Fluid Motion Analysis

Using OpenCV and Python

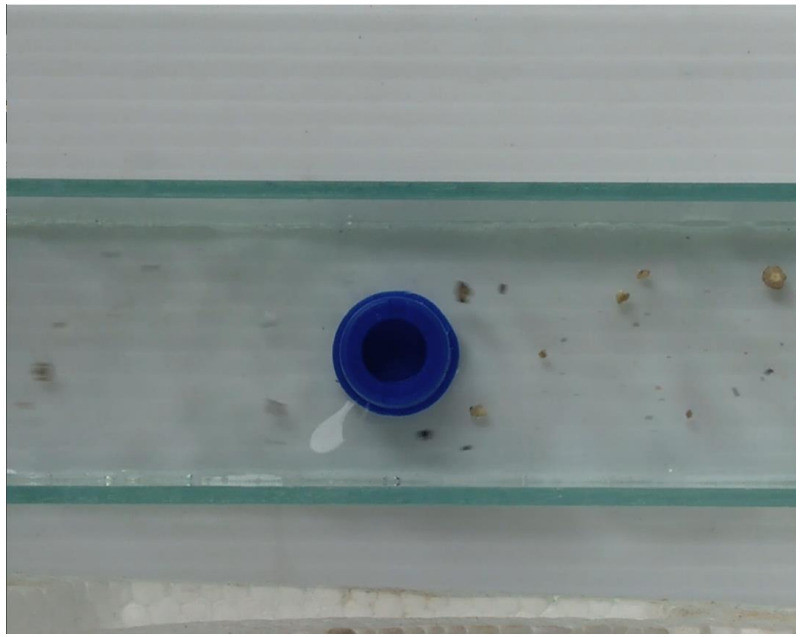
s/19/435

Problem Statement

- Fluid motion analysis plays a crucial role in various scientific and engineering fields.
- By understanding fluid behavior, we can improve designs in:
  - Aerospace engineering
  - Civil engineering
  - Chemical engineering
  - Medical research

Data set

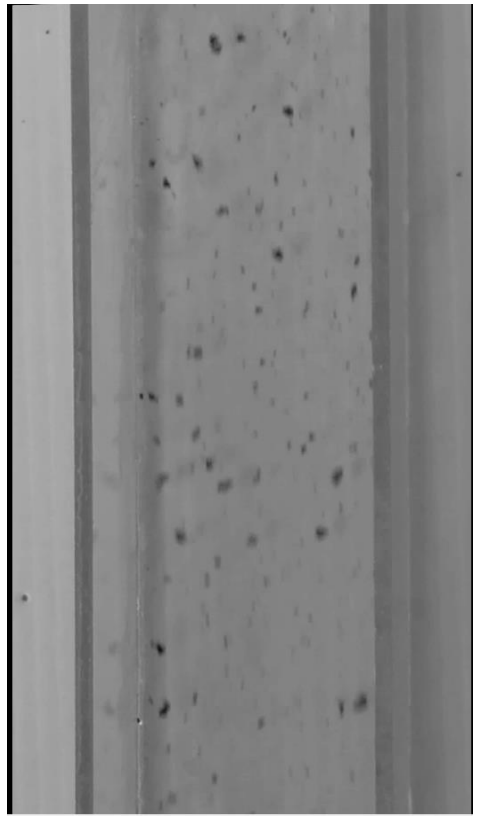
- Custom-built apparatus for data acquisition
- Clear glass rail to allow for unobstructed video recording



Amount of Work Done So Far

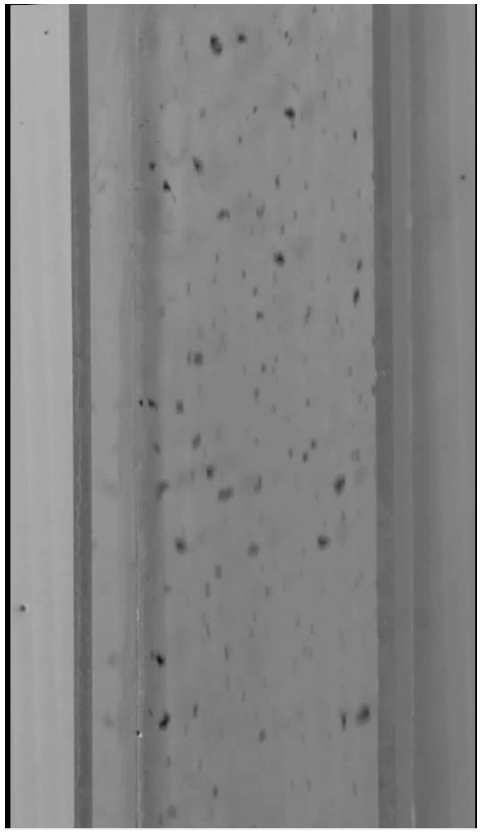
- Video Enhancement
  - Converted to grayscale

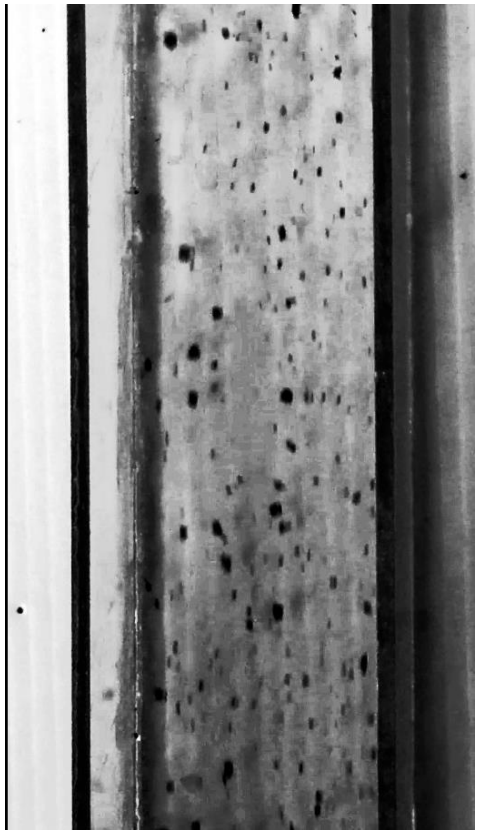
From Original input video



After converting into grayscale

- Grayscale frame equalization

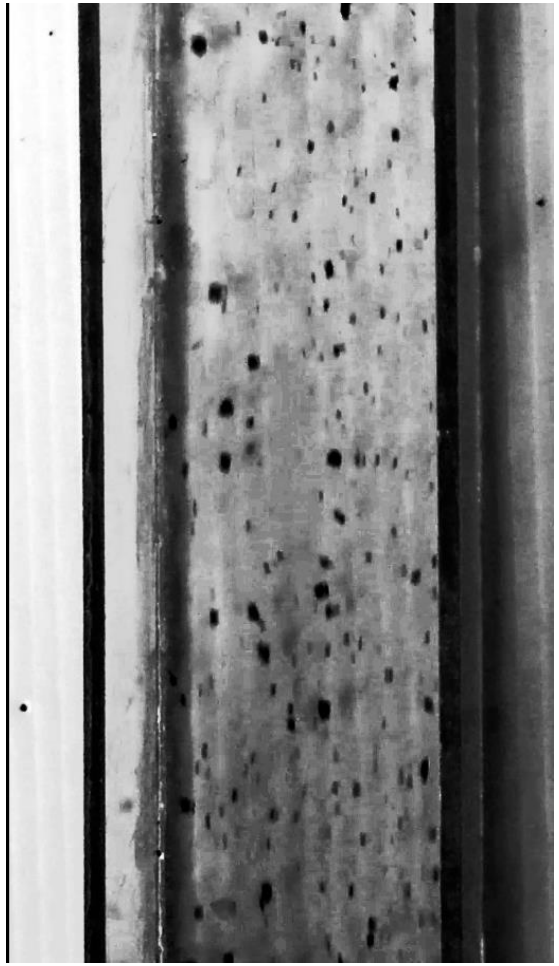




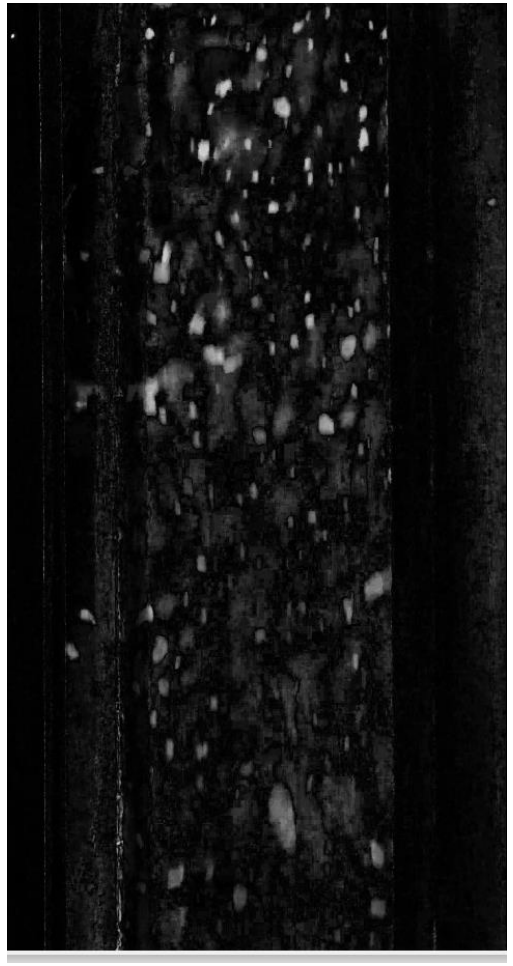
Grayscale video

Equalized video

- Background subtraction (remove static background)
  - Each frame of the video was subtracted from the first frame of the video

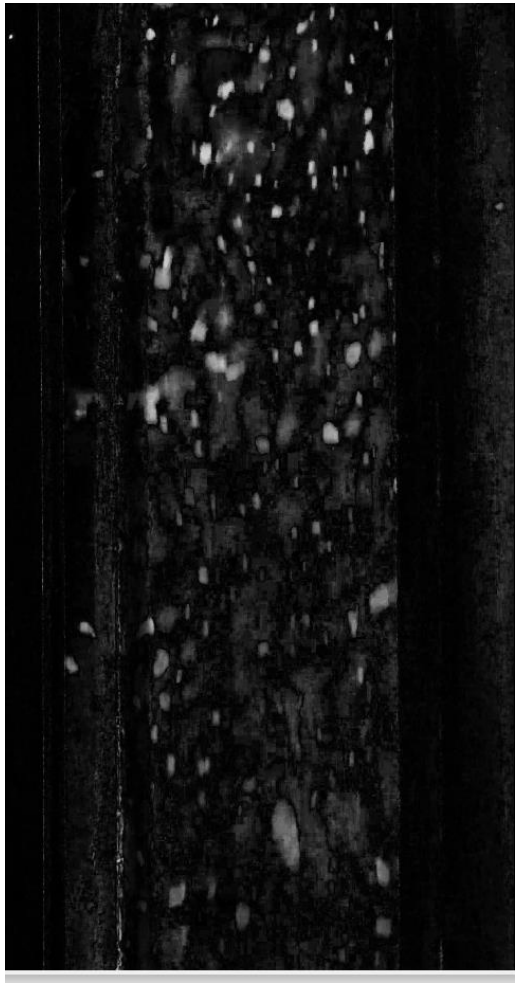


Equalized video



After Subtraction

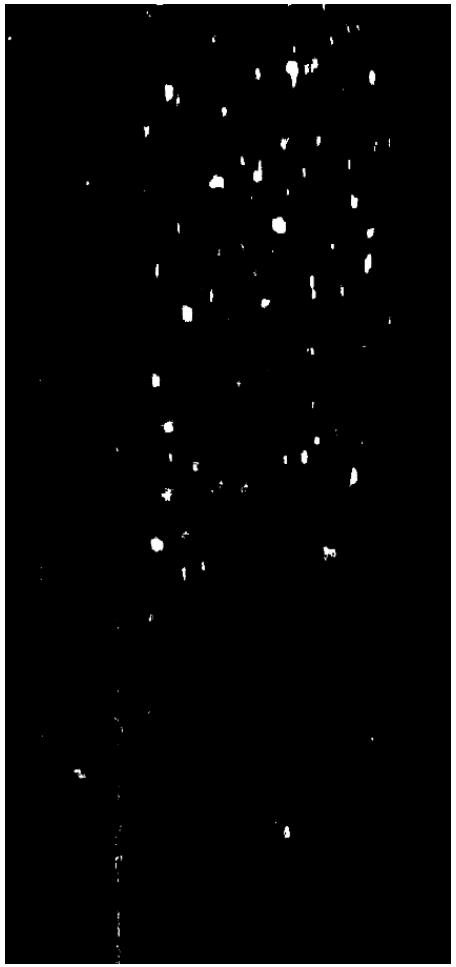
- Thresholding (isolate particles)



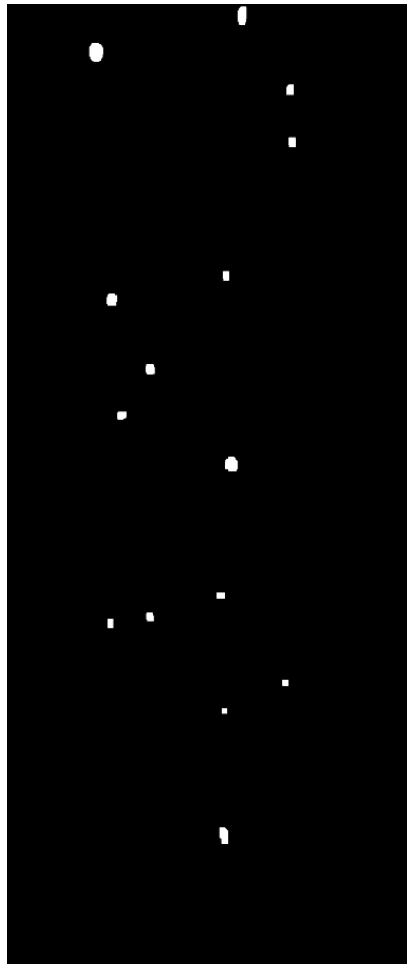
Subtracted frame

Created Binary frame

- Morphological operations (refine particle detection)

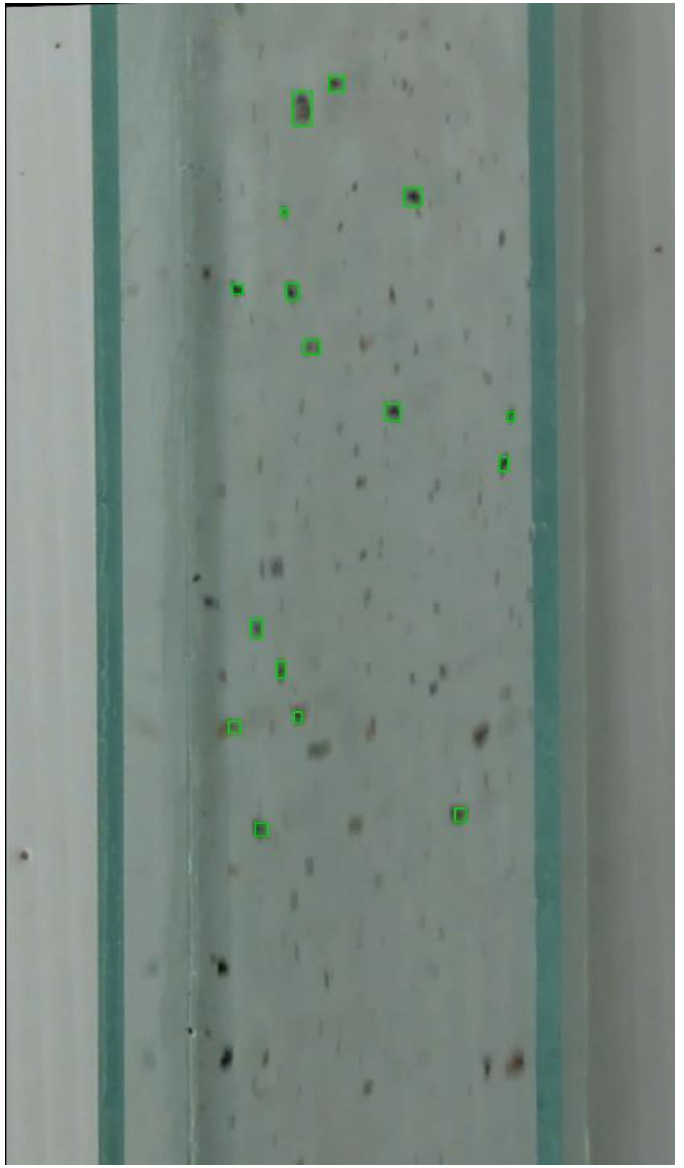


Binary frame



After applying
Morphological operation

- Visualized detected particles



Visualized particles

Remaining Work

- Determine the velocity of each detected particle
- Visualize particle paths to identify flow patterns
- Calculate Turbulent Kinetic Energy (TKE) and Turbulence Intensity (TI) from velocity data

Issues/Challenges Encountered

- **Video vs. Image Processing:** Initially, we weren't sure if image processing techniques could be applied directly to videos.
- **Data Acquisition:** No suitable online resources were available, so we had to create our own apparatus and capture video footage.
- **Particle Path Tracking:** Accurately tracing the paths of particles to identify flow patterns presents a challenge.

Thank You!