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Cellular Mechanics and Tissue Morphogenesis

Positions

Associate Professor, Sackler Faculty of Medicine

Visiting Professor, Mechanobiology Institute,
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Research

Our main interest is in understanding how mechanical forces are generated by cells and how cells use these forces to change shape and move, as happens during cell division, cell migration and tissue morphogenesis. We focus on distinct cellular structures that mediate cell adhesion and contractility: cell-matrix and cell-cell junctions and the actomyosin cytoskeleton. Together, these structures are responsible for the dynamic control of cell and tissue shape during development and homeostasis and their misregulation is associated with various diseases.

We take a multi-scale approach in our investigations, from single proteins to an entire organism, and employ a variety of tools, including genetic engineering, proteomics, biochemistry and bioinformatics, but primarily relying on live imaging with fluorescence microscopy.

Our findings, both in mammalian cells and in the nematode *C. elegans*, are defining the protein

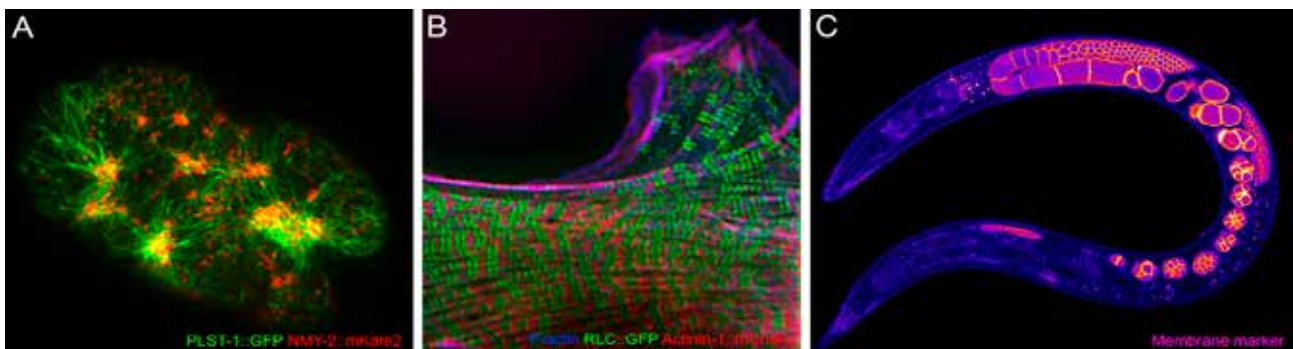
network regulating cell adhesion and contractility in vivo and elucidating molecular mechanisms of mechanosensing and mechanotransduction.

Publications

Ding W-Y, Ong H-T, Hara Y, Wongsantichon J, Toyama Y, Robinson R, Nédélec F, **Zaidel-Bar R**. Plastin increases cortical connectivity to facilitate robust polarization and timely cytokinesis. *Journal of Cell Biology* 216(5): 1371-1386. 2017.

Hu S, Dasbiswas K, Guo Z, Tee Y-H, Thiagarajan V, Hersen P, Chew L, Safran S, **Zaidel-Bar R*** and Bershadsky AD*. Long range self-organization of cytoskeletal myosin-II filament stacks. *Nature Cell Biology* 19(2):133-141. 2017. *corresponding author
Bertocchi C, Wang Y, Ravasio A, Wu Y, Sailov T, Baird MA, Davidson MW, **Zaidel-Bar R**, Ladoux B, Mege RM, and Kanchanawong P. Nanoscale architecture of cadherin-based adhesions. *Nature Cell Biology* 19(1):28-37. 2017.

Padmanabhan A, Ong H-T and **Zaidel-Bar R**. Non-junctional E-Cadherin Clusters Regulate the Actomyosin Cortex in the *C. elegans* Zygote. *Current Biology* 27:1-10. 2017.



Actomyosin-generated forces shape cells and tissues: (A) A contractile actomyosin network at the cortex of a *C. elegans* early embryo. It is essential for cell polarization and division. (B) Actin and myosin self-organize into arrays of parallel stress fibers in a REF52 fibroblast. They are required for cell spreading and adhesion. (C) The germline of *C. elegans*, highlighted by a membrane marker, is like an assembly line for embryos. Actomyosin contractility is essential for maintaining germline architecture and for moving oocytes and embryos along.

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Hu S, Tee YH, Kabla A, **Zaidel-Bar R**, Bershadsky A, Hersen P. Structured illumination microscopy reveals focal adhesions are composed of linear subunits. *Cytoskeleton* 72(5):235-45. 2015.

Budirahardja Y, Doan T, and **Zaidel-Bar R**. Glycosyl phosphatidylinositol anchor biosynthesis is essential for maintaining epithelial integrity during *Caenorhabditis elegans* embryogenesis. *PLoS Genetics* 11(3):e1005082. 2015.

Wu Y, Kanchanawong P, and **Zaidel-Bar R**. Actin-delimited adhesion-independent clustering of E-cadherin forms the nanoscale building blocks of adherens junctions. *Developmental Cell* 32(2):139-54. 2015.

Tan P-Y and **Zaidel-Bar R**. Transient membrane localization of SPV-1 drives cyclical actomyosin contractions in the *C. elegans* spermatheca. *Current Biology* 25(2):141-51. 2015.

Guo Z, Neilson LJ, Hang Z, Murray P, Zanivan S, and **Zaidel-Bar R**. E-cadherin adhesome complexity and robustness resolved by quantitative proteomics. *Science Signaling* 7(354), rs7. 2014.

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Reviews

Sethi K, Cram EJ, **Zaidel-Bar R**. Stretch-induced actomyosin contraction in epithelial tubes: Mechanotransduction pathways for tubular homeostasis. *Semin Cell Dev Biol*. 2017 pii: S1084-9521(17)30176-3. 2017.

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Padmanabhan A, Vaman Rao M, Yao W, and **Zaidel-Bar R**. Jack of all trades: functional modularity in adherens junctions. *Current Opinion in Cell Biology* 36:32-40. 2015.

Zaidel-Bar R, Gou Z, and Luxenburg C. The contractome – a systems view of actomyosin contractility in non-muscle cells. *Journal of Cell Science* 128(12):2209-17. 2015.

Zaidel-Bar R. Cadherin adhesome components and interactions at a glance. *Journal of Cell Science* 126:373-378. 2013.

Grants

2014 –2018 National Research Foundation Singapore: Controlling cell-cell signaling using synthetic biometric interfaces

2016 –2018 Ministry of Education Tier2: Regulation of actomyosin cortex force generation by non-junctional E-cadherin.

2017 –2020 Israel Science Foundation Research grant: Mechanotransduction in contractile tubes: using the *C. elegans* spermatheca as a model to study the regulation of RHO-1- and Ca²⁺-dependent actomyosin contractility in response to stretching.

2017 –2020 Israel Science Foundation Equipment Grant