Identifying and Measuring Curvature of Caulobacter Cells

Jenna Schabdach
Department of Biomedical Informatics
University of Pittsburgh

Caulobacter Bacteria 101

- Highly studied by biological researchers
- Cells divide into 2 cell types
  - Stationary, stalked cell
  - Motile swarmer cell
- Similar functionalities to stem cells

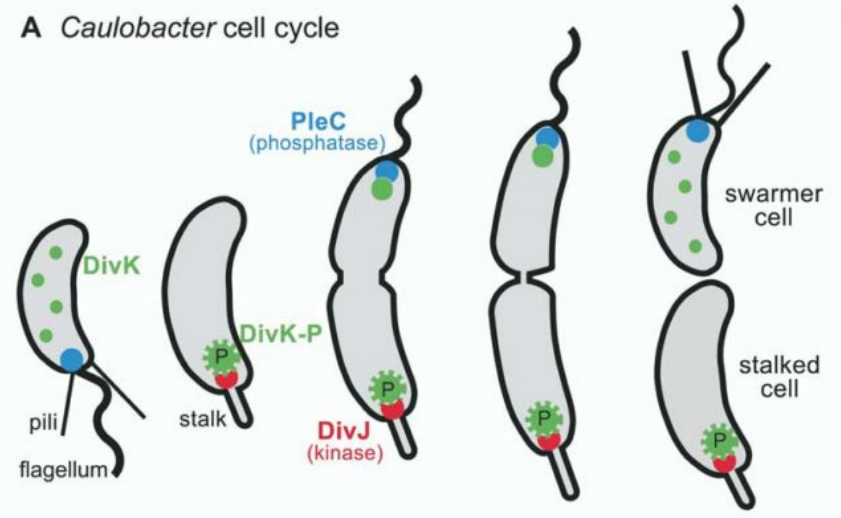


Image source: Z. Gitai, “The New Bacterial Cell Biology: Moving Parts and Subcellular Architecture,” *Cell*, vol. 120, pp. 577–586, 2005.

Caulobacter Bacteria 101

- Current research: division process
  - Proteins localize to different points in the cell
  - How do they know where to go?
- Theory: curvature plays a role
  - Force cells to grow to a curvature using a scaffold
  - Image cells using light microscope
  - Measure the curvature of the cells

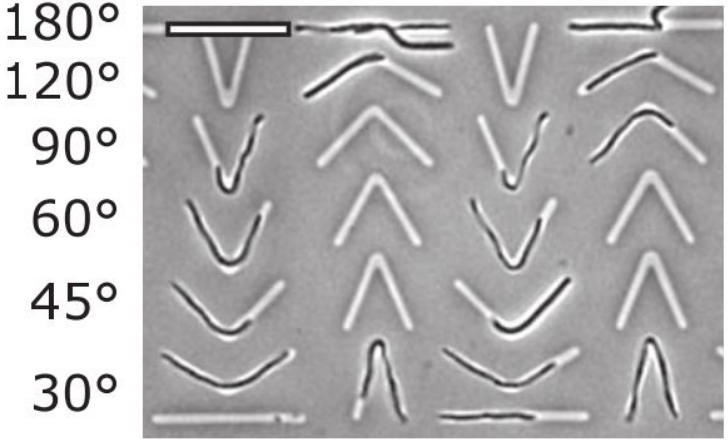
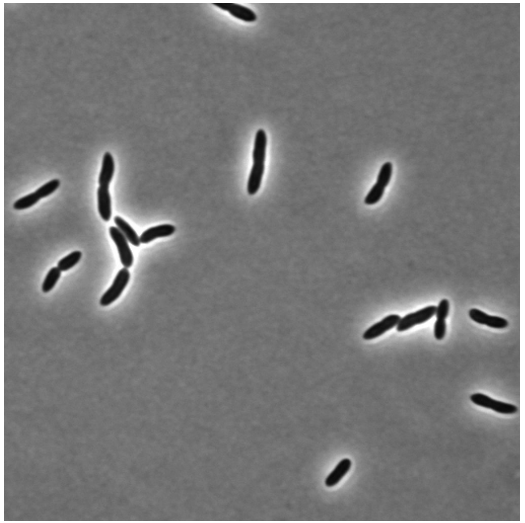


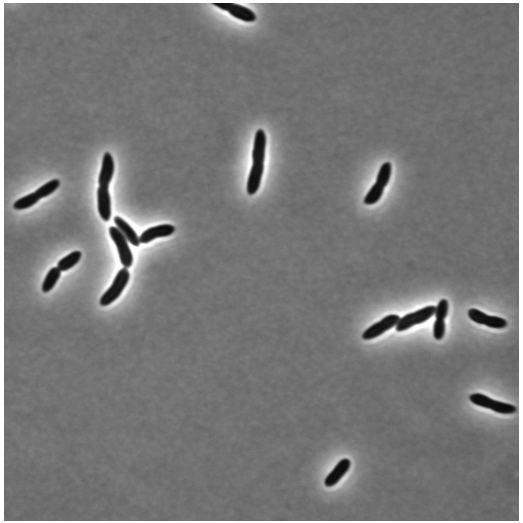
Image credit: L. D. Renner, P. Eswaramoorthy, K. S. Ramamurthi, and D. B. Weibel, “Studying Biomolecule Localization by Engineering Bacterial Cell Wall Curvature,” *PLoS One*, vol. 8, no. 12, 2013.

Analyzing *Caulobacter* Images

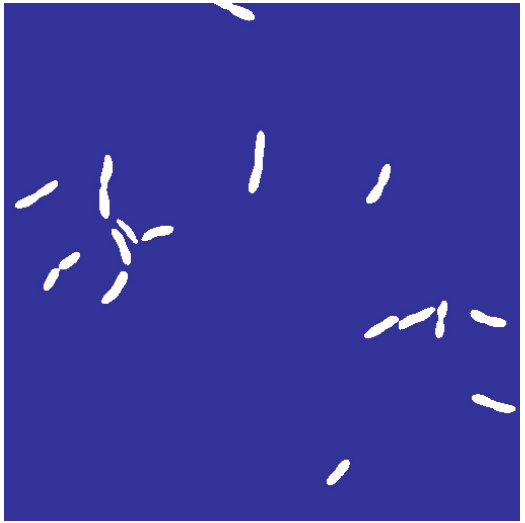
1. Segment the image: identify bacteria cells vs. background
2. Measure the curvature of the cells



Segmenting Cells vs. Background



Original



Thresholded Image

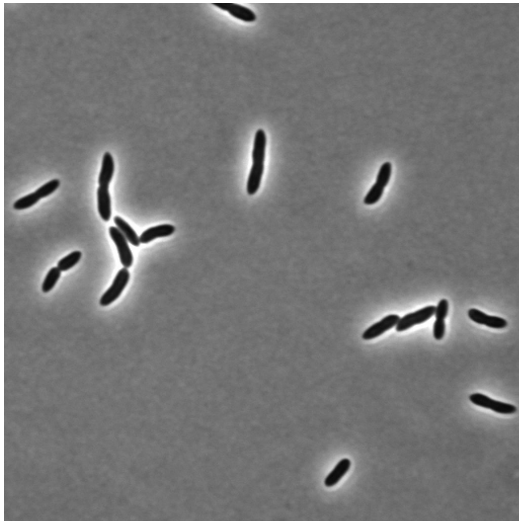
Label Map

Measuring Curvature

Label Map

- Iterate through label map
- Fit a polynomial to the cells
- Calculate the curvature of the polynomial

Preliminary Results: Counting Cells



Original

Label Map

How many cells in original?

- Researcher: 16
- Label map: 16

Challenges, Limitations, and Future Work

Challenges

- File formats
- Finding best segmentation pipeline
- Researcher needs unclear

Limitations

- Thresholds specific to test image
- Specific to type of microscopy image

Future Work

- Tweak parameters using more images
- Coordinate with researchers
- Incorporate fluorescent images

Acknowledgements

- Sara Whitlock
- Childers Lab