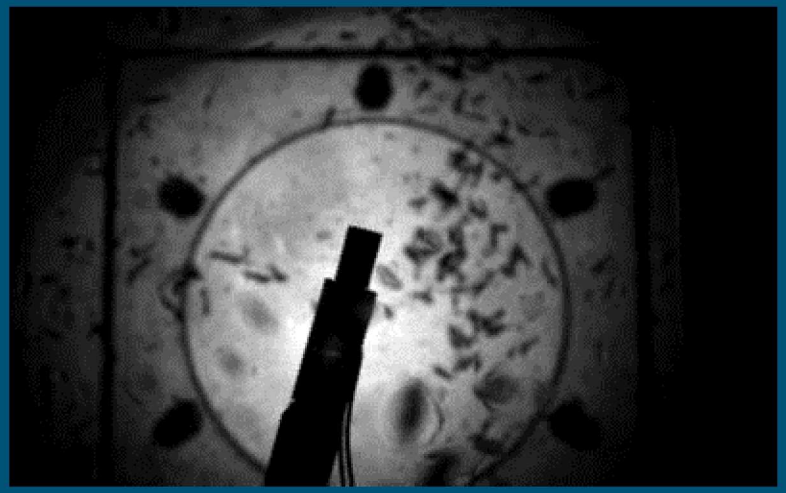
- Smaller average errors with perspective shift
- Narrower confidence intervals

Precision



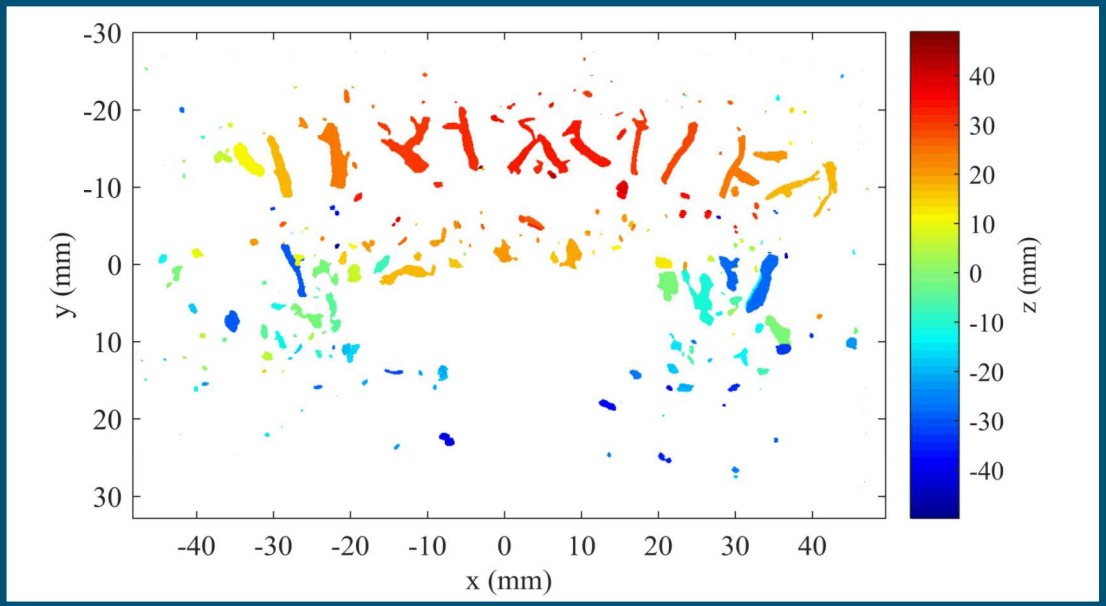
- Smaller standard deviations and narrower confidence intervals with perspective shift
- Perspective shift results more consistent with depth

Detonator experiment



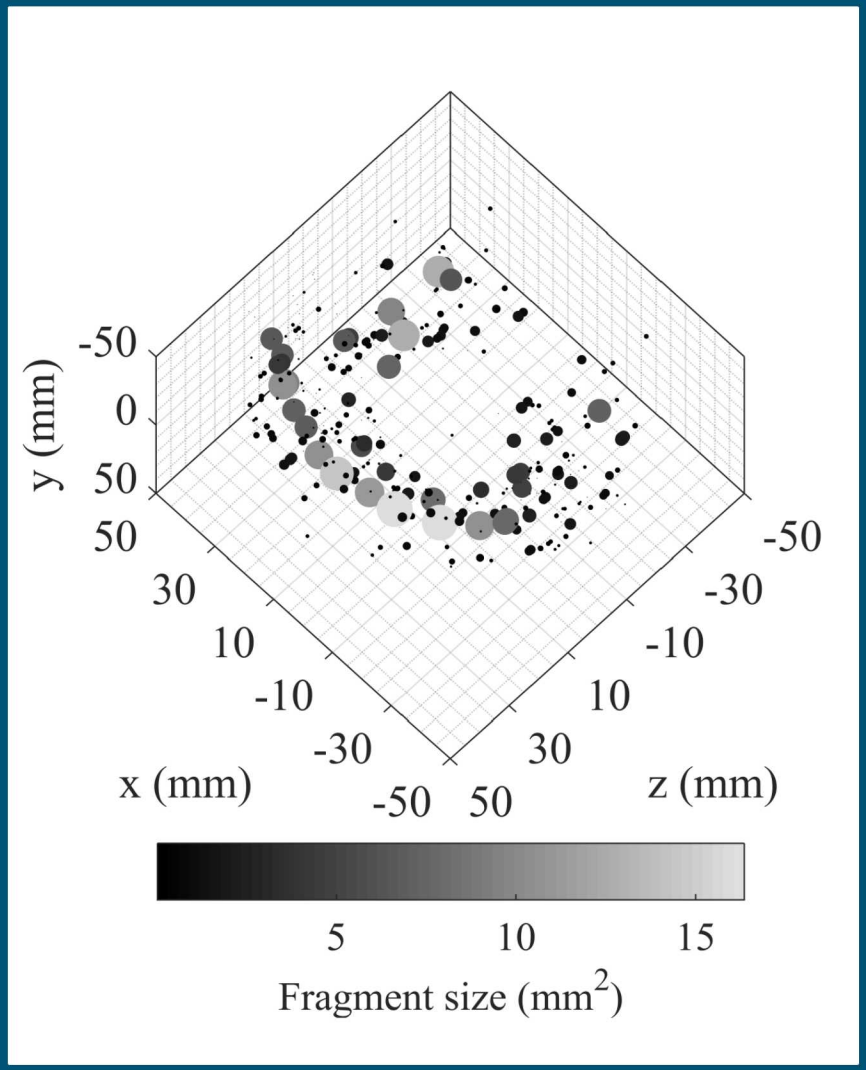
High-speed video

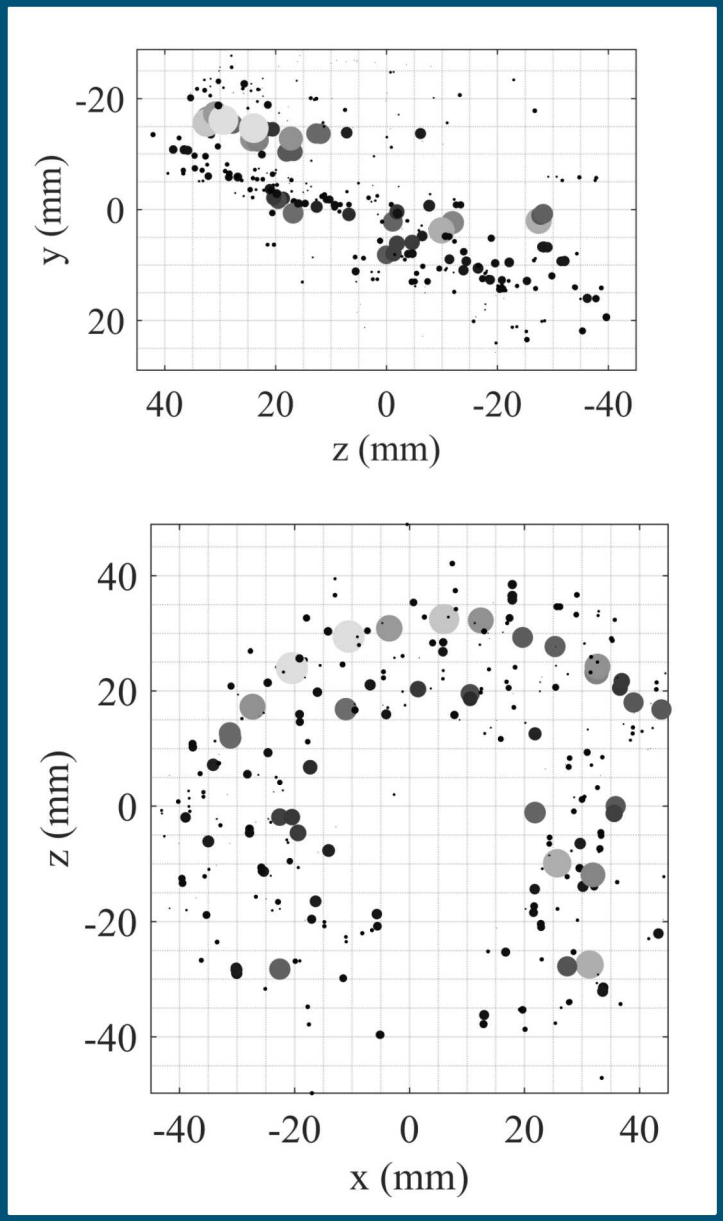
Plenoptic perspective shift



Depth map

Detonator experiment






QUESTIONS?