

# Integration of chemical and mechanical signals in cell motility



Sebastien Besson  
Danuser Lab, HMS

A background image showing a dense field of small, bright, circular spots, likely representing individual cells or particles in a microscopy experiment. The spots are distributed across the frame, with a higher concentration on the left side.

# Integration of chemical and mechanical signals in cell motility

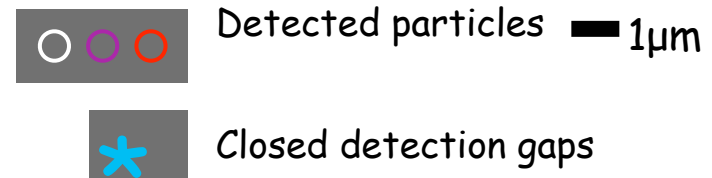
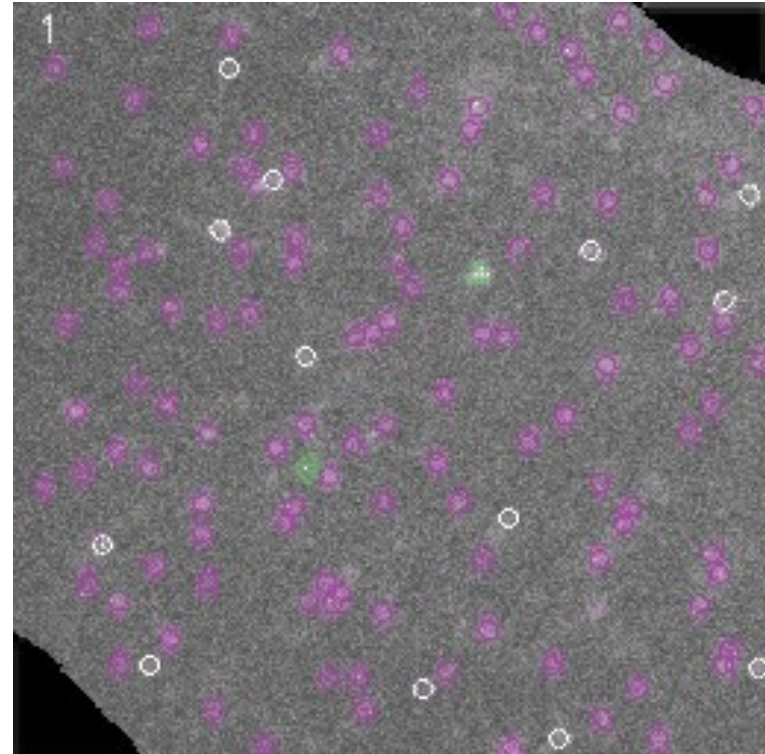
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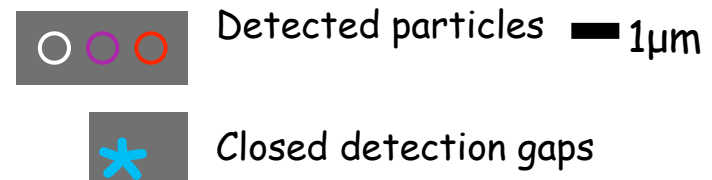
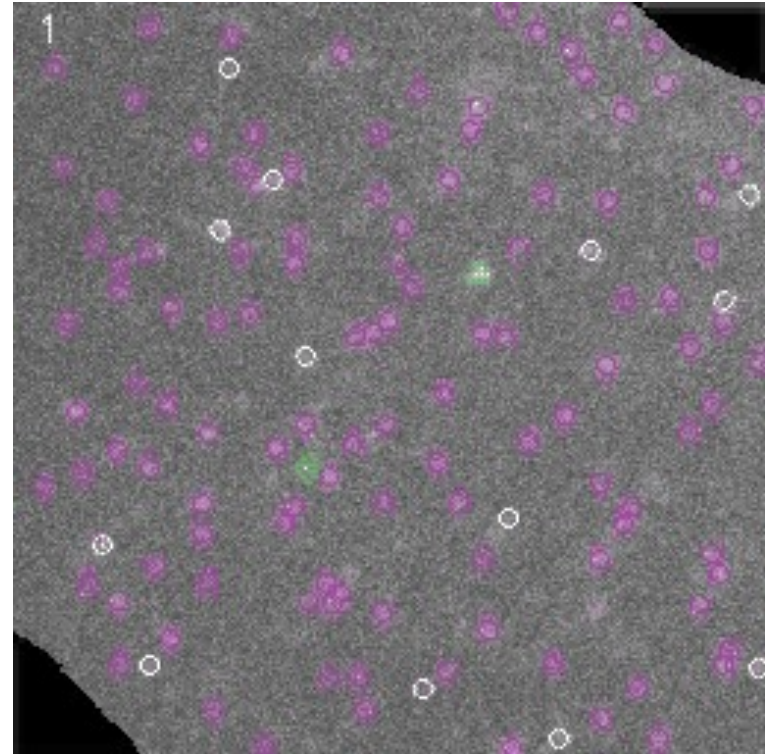
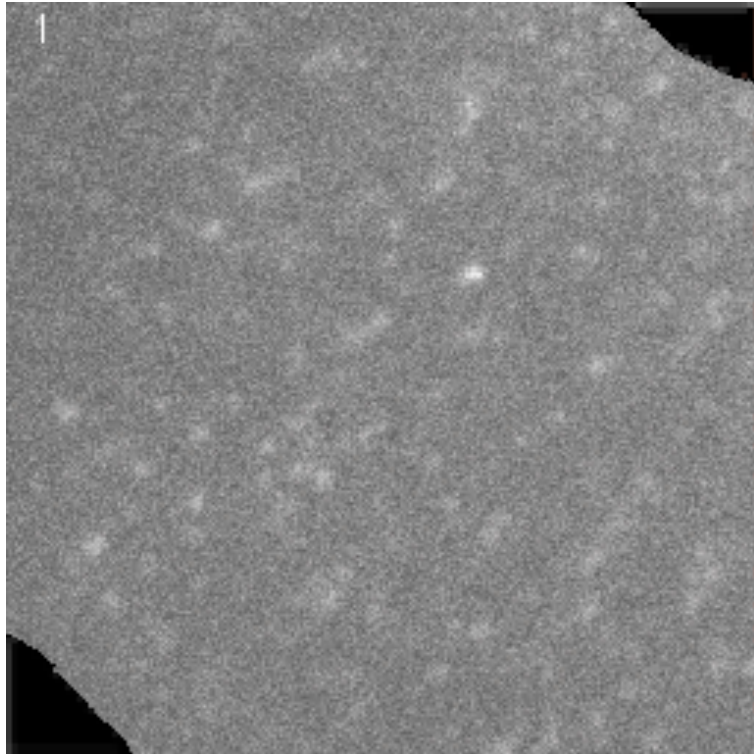
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# Capturing relevant single molecule events, e.g., dynamics of individual surface receptors



Jaqaman, et al. Nature Methods. 2008

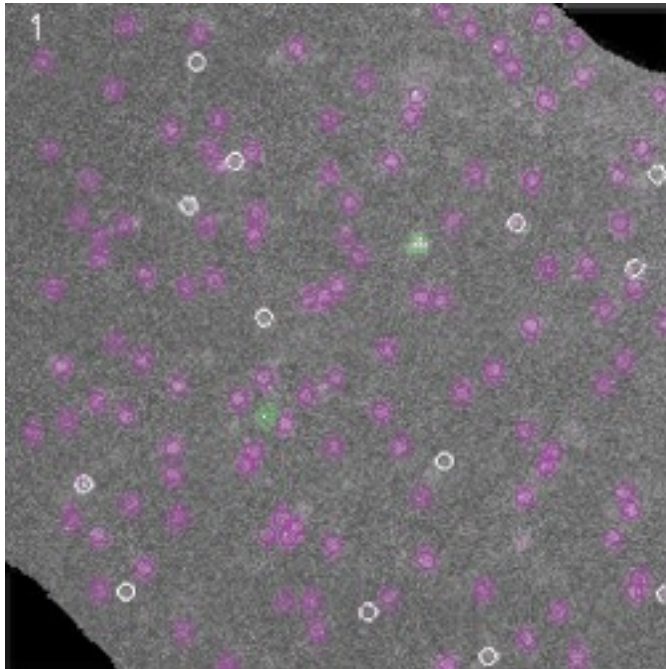
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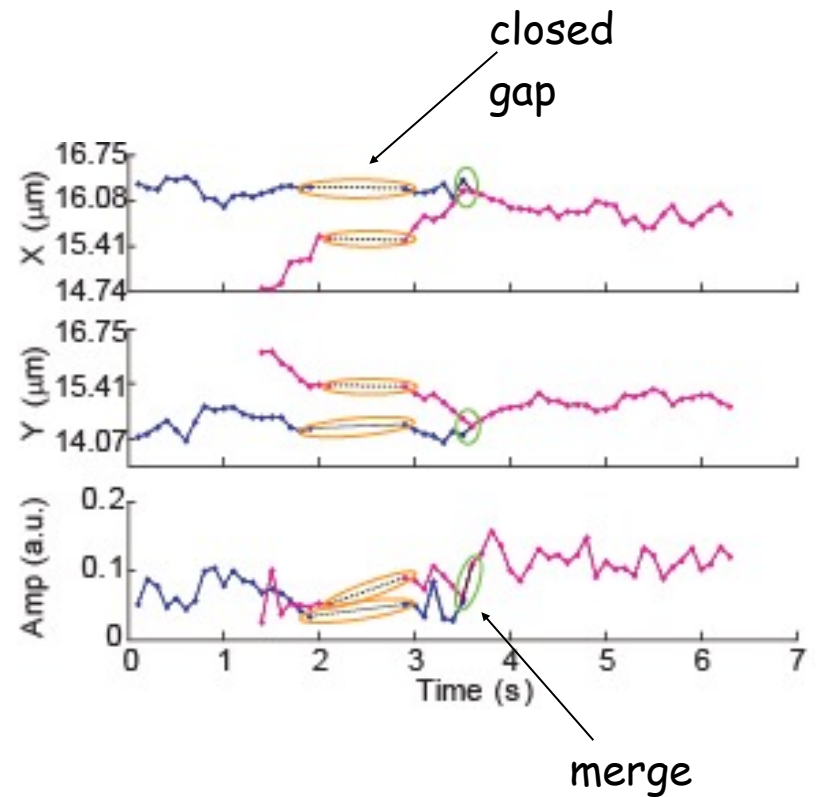
# Capturing aggregation dynamics of surface receptors



○ ○ ○ Detected particles — 1μm

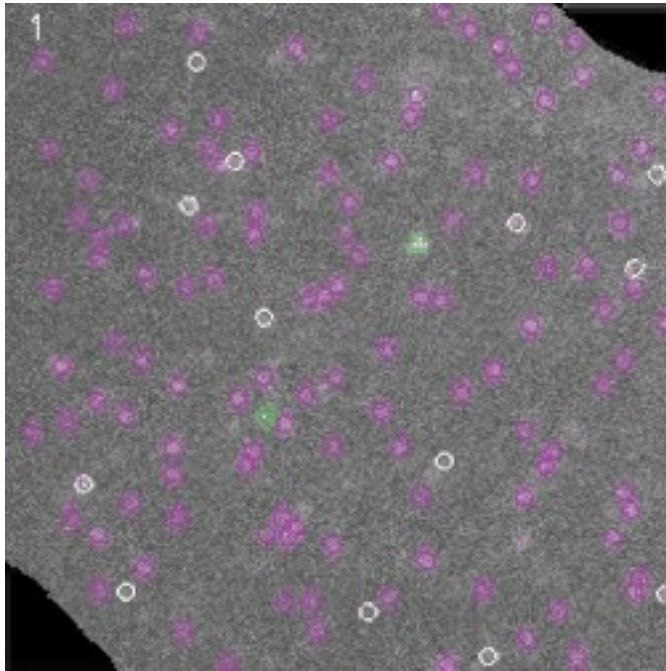
\* Closed detection gaps

◇ ◇ Merges/splits **rare event**



Jaqaman, et al. Nature Methods. 2008  
 Jaqaman, Kuwata, et al. Cell. 2011

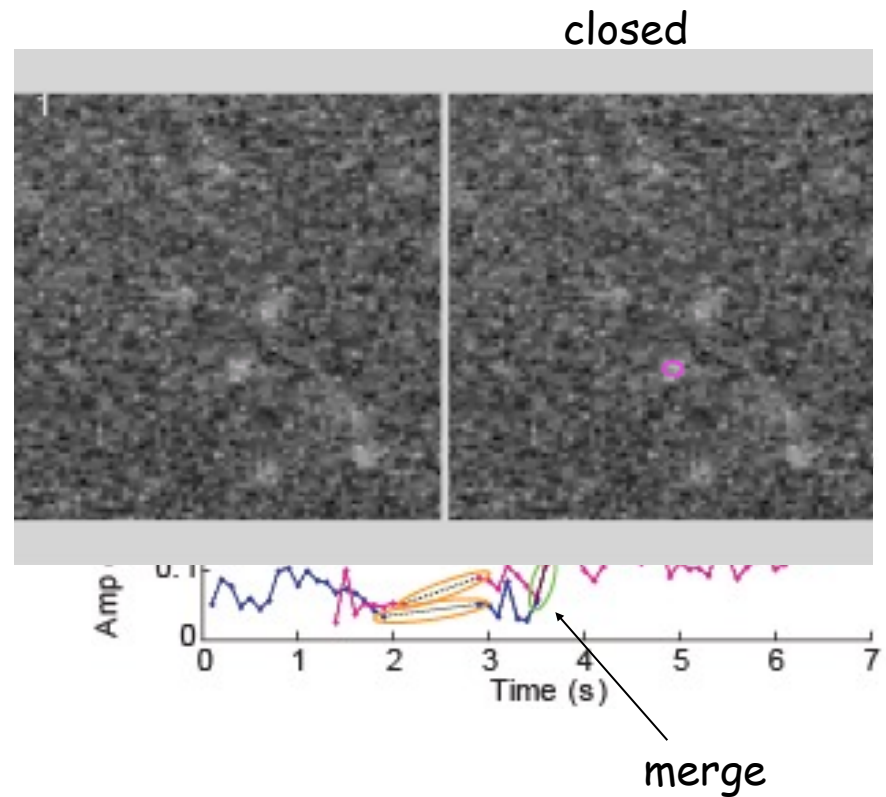
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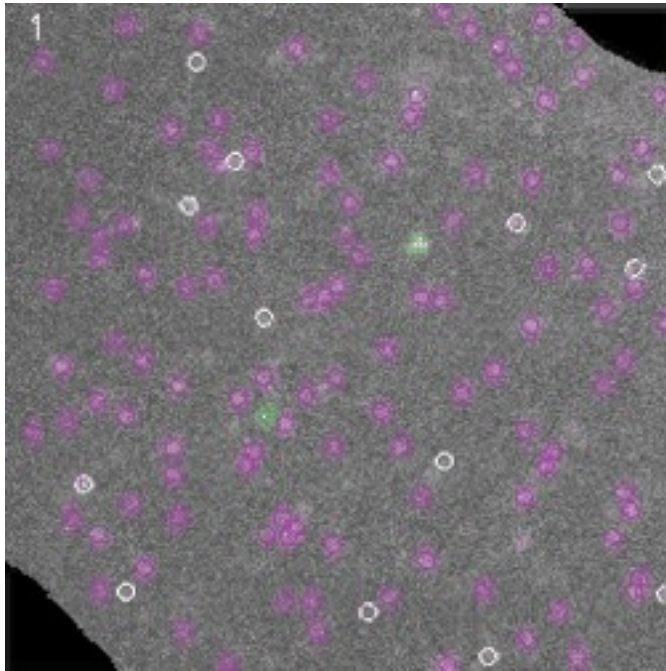
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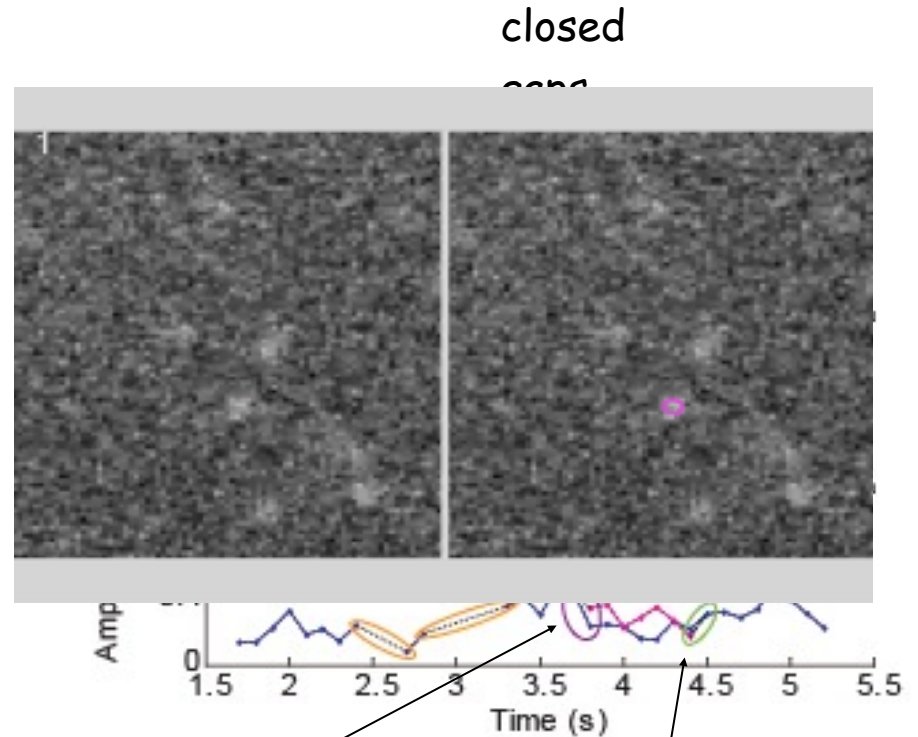
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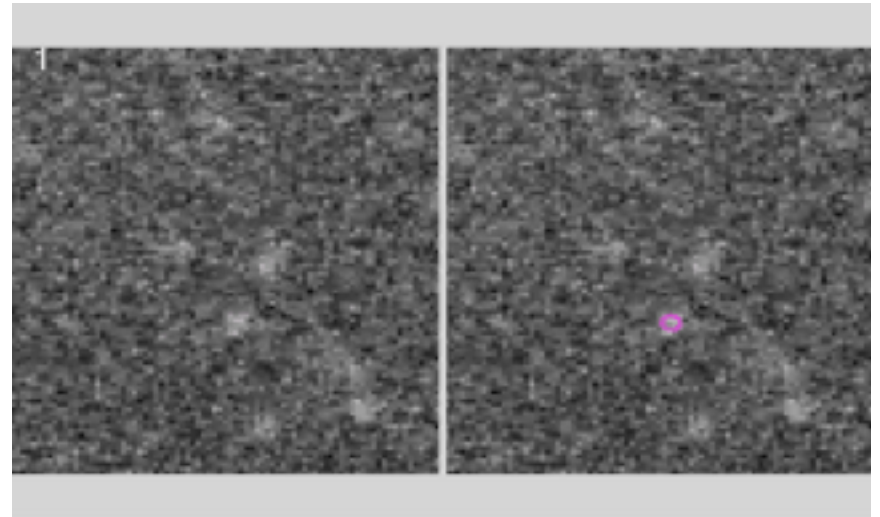
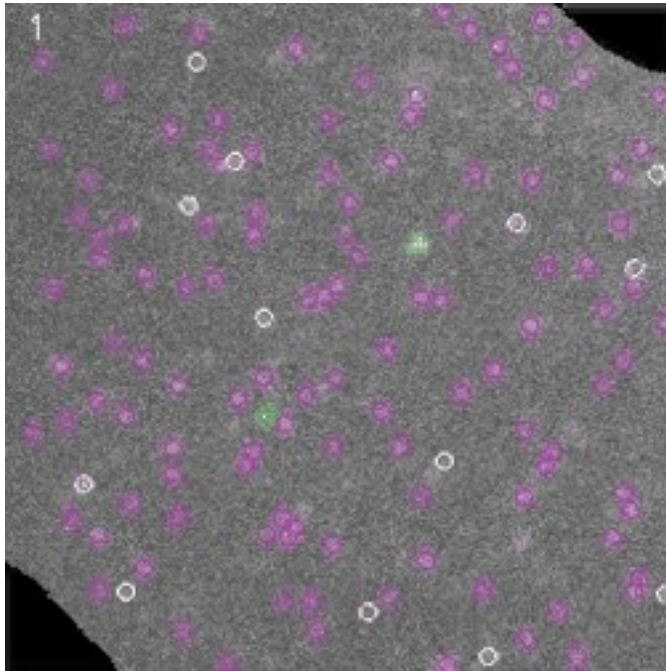
split

merge

Jaqaman, et al. Nature Methods. 2008  
 Jaqaman, Kuwata, et al. Cell. 2011



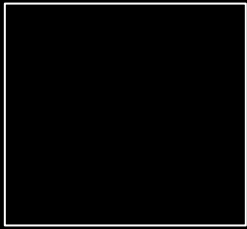
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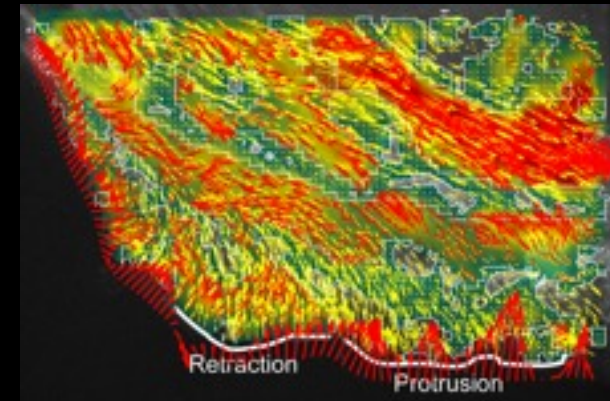
- ○ ○ Detected particles — 1μm
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- ◇ ◇ Merges/splits ← rare event

Jaqaman, et al. Nature Methods. 2008  
Jaqaman, Kuwata, et al. Cell. 2011

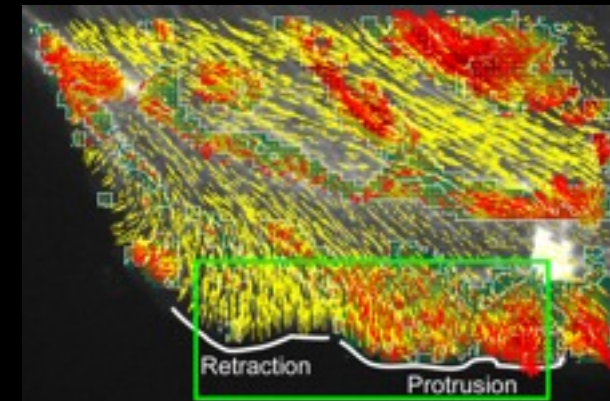
# Spatiotemporal analysis of intracellular forces in epithelial cell migration



Contraction and Boundary Forces



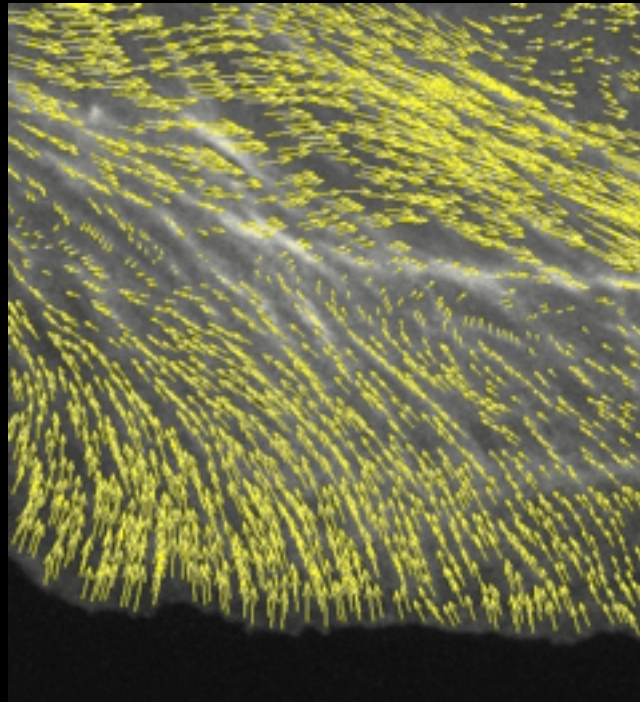
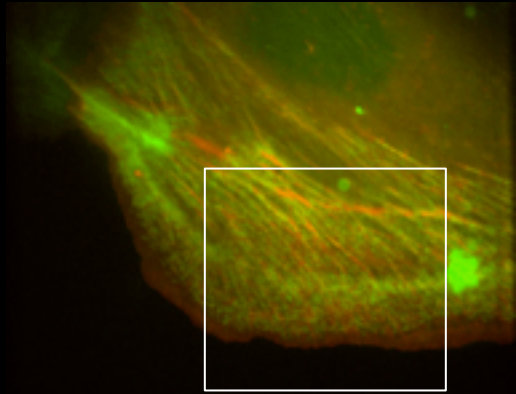
Adhesion Forces



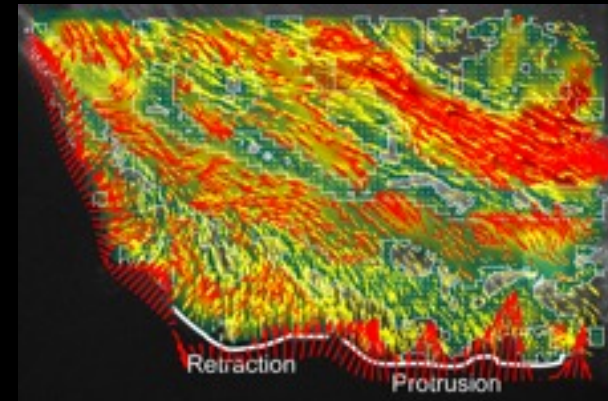
Ji et al. *Methods in Cell Bio*, 2008

Ji et al. *Nature Cell Bio*, 2008

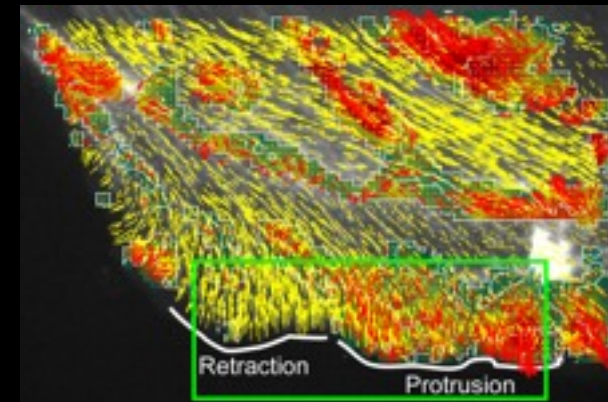
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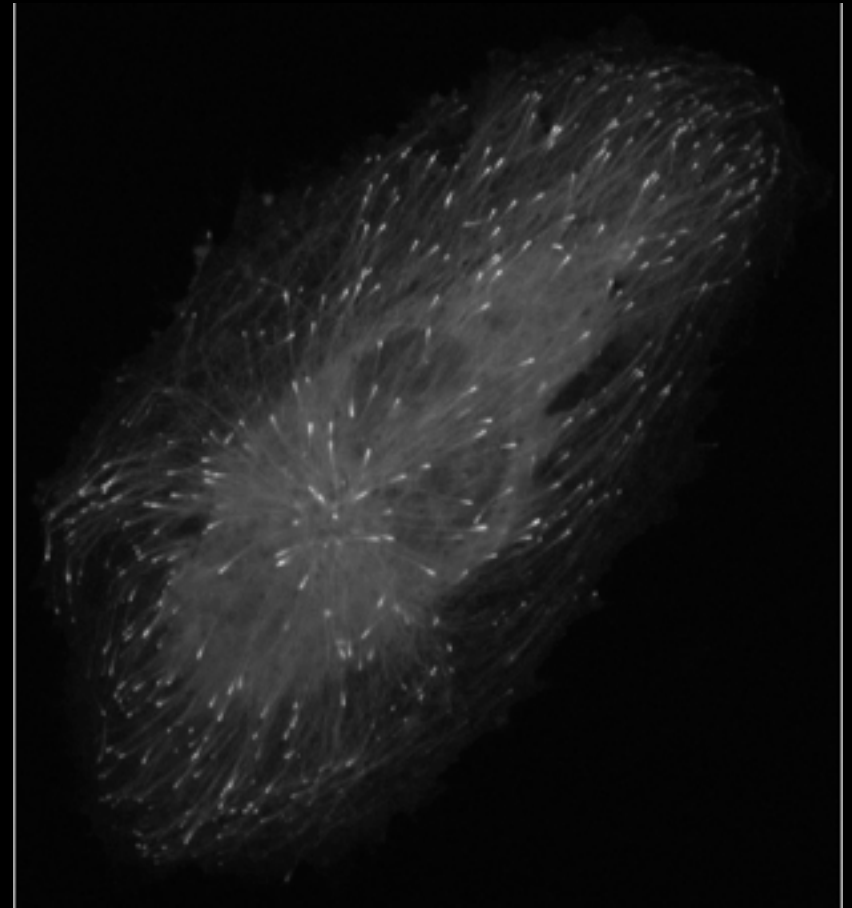
Adhesion Forces



Ji et al. *Methods in Cell Bio*, 2008

Ji et al. *Nature Cell Bio*, 2008

# Tracking the motion of plusTip marked microtubules

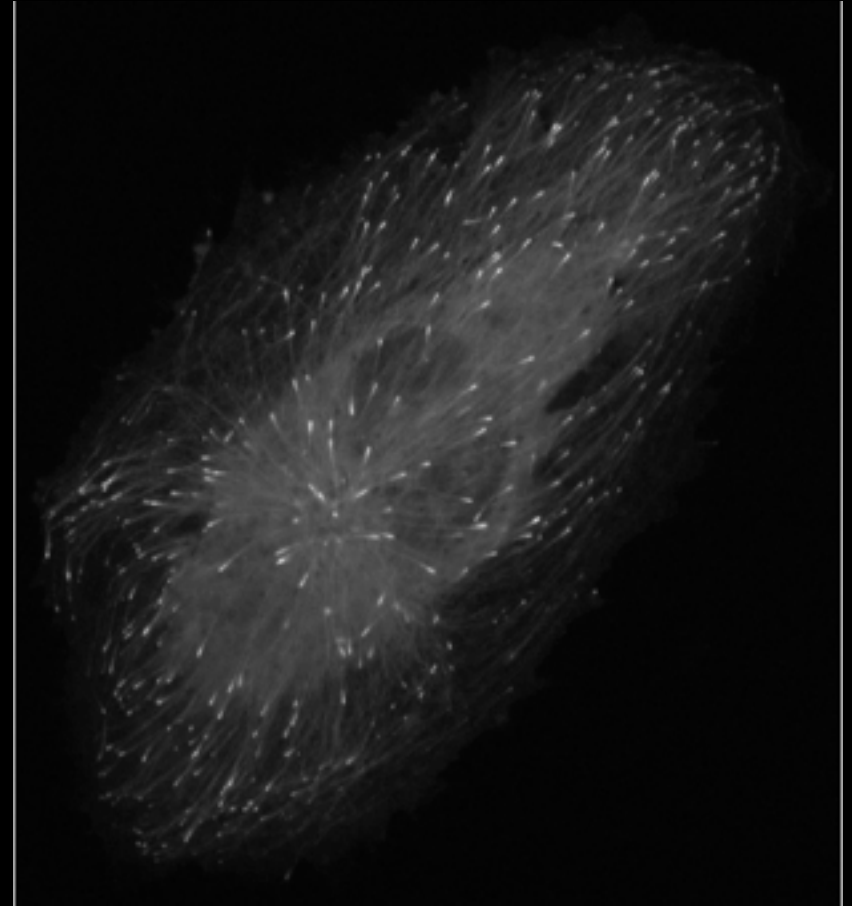
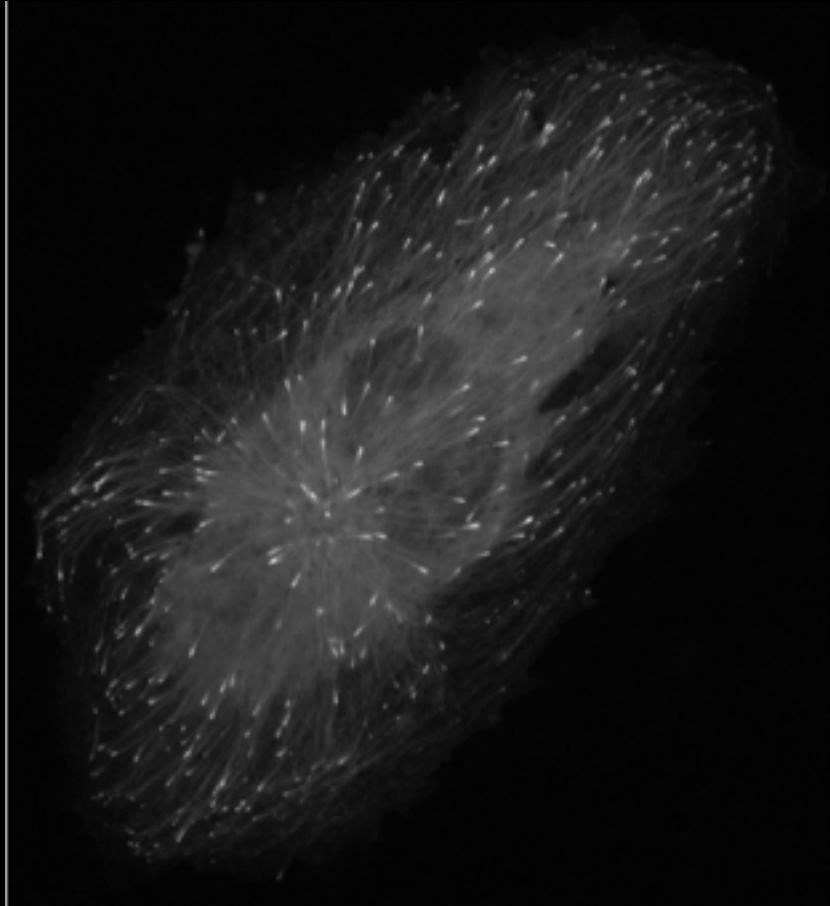


Applegate et al. J. Struct Biol, 2011

- Growth events
- Forward gaps (pauses)
- Backward gaps (shrinkage)



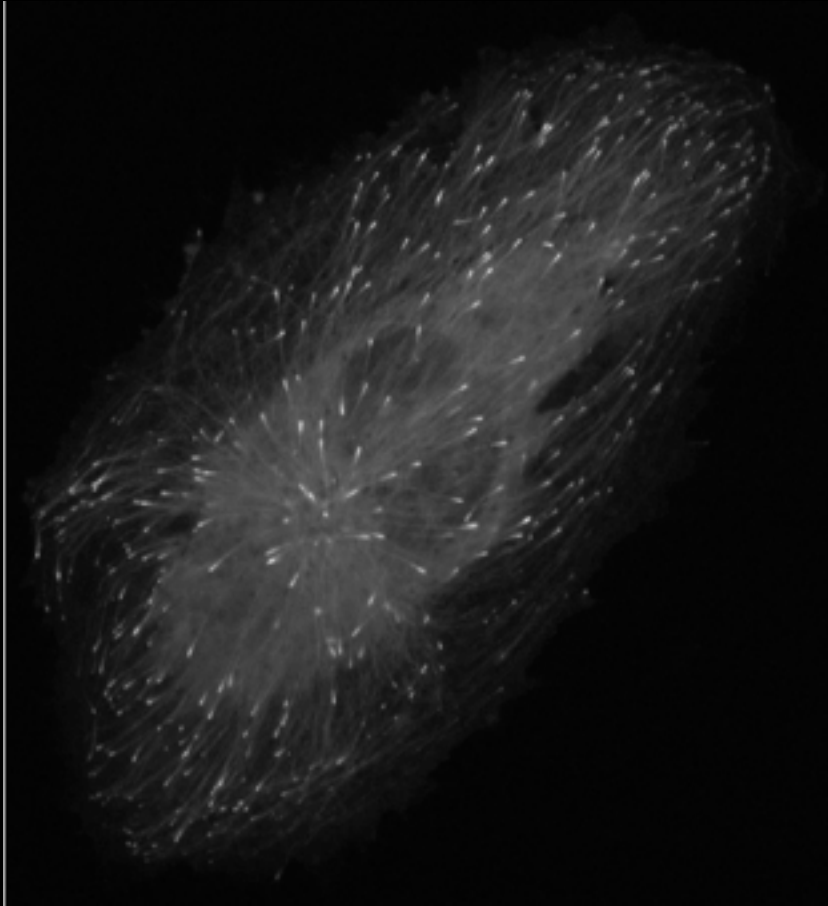
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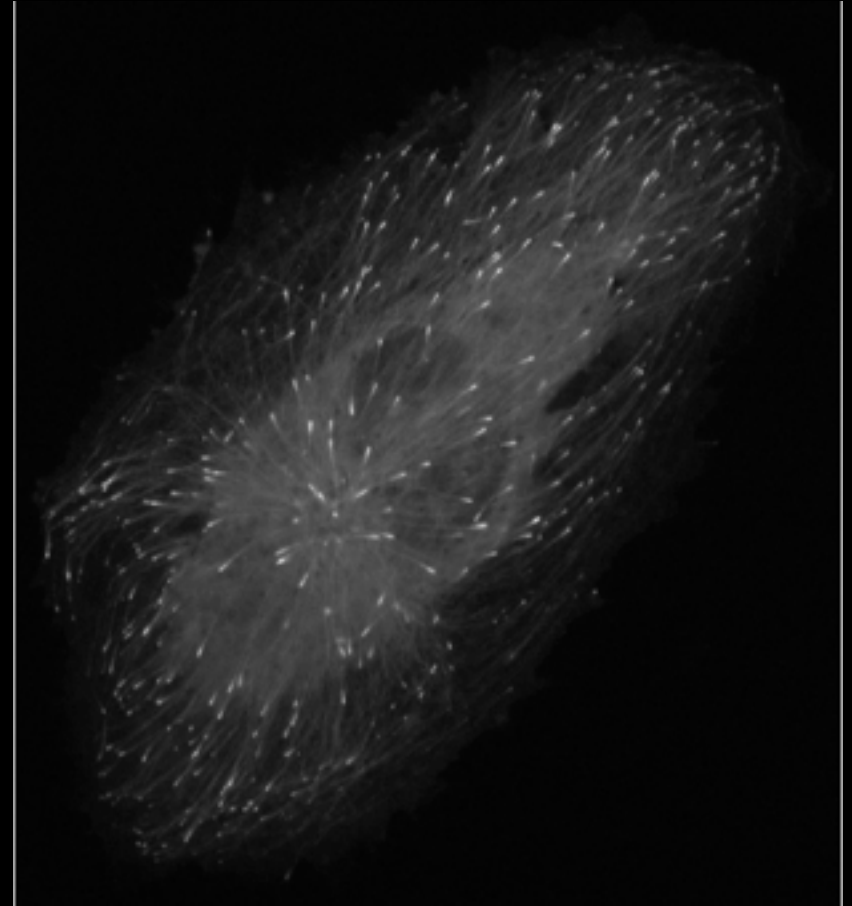
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# Integration into OMERO

Tracking framework



Detection

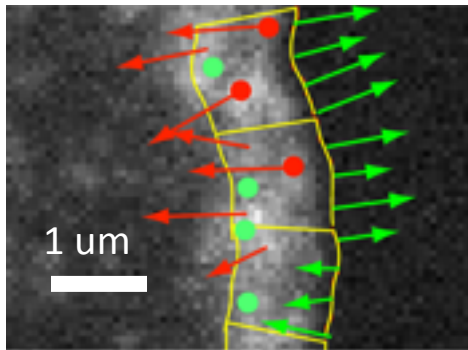
Tracking

Post-  
tracking  
tools

Matlab code under SVN repository



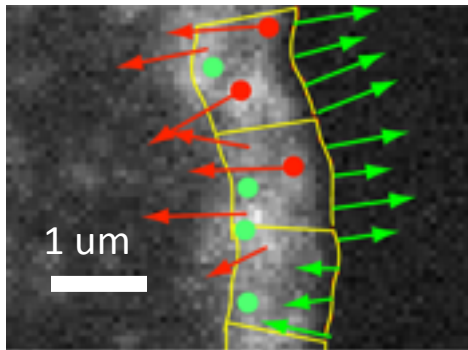
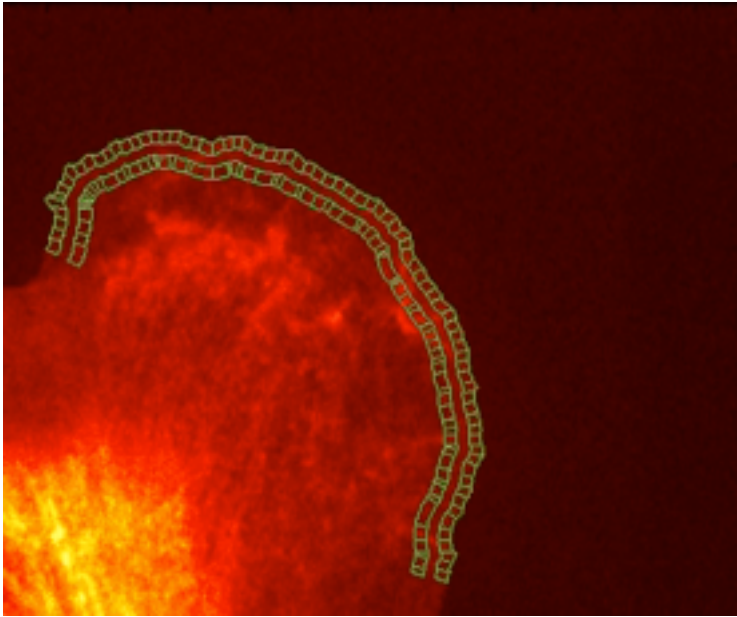
# ImageBlast: Reconstruction of mechanochemical pathway hierarchy and



## Variables

- Protrusion
- ← Actin network flow
- Polymerization
- Depolymerization
- Adhesion dynamics
- Forces
- Signaling activities
- etc ...

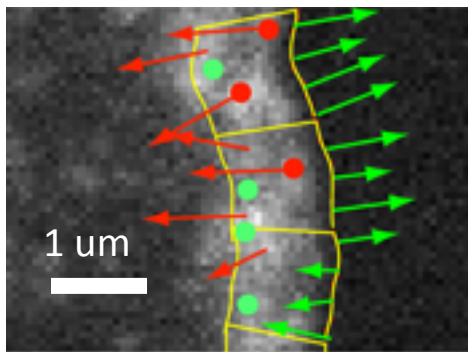
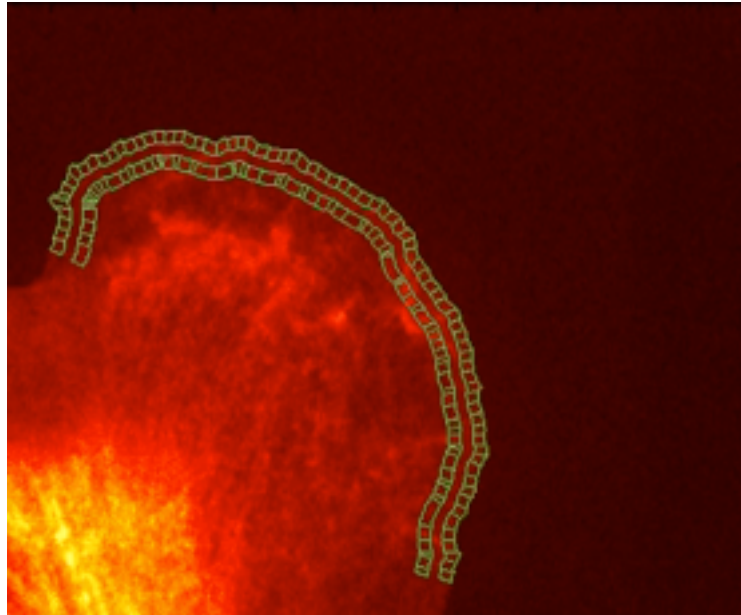
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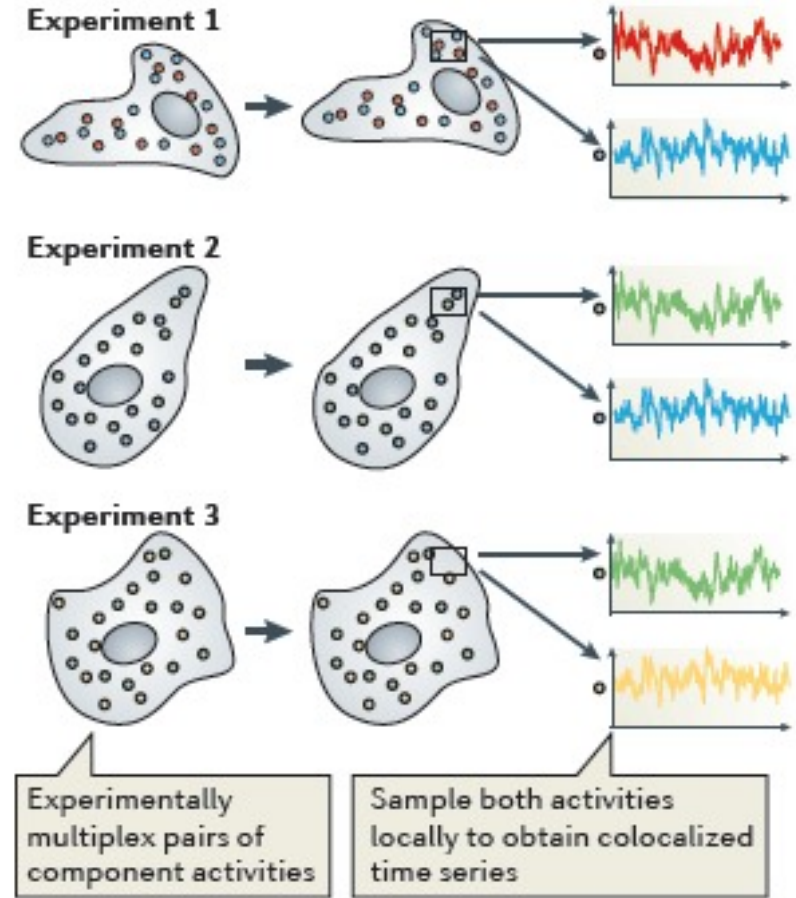
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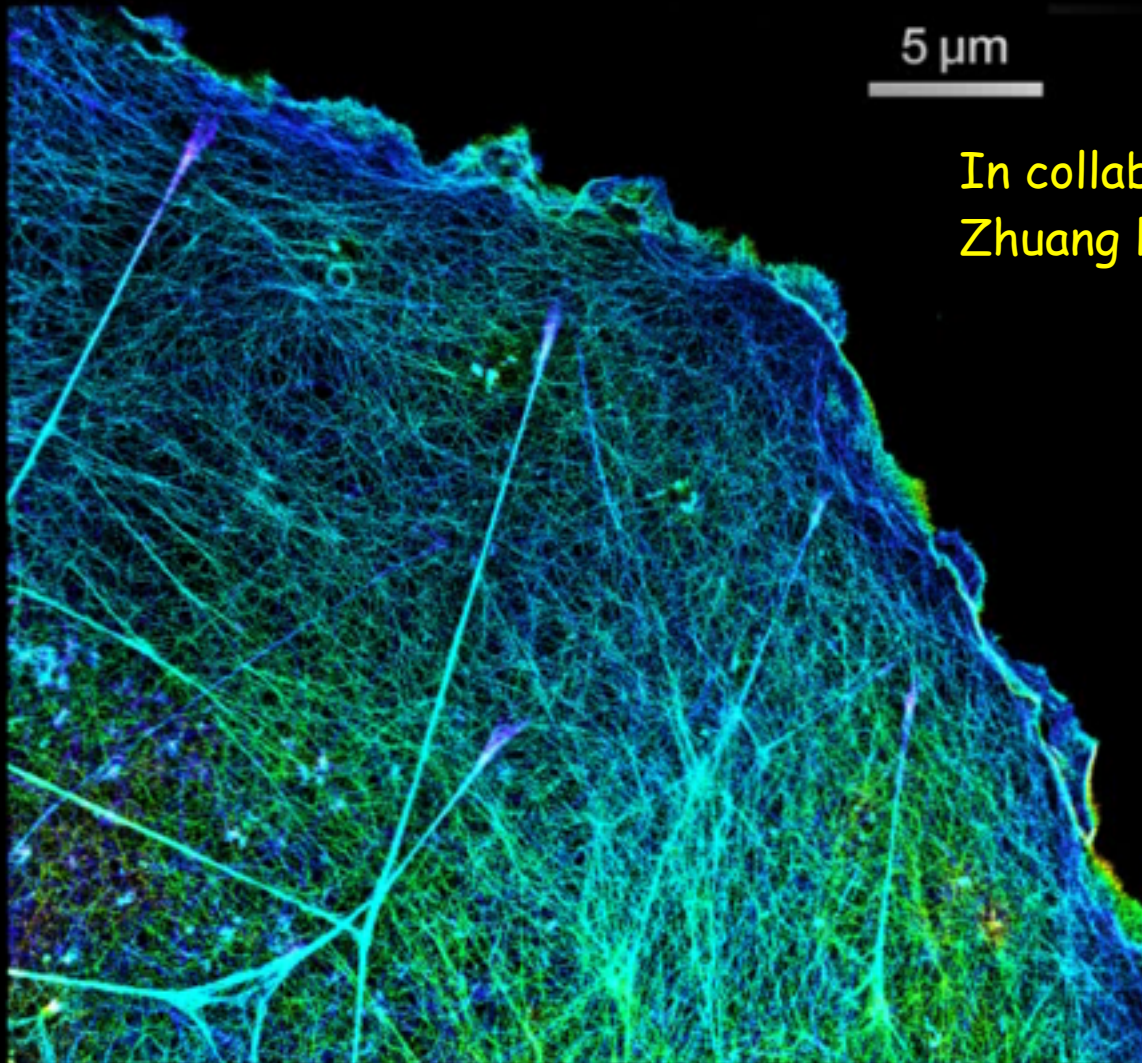
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- Signaling activities
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Welch, Elliott, et al. Nature Rev. Mol Cell Bio, 2011

# Reconstruction of Cytoskeleton Ultrastructure from STORM images



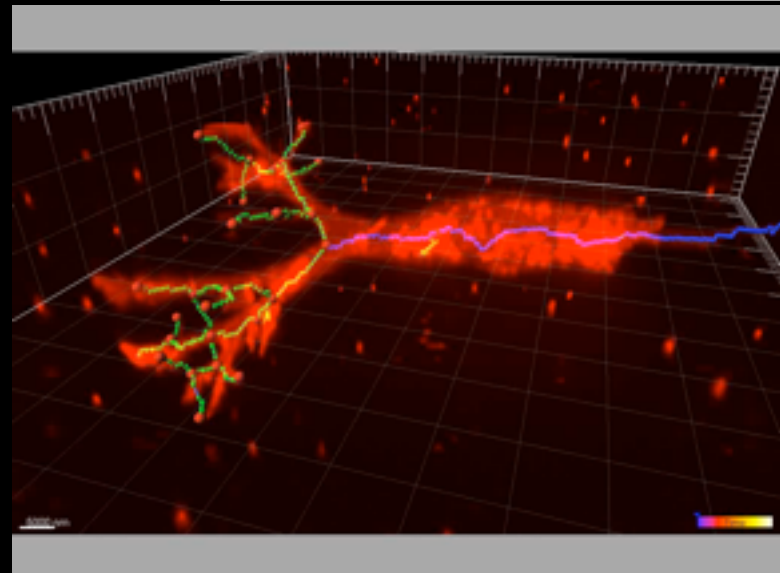
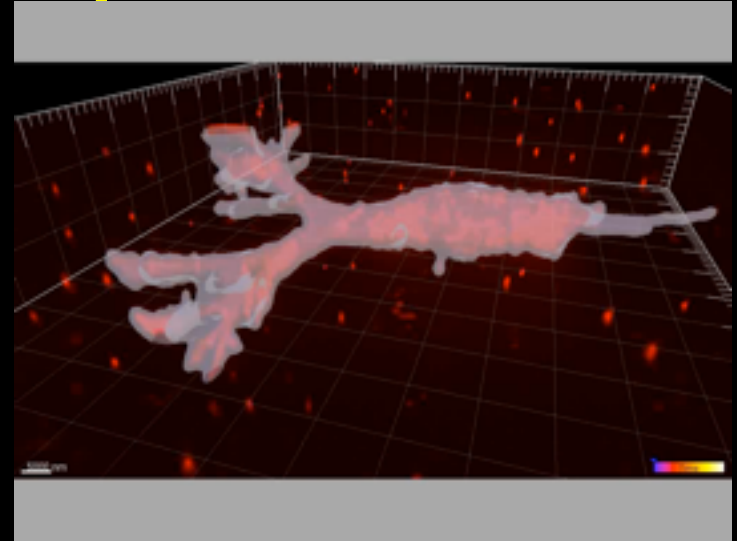
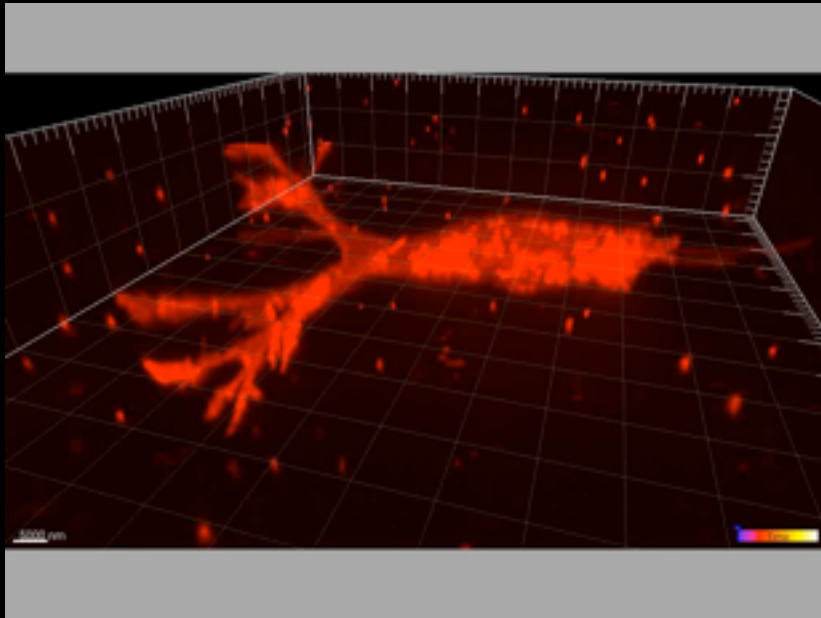
In collaboration with  
Zhuang lab, Harvard



# Endothelial cell migration in physiological explants

In collaboration with  
Waterman lab, NIH

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