FLUID TOMOGRAPHY: BUBBLE TRAJECTORIES

MICHAEL KRIMERMAN

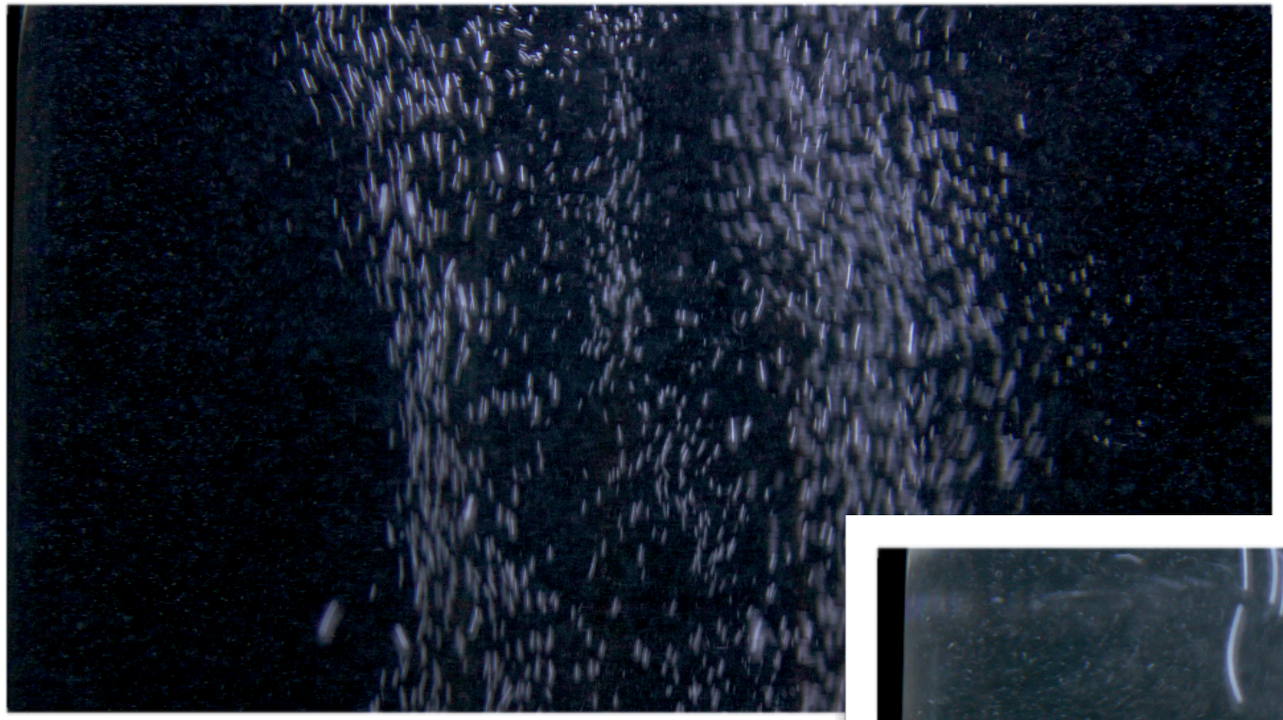
GOAL

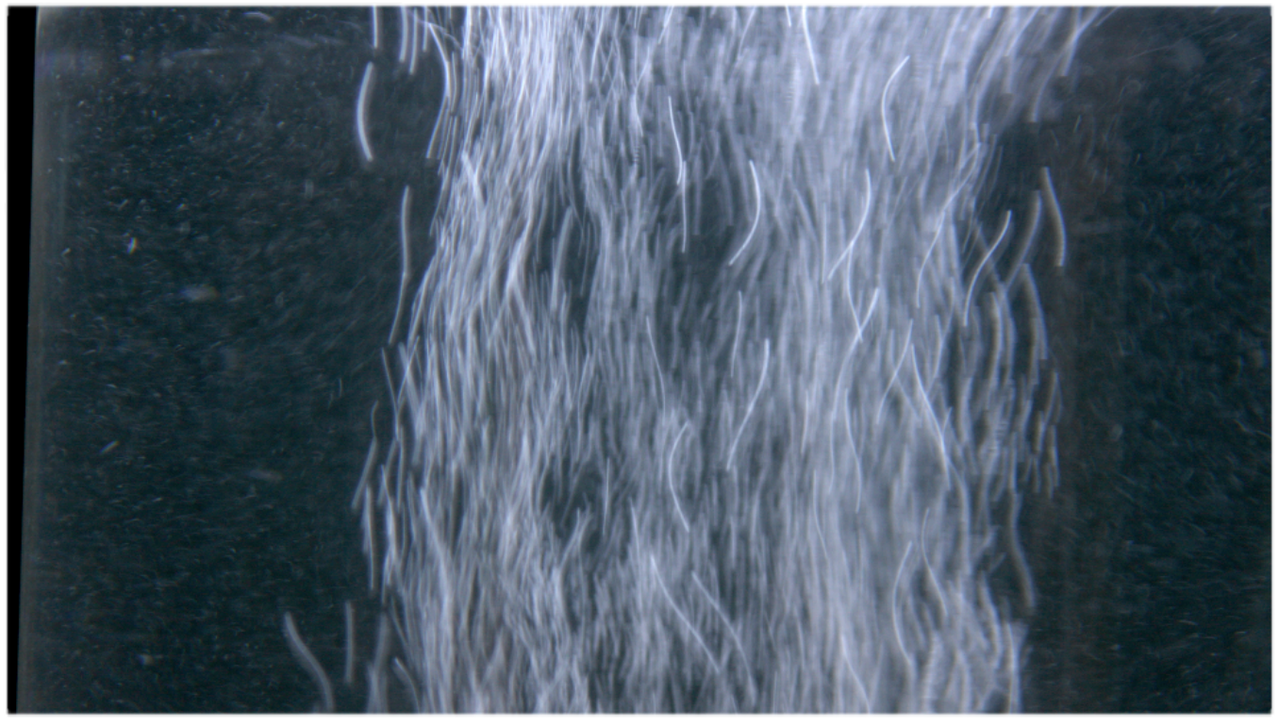
- [ ] CAPTURE PARTICLE TRAJECTORIES IN FLUIDS
- [ ] SPECIFICALLY: BUBBLE TRAJECTORIES IN WATER
  - [ ] EXPERIMENTED WITH VARIOUS:
    - [ ] PARTICLE TYPES
    - [ ] BUBBLE DIFFUSERS

METHODOLOGY

- [ ] ARRAY OF 8 (VIDEO) CAMERAS
- [ ] SYNCHRONOUS EXPOSURE USING STROBE LIGHTS
- [ ] STREAK PATTERNS CREATED BY LONG EXPOSURES
- [ ] TOMOGRAPHY (VISIBLE LIGHT)

SETUP

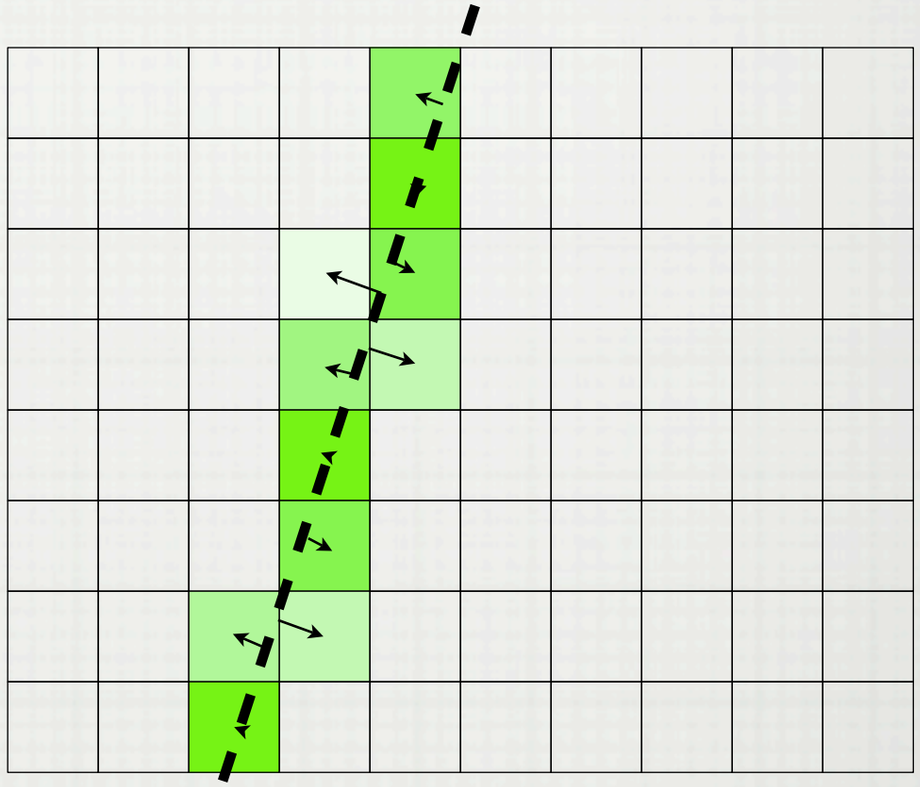




EXPOSURE

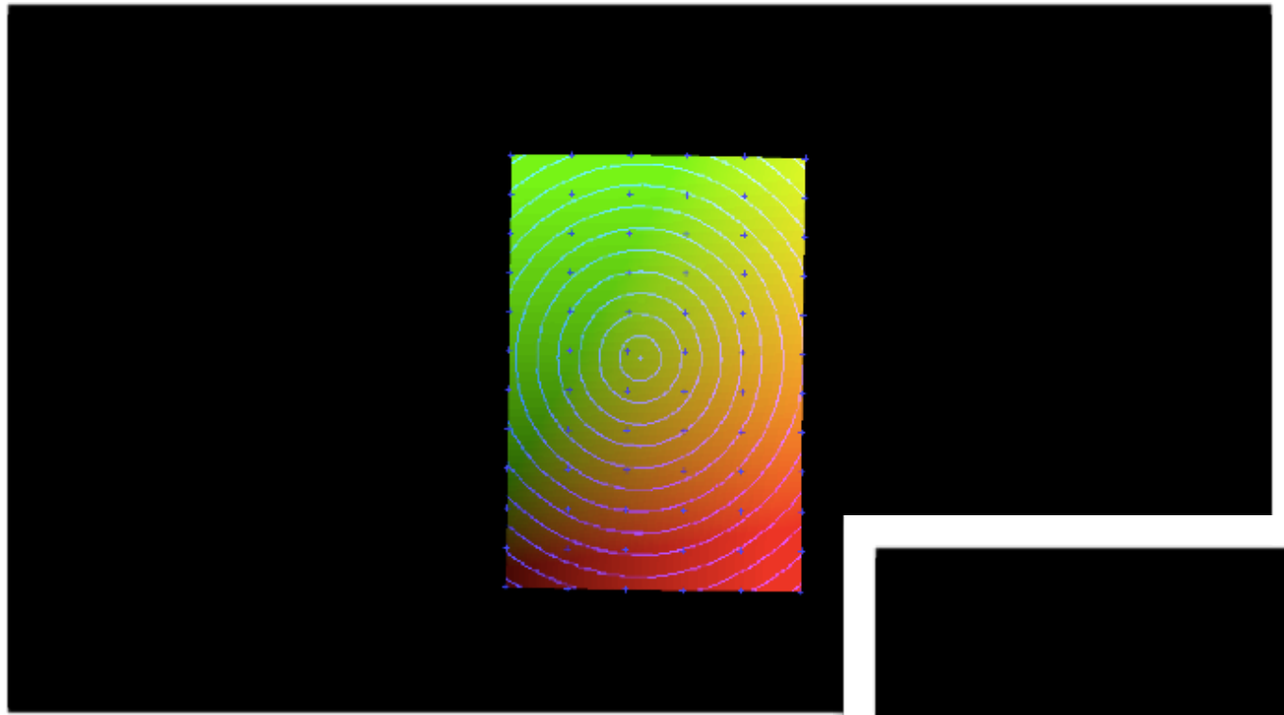
ALGEBRAIC RECONSTRUCTION TECHNIQUE

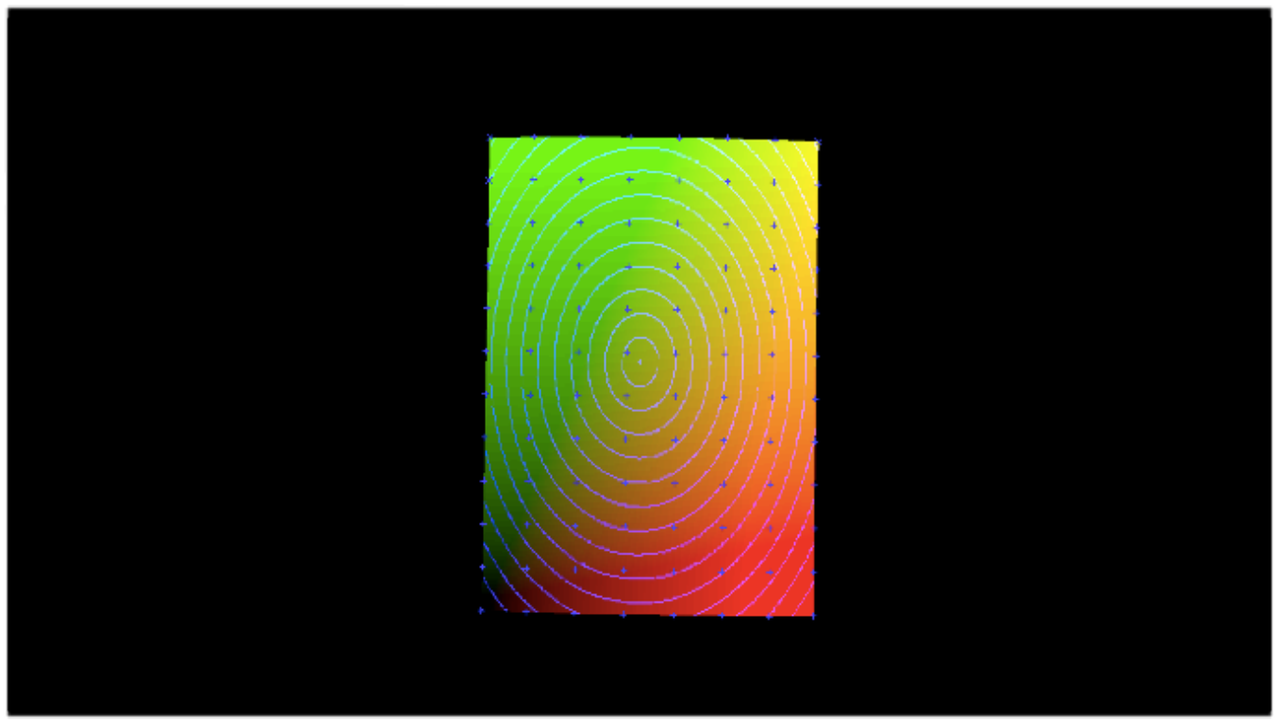
$$p_i = \sum_{j=1}^{N} w_{ij} v_j \qquad 1 \leqslant i \leqslant M$$



$$v_j^{k+1} = v_j^k + \mu \frac{p_i - q_i}{\sum_{j'=1}^{N} w_{ij'}^2} w_{ij} \qquad q_i = \sum_{j=1}^{N} v_j^{k-1} w_{ij}$$

CALIBRATION: USING CALTAG PATTERNS

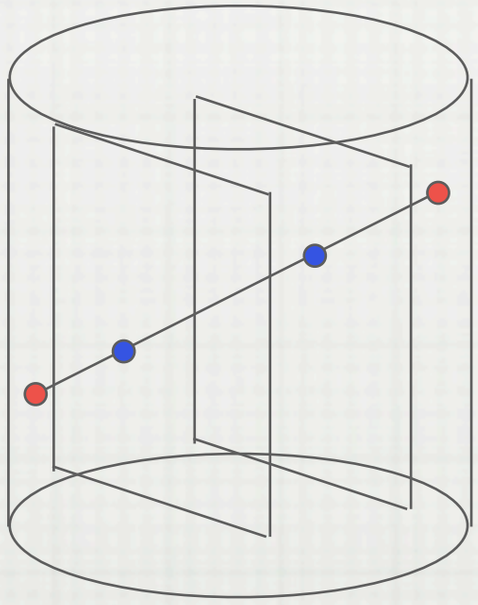


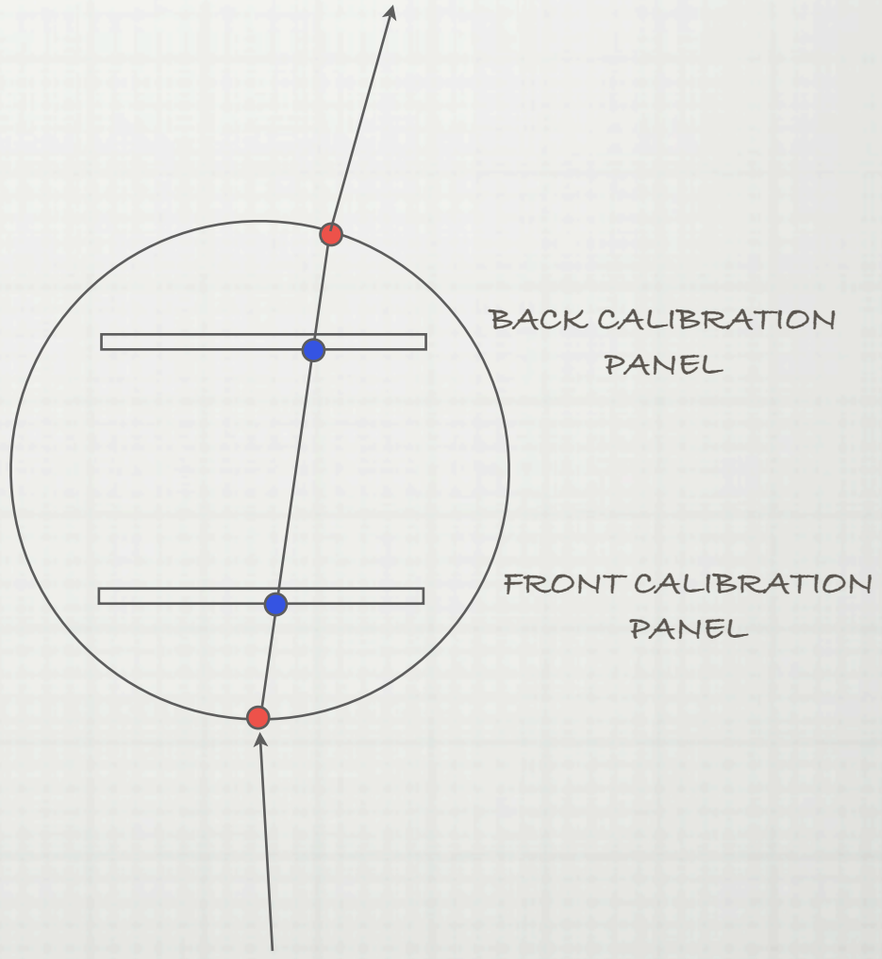


CALIBRATION: INTERPOLATION OF GRID POINTS

CALIBRATION: BLENDING

RAY/CYLINDER INTERSECTION





ASSUMPTIONS & CHALLENGES

- ☐ ANGLE BETWEEN CAMERAS CAN BE MEASURED
- ☐ BUBBLE BRIGHTNESS PERCEIVED EQUALLY AMONG CAMERAS
- ☐ INTENSITY ATTENUATION DUE TO BUBBLE DISTANCE FROM CAMERA (DEPTH) CAN BE IGNORED
- ☐ INTENSITY CHANGES DUE TO PROXIMITY TO LIGHT SOURCE CAN BE ACCOUNTED FOR