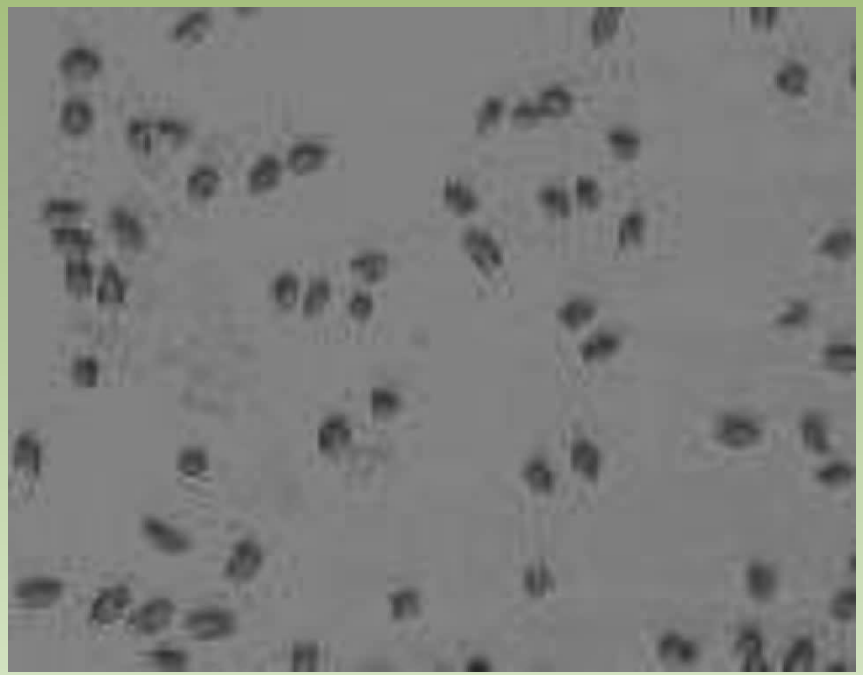
Automated Tracking of Biological Cells

Lance Rice

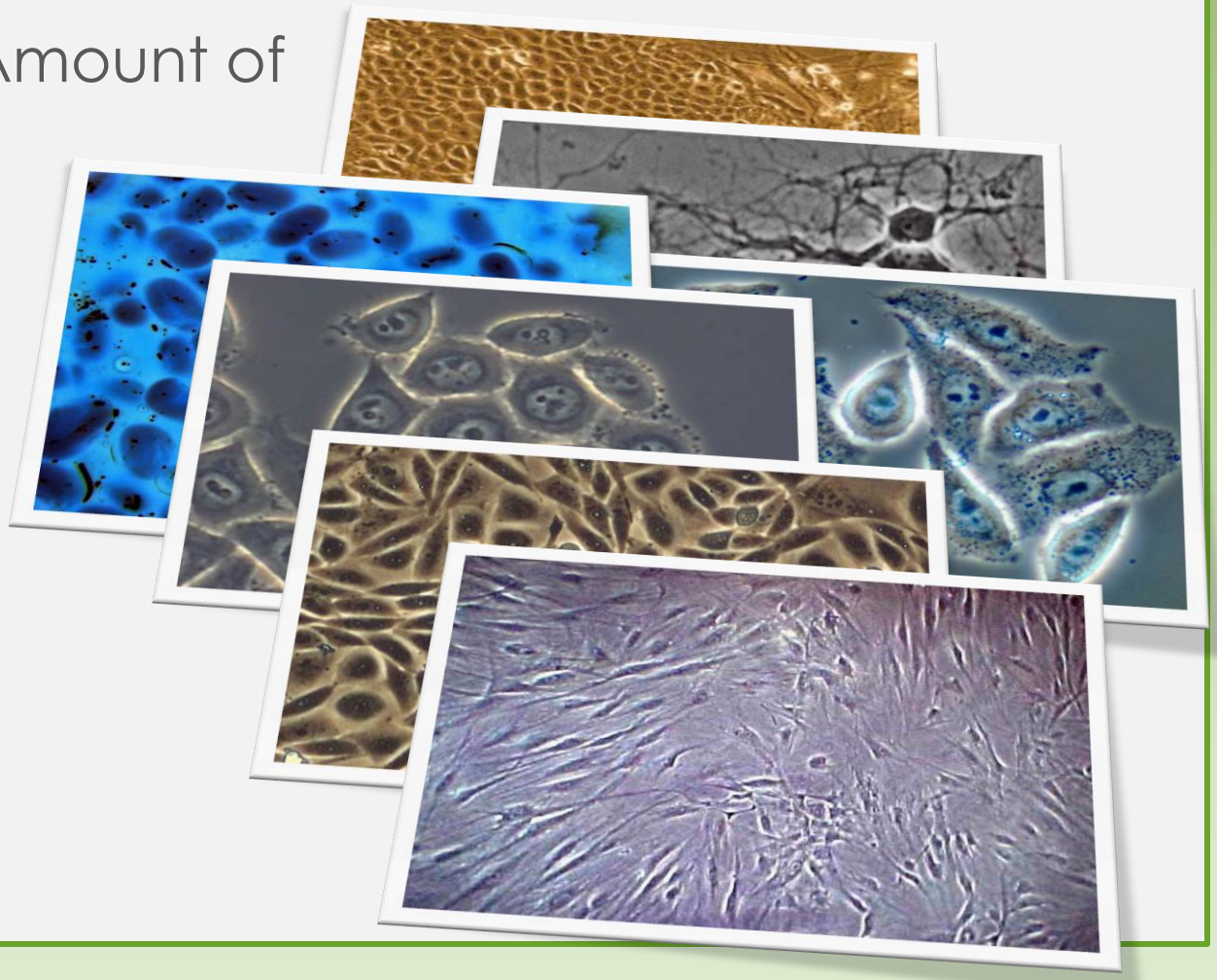


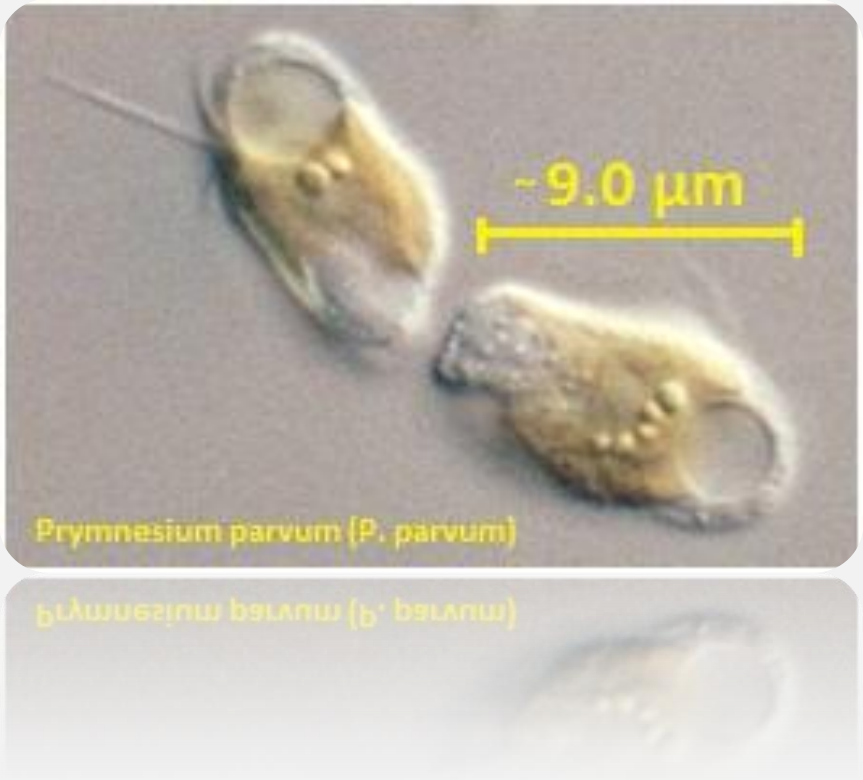
Automated Cell Tracking

- Biological cell cultures
- Prerecorded microscopy video
- Maintain location of every cell over entire video

Why it Matters

- Incredible Amount of
  - Diversity
  - Volume

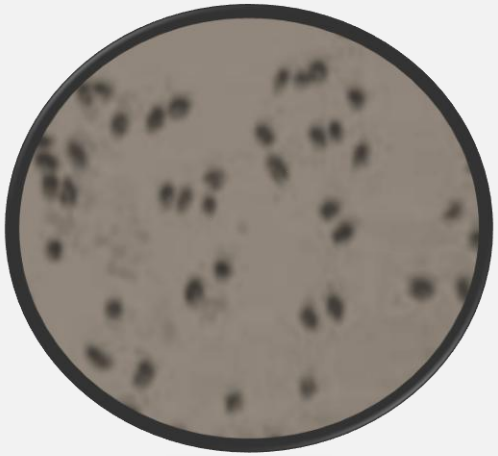




Toxins

Ecological Factors?

Toxins



(Recorded experiments) x 12

- ~100 cells
- ~1000 frames

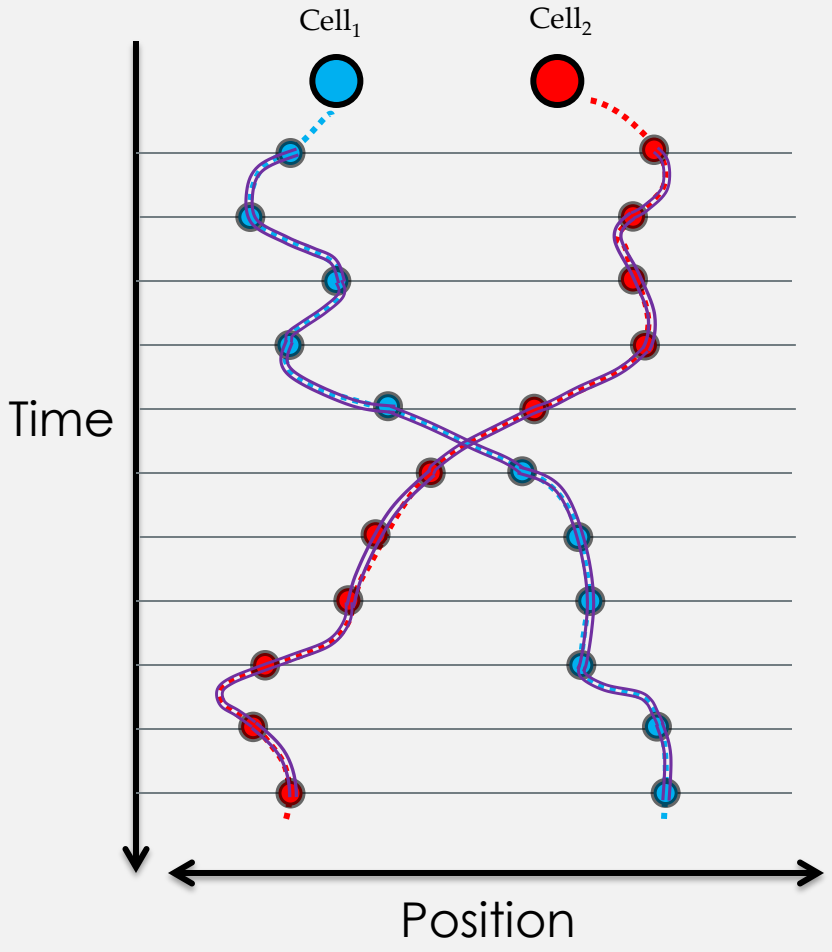
(100 clicks) x (1000 frames) x (12 Videos) =

1.2 MILLION CLICKS!

- Efficiency
- Accuracy
- Completeness

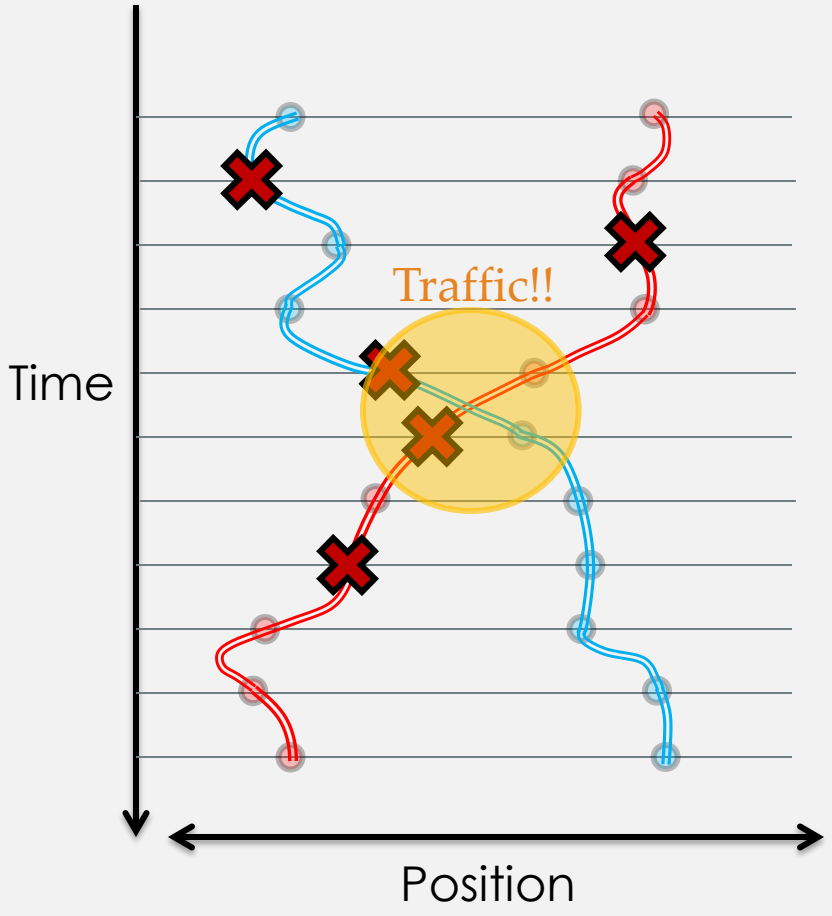
Method Overview

- Detection
- Association (Low)
- Association (High)



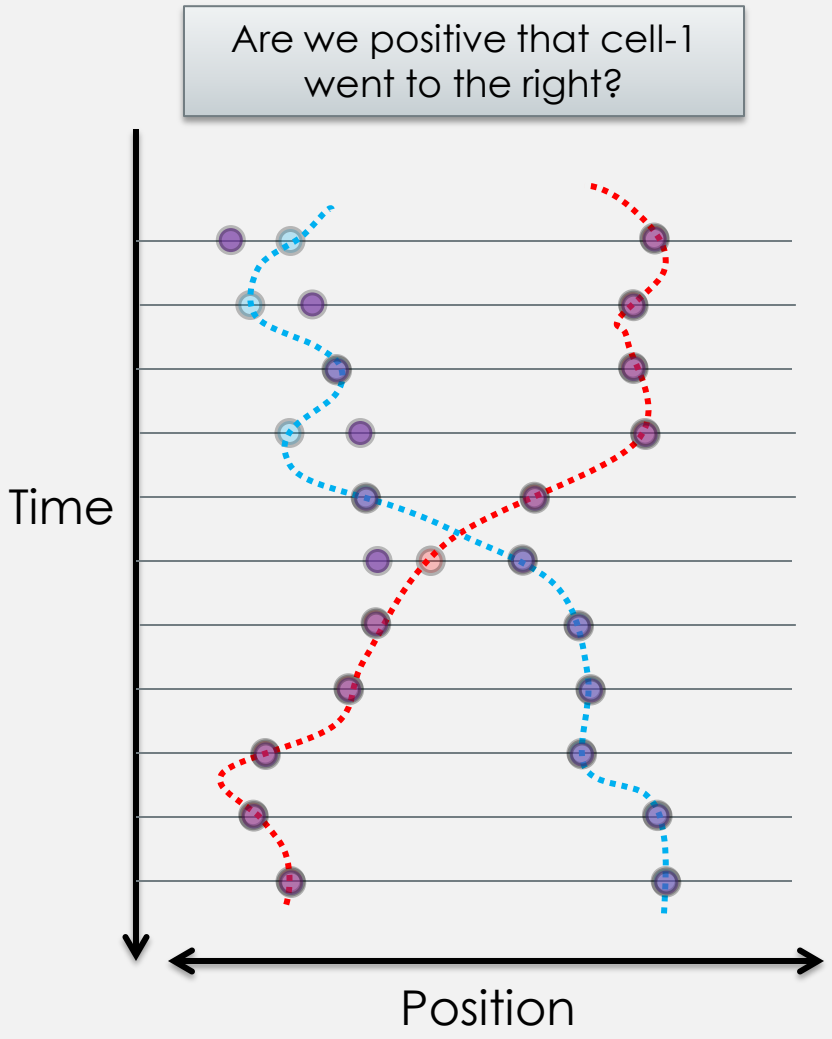
Challenges

- Detection
  - Missed Detections



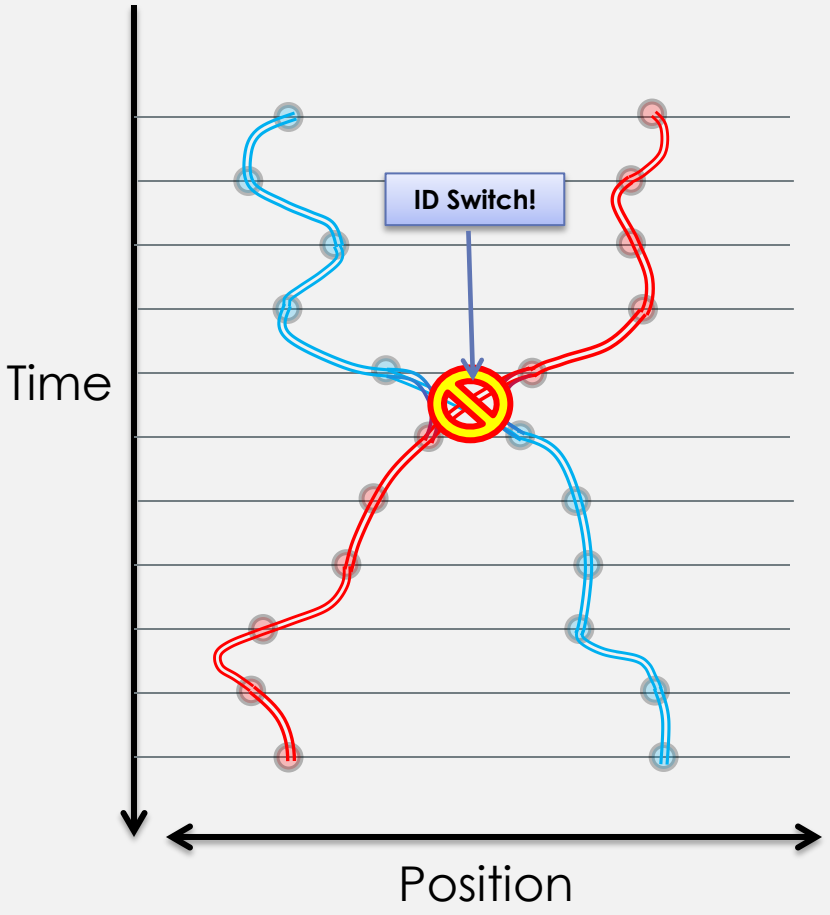
Challenges

- Detection
  - Missed Detections
  - Detection noise



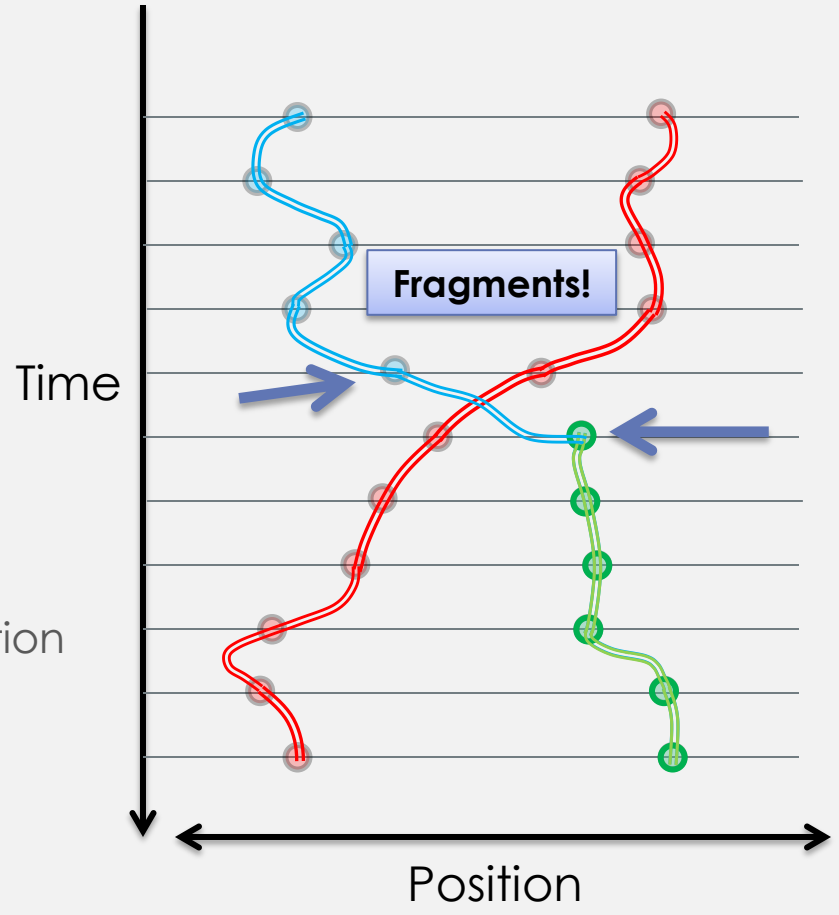
Challenges:

- Detection
  - Missed Detections
  - Detection noise
- Association
  - Incorrect Matches



Challenges:

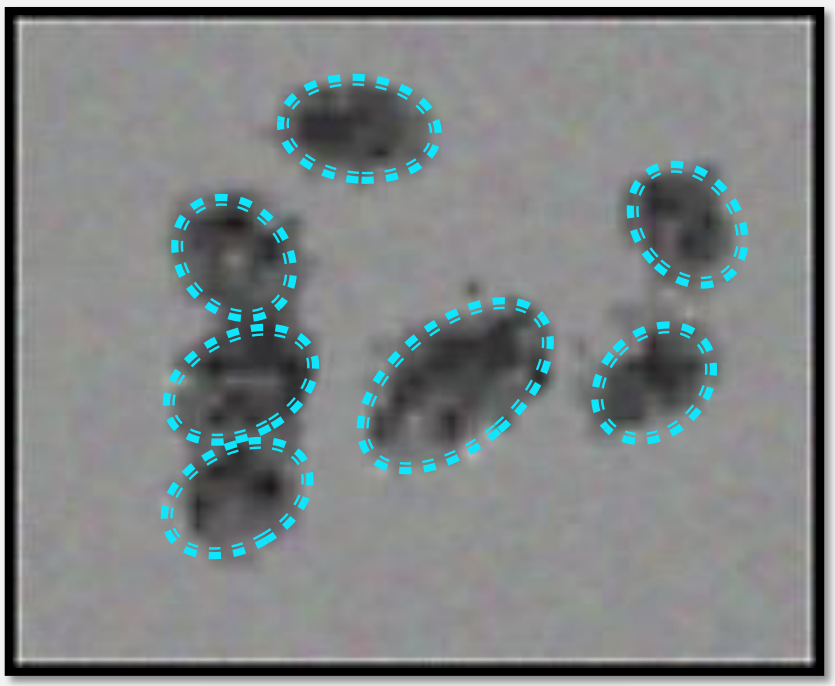
- Detection
  - Missed Detections
  - Detection noise
- Association
  - Incorrect Matches
  - Failed to make any connection



Detection

Experimented with 3 approaches

1. Circle Fitting

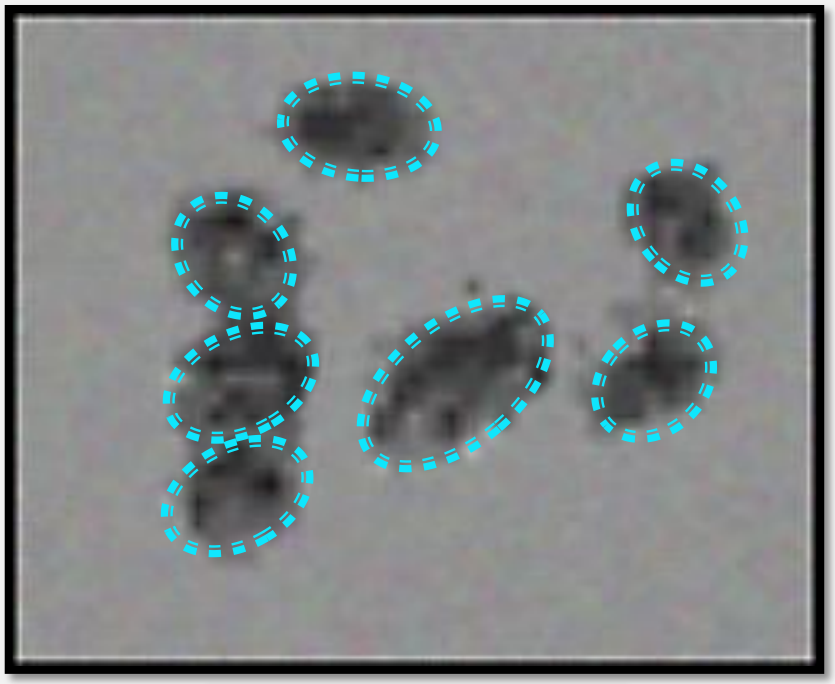


Correct Answer

Result

Detection

1. Circle Fitting
2. Watershed

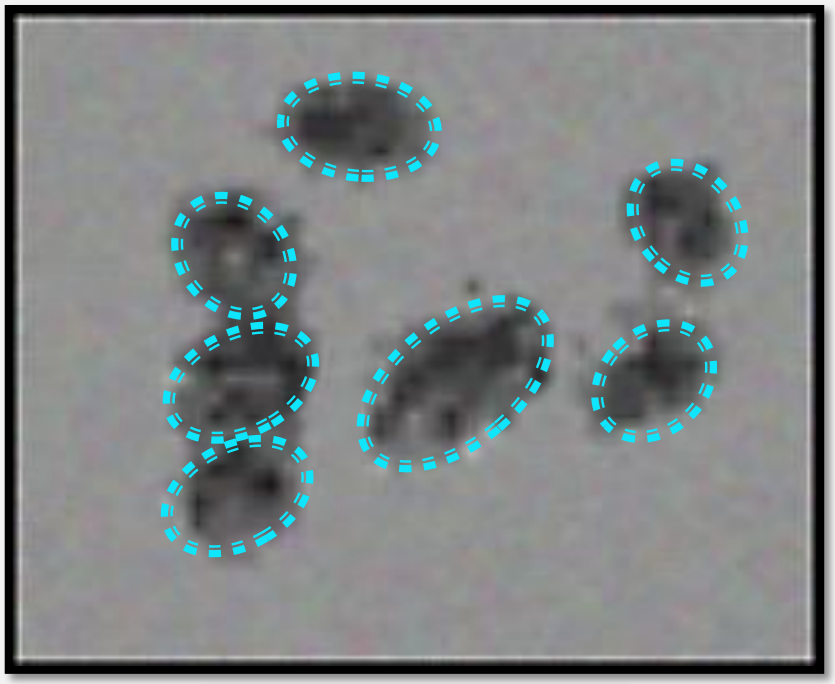


Correct Answer

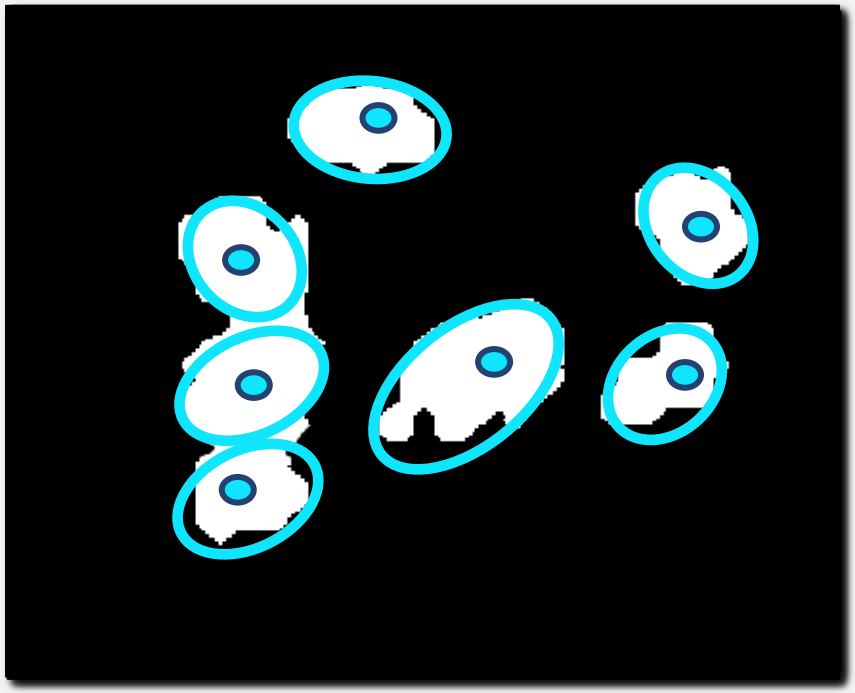
Result

Detection

1. Circle Fitting
2. Watershed
3. Distance Fitted Ellipse

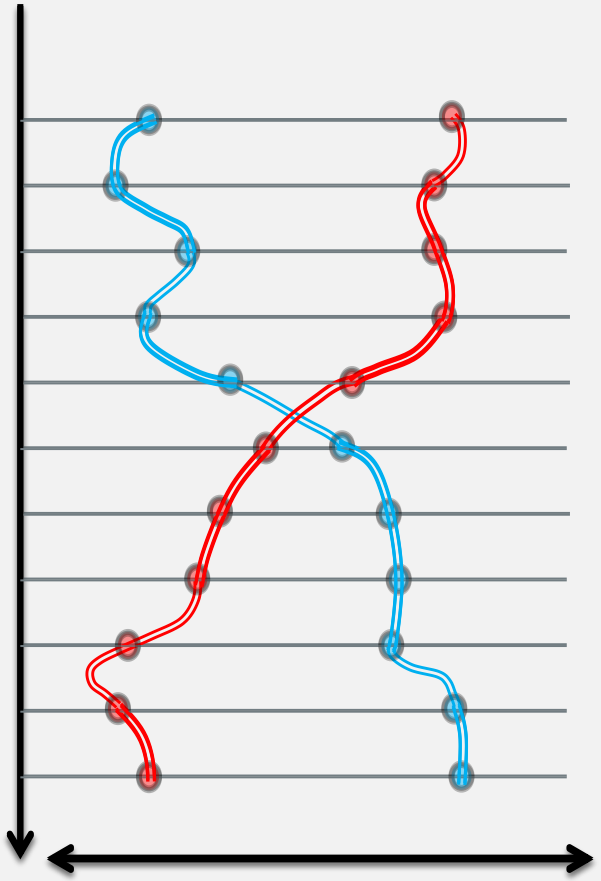


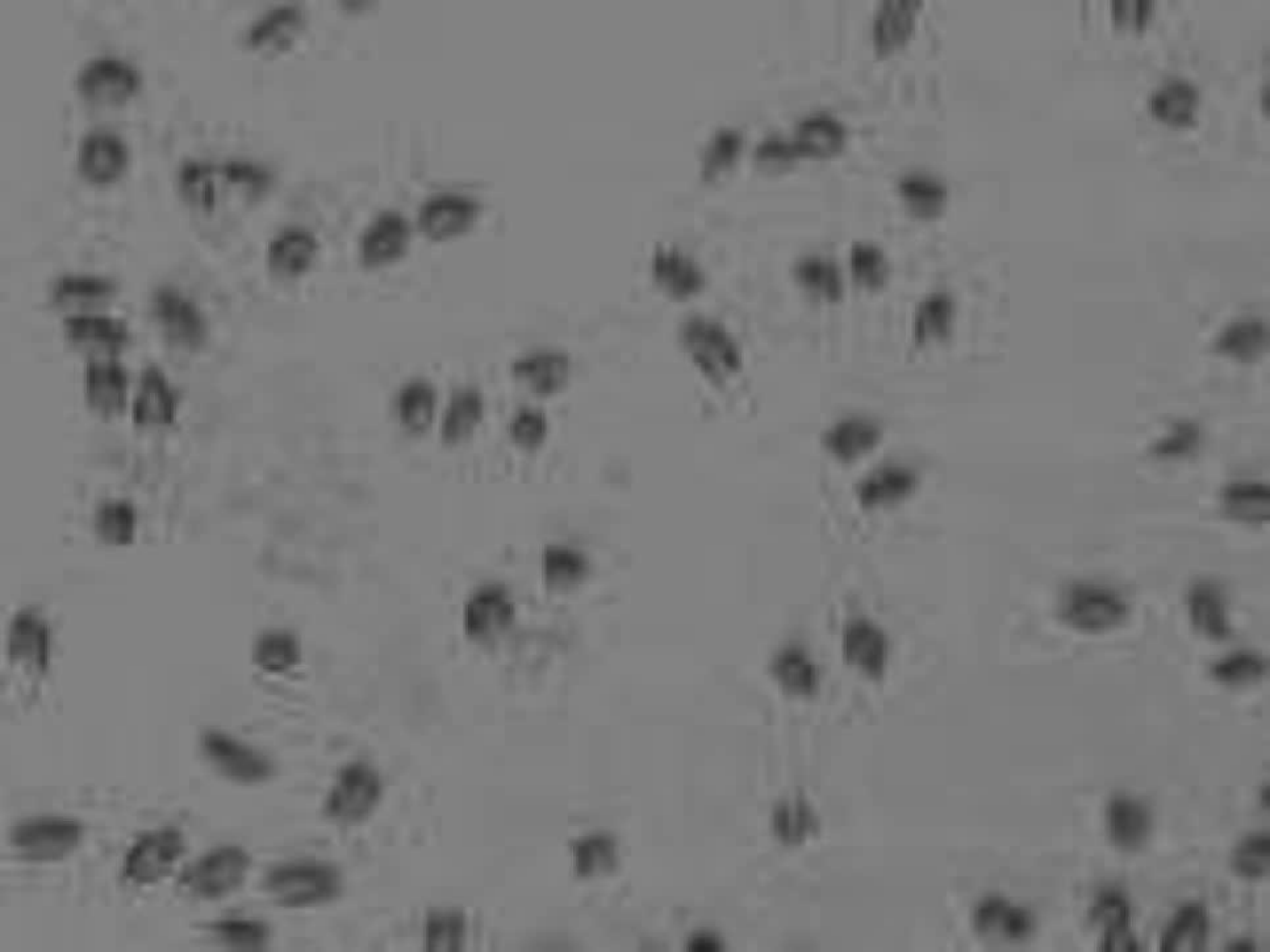
Correct Answer

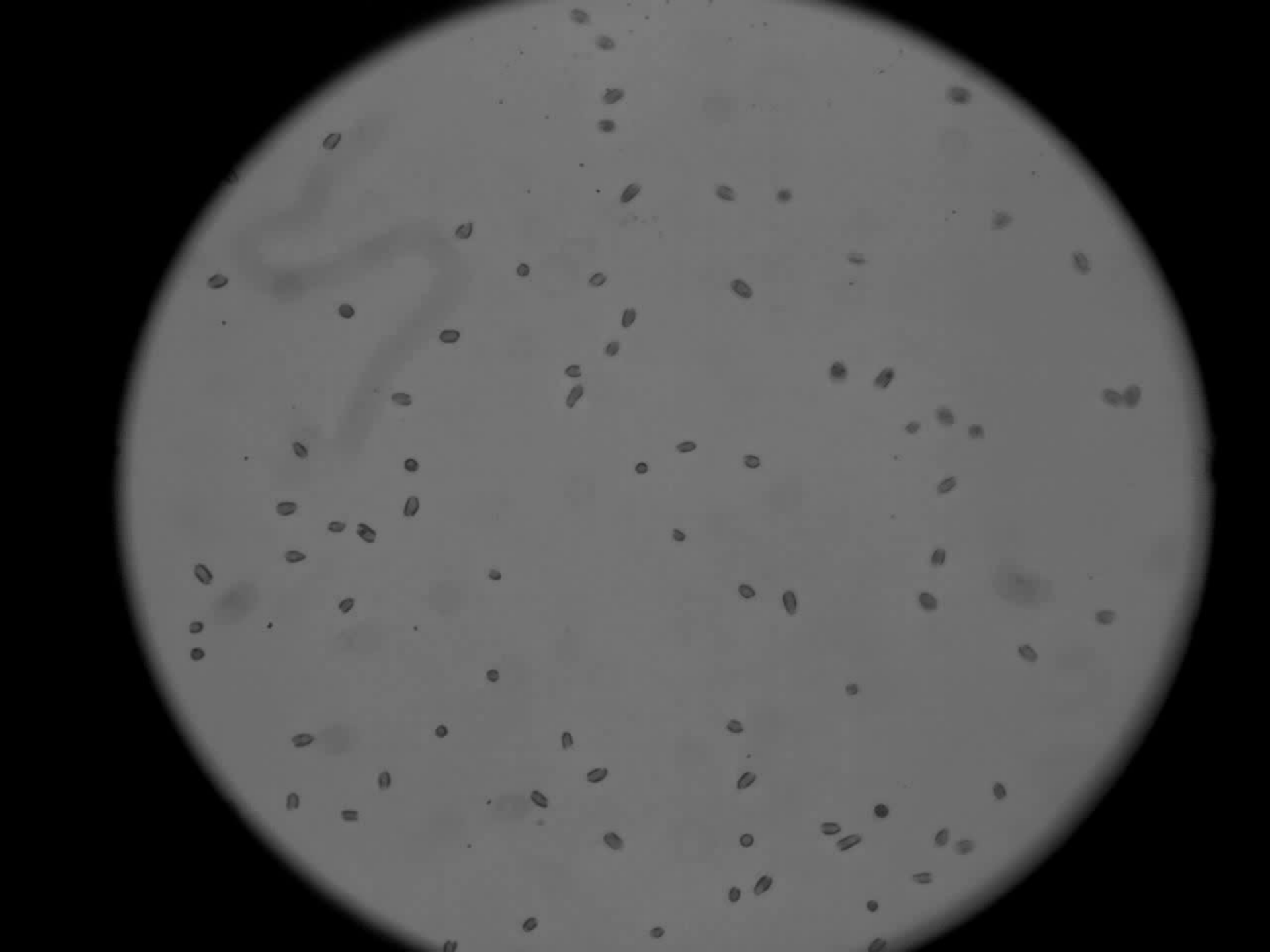


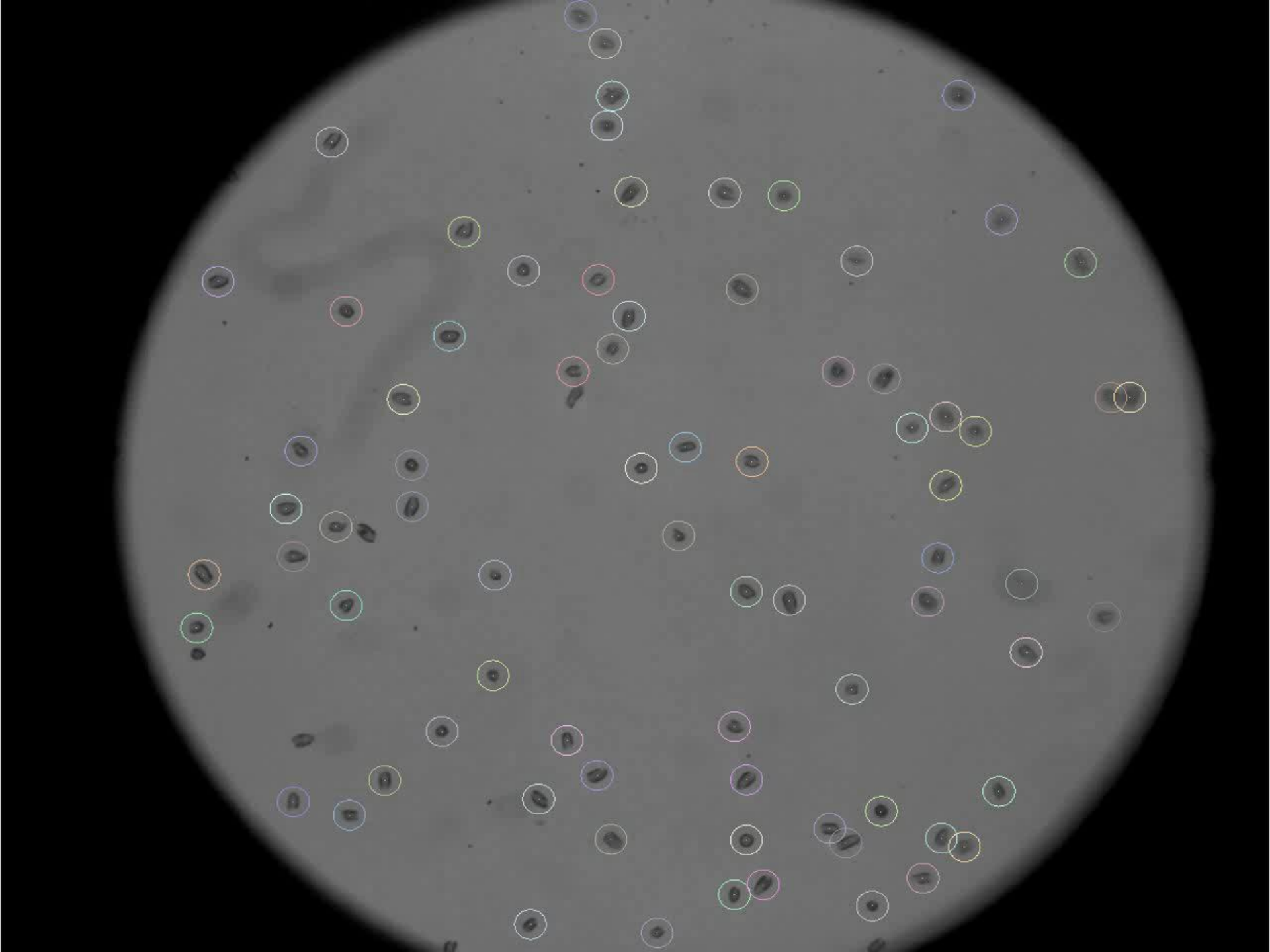
Association

	Low Level	High Level
Position	✓	✓
Size	✗	✓
Motion Pattern	✗	✓
Appearance	✗	✓
Gab Connections	✗	✓

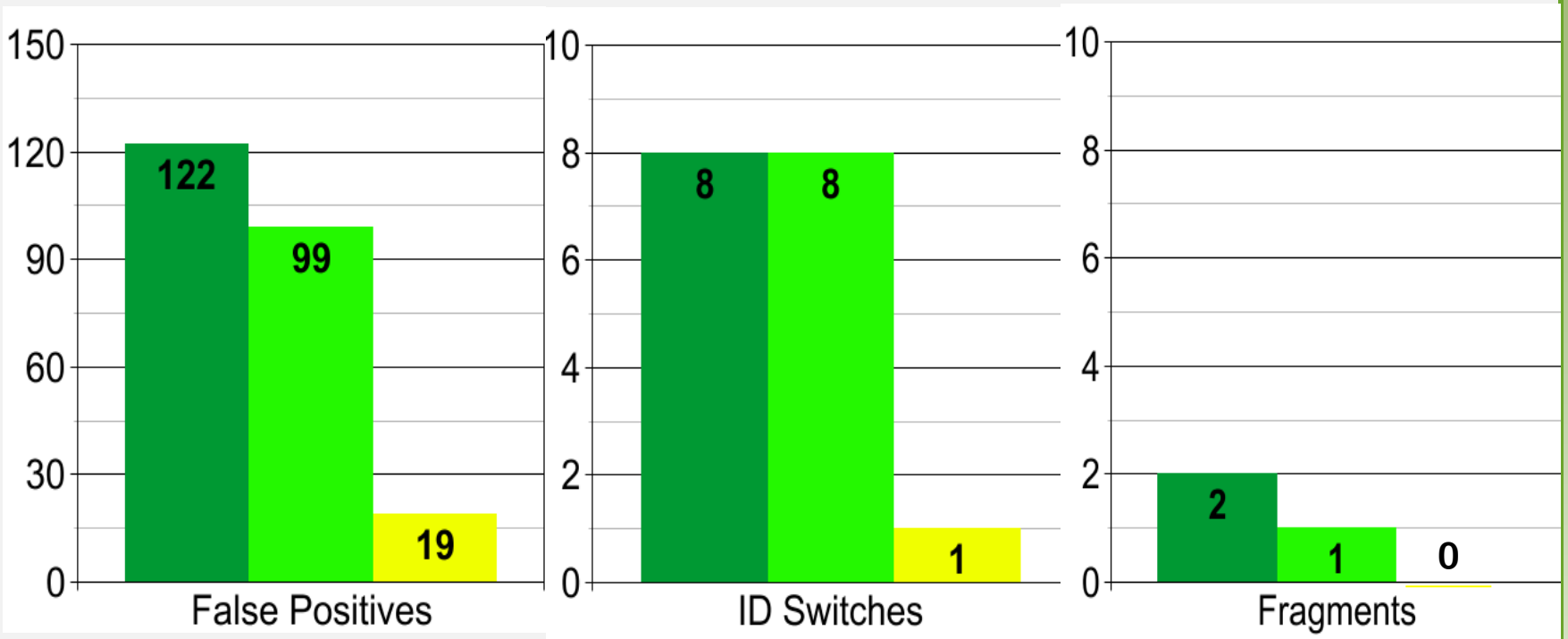








Results (cont.)



Circle Fitting

Watershed

Distance Fitted Ellipse

Conclusions

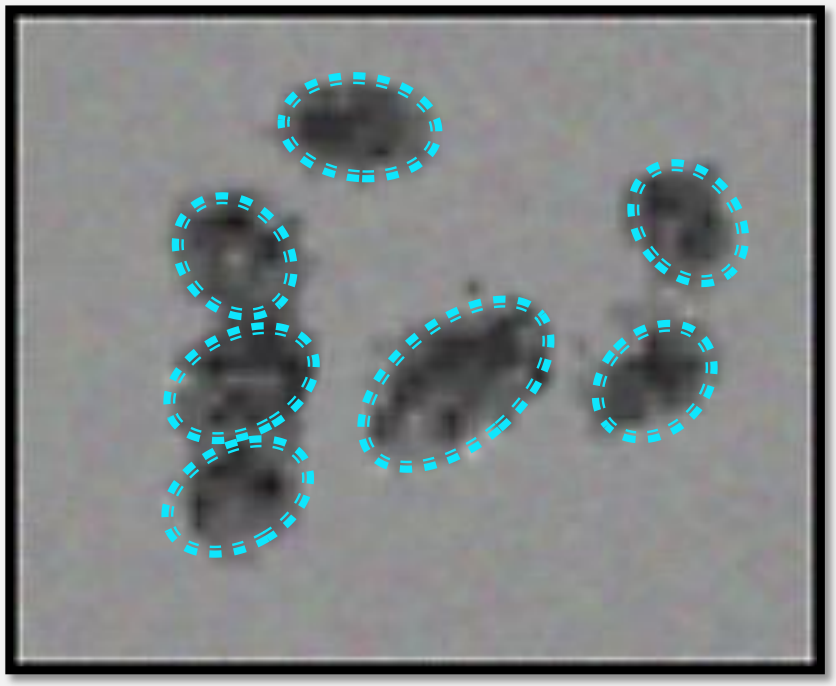
- P. Parvum tracking on low quality video
- Improvements through better Detection
- Problem areas
  - False Positives & ID switches
  - Dropped tracks

The Next Step

Trained Detector

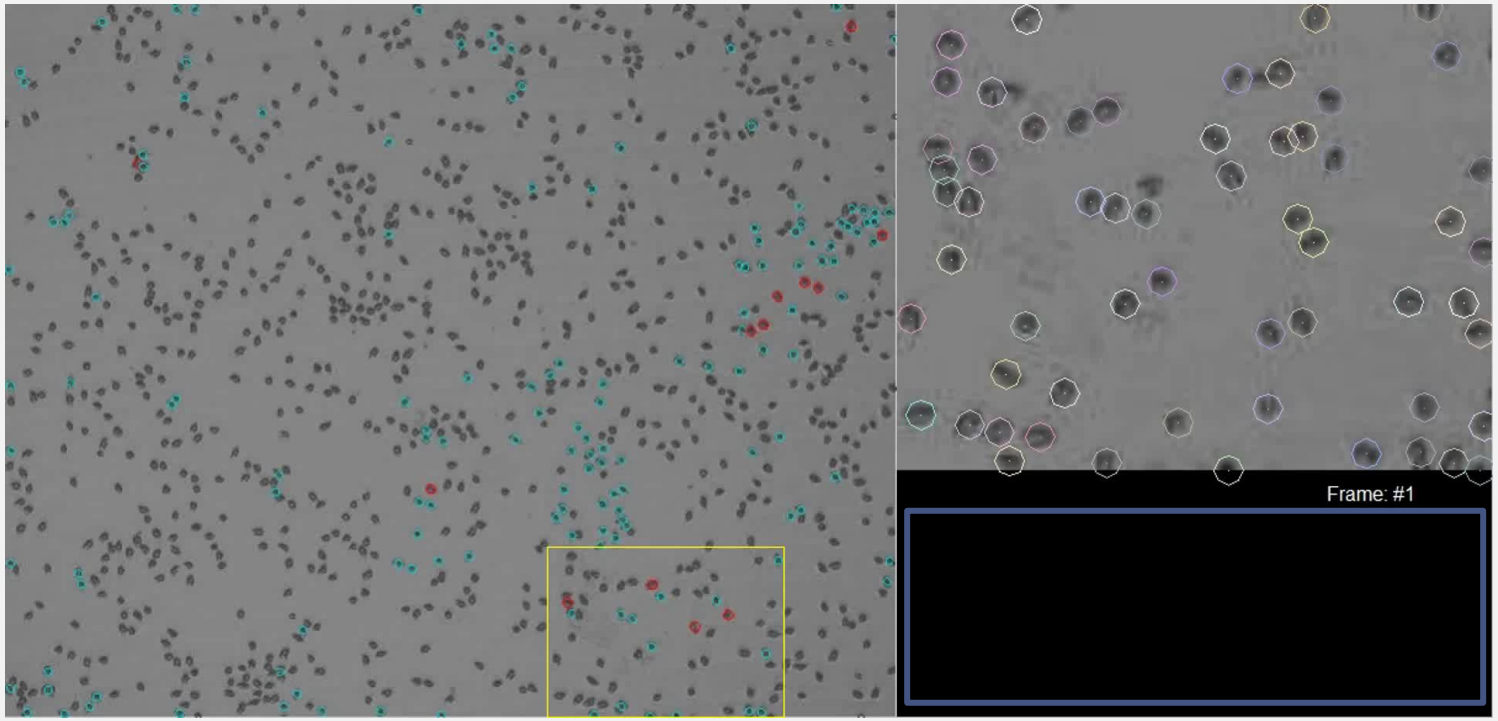
- Expand on variety of data

Area	?
Color	?
Shape	?
Proximity	?



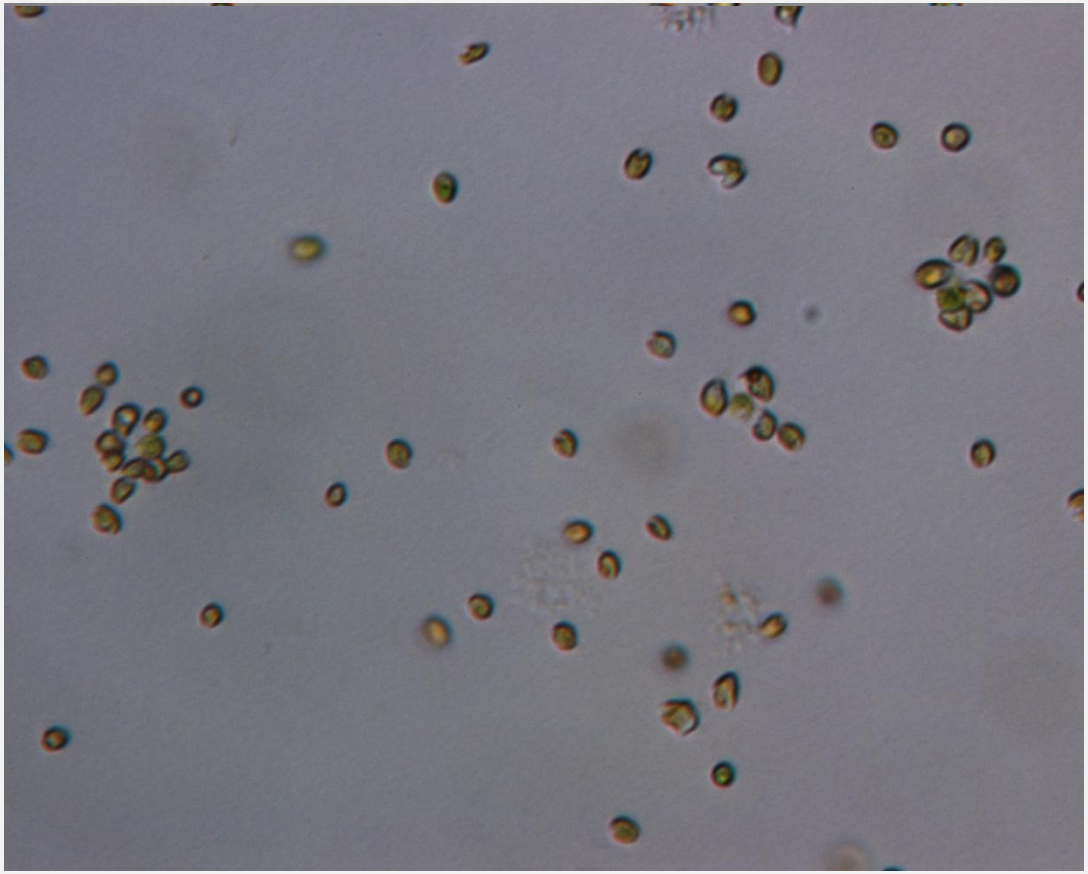
The Next Step

- Visualization of cell motion patterns



The Next Step

- Cluster analysis



Thank you

Questions?