Serge E. Parent, Ph.D.

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Profile Summary

I am a quantitative cell and developmental systems biologist who completed a Ph.D. in cell-cell adhesion biophysics. Previous biophysical models of cell-cell adhesion were equilibrium-based. In my thesis I found support for an extracellular matrix-based low adhesion state and showed that this combined with cytoskeletal elasticity and turnover are sufficient for describing adhesion as a dynamical system using a combination of mathematical modeling and experimentation. My research interests include topics in systems biology such as how we can model and make sense of complex or data-rich biological systems, how cells build and maintain tissues, and dynamics in biology.

Skills

- Programming with Python in a scientific capacity (*numpy, scipy, pandas, scikit-image, matplotlib, seaborn, uncertainties, statsmodels, pathlib*)
- Mathematical and computational modeling of biological processes (*geometric models, systems of ODEs*)
- Quantitative data analysis, visualization, statistical testing, linear and non-linear regression fitting
- Familiarity with Bash, Linux (*WSL2, Ubuntu*), version control (*Git, GitHub*), environment management (*conda*), and R (*RStudio*)
- Image analysis (*FIJI/ImageJ, scikit-image*)
- Microscopy (*confocal, epifluorescence, dissection, multiphoton, transmission electron; confocal imaging includes multidimensional multichannel fluorescence/CXYZT and subsets thereof*)
- Live and fixed cell and tissue sample preparation (*IHC, ICC, Xenopus and zebrafish embryo microdissection and mRNA microinjection, tissue isolation and dissociation, primary cell culture*)
- Basic molecular biology (*DNA linearization and extraction, mRNA transcription*)
- 3D modeling and 3D printing to create custom experimental tools (*Blender, MakerBot*)
- Scientific article and report preparation (*Word, LaTeX, Inkscape/Adobe Illustrator, FIJI/ImageJ*)
- Scientific communication (*PowerPoint and poster presentations of results*)

Education

- Ph.D. – Cell & Systems Biology (Dev. Biol. focus); *University of Toronto, CA* Sept. 2014 – Oct. 2022
  Thesis: Cell-Cell Adhesion Dynamics & Cortical Tensions in Embryonic Tissue Structure & Mechanics.
- B.Sc. – Cell & Molecular Biology; *University of Toronto, CA* Sept. 2010 – Apr. 2014

Research Experience

Postdoctoral Fellow, Scientist (Casual Contract) Jan. 2023 – June 2023

- designed and executed experiments to address reviewer comments including live confocal and compound microscopy (*XYZT, XYT*) of drug-treated cultured cells, fluorescence confocal imaging of ICC samples (*XYZ*)
- acquired, manipulated, plotted, and ran statistical tests on time series data to determine if a drug affected cell-cell adhesion dynamics between cultured cells
- developed and implemented a method to correct for fluorescence light loss in Z-stacks due to light scattering
- revised manuscript text and figures to address reviewer concerns/criticisms and resubmit paper

Ph.D. Candidate, University of Toronto 2014 – 2022

- designed and executed quantitative microscopy experiments producing multichannel timelapses (*XYZT, XYT*)
- developed and implemented microscopy image analysis pipelines for reproducible, high-throughput data analysis to better understand cell-cell adhesion, contributing to a manuscript resubmitted for peer review
  - cell identification (*blob detection*), segmentation (*watershed*), region labeling, and edge detection (*outlining segmentations, sobel filters, Canny edge detection*) of images in timelapses
  - feature extraction (*edges, ridges, curvatures, lengths, angles, cell centers, fluorescence intensities*)
  - quality control processes (*overlays of input images and cell outlines and measurements, interactive plots, checking outputs for NaNs/inadmissible data, masking and filtering data*)
- performed live microscopy, IHC, and ICC to visualize adhesion-relevant molecules and improve our understanding of cell-cell adhesion, contributing to publications
- developed and implemented computational, mathematical, and bias-correcting approaches in Python to model and understand microscopy-derived biological data, resulting in publications

    - developed a system of differential equations model of cell-cell adhesion showing that elasticity and turnover of the cytoskeleton can explain empirical adhesion kinetics data that I acquired, whereas the previously established model based solely on cytoskeletal contractility could not
    - developed geometric models of interstitial spaces within tissues
    - corrected for elongation of imaged tissue structures from oblique sectioning of samples
- analyzed, visualized, and evaluated data from experiments and modeling to improve our understanding of cell-cell adhesion, contributing to publications
    - non-linear (*logistic*) curve fitting and aligning of time series data, orthogonal distance regressions for fitting arcs to features in images, normalizing data, statistically comparing samples
    - various basic and advanced plots (*line plots, heatmaps, 3D plots, "straightening" outlines of cells to plot their fluorescence data as kymographs, etc.*), visualizing Z-stacks in 3D (*Imaris, FIJI/ImageJ, Blender*)
- communicated results to varied audiences through multiple peer-reviewed publications and poster/oral presentations at departmental, institutional, and international meetings

Teaching Experience

Teaching Assistant, University of Toronto 2014 – 2020

- 6 semesters leading groups of ∼24 students through scientific seminars, lab experiments, and oral presentations (*incl. courses in Developmental Biology, Cell and Molecular Biology*)
- 2 semesters mentoring a 4th-year project student doing experiments I designed, contributing to a manuscript
- 2 semesters organizing and assessing large groups of ∼50–200 students (*Stem Cell Biology course*)

Awards

- (National Award) NSERC C-GSD Alexander Graham Bell Scholarship Sept. 2018 – Dec. 2020
- (Provincial Award) Ontario Graduate Scholarship Jan. 2018 – Aug. 2018
- (Departmental Award) Yoshio Masui Prize in Development, Molecular or Cell Biology Jan. 2018

Publications

- **Parent, S. E.**, O. Luu, A. E. E. Bruce, R. Winklbauer. *Resubmitted to Developmental Cell.* Two-phase kinetics and cell cortex elastic behavior in *Xenopus* gastrula cell-cell adhesion.
- Fei, Z., K. Bae, **S. E. Parent**, K. Goodwin, G. Tanentzapf, A. E. E. Bruce. 2019. A cargo model of yolk syncytial nuclear migration during zebrafish epiboly. *Development* 146(1): dev169664. DOI: 10.1242/dev.169664.
- **Parent, S. E.**, D. Barua, R. Winklbauer. 2017. Mechanics of fluid-filled interstitial gaps. I. Modeling gaps in a compact tissue. *Biophys. J.* 113(4): 913–922. DOI: 10.1016/j.bpj.2017.06.062.
    **This work was recommended in Faculty Opinions as being of importance by Francois Fagotto.*
- Barua, D., **S. E. Parent**, R. Winklbuaer. 2017. Mechanics of fluid-filled interstitial gaps. II. Gap characteristics in *Xenopus* embryonic ectoderm. *Biophys. J.* 113(4): 923–936. DOI: 10.1016/j.bpj.2017.06.063.
    **This work was recommended in Faculty Opinions as being of importance by Francois Fagotto.*
- Winklbauer, R., **S. E. Parent**. 2017. Forces driving cell sorting in the amphibian embryo. *Mech. Dev.* 144(Pt A): 81–91. DOI: 10.1016/j.mod.2016.09.003.
- Luu, O., E. W. Damm, **S. E. Parent**, D. Barua, T. H. L. Smith, J. W. H. Wen, S. E. Lepage, M. Nagel, H. Ibrahim-Gawel, Y. Huang, A. E. E. Bruce, R. Winklbauer. 2015. PAPC mediates self/non-self-distinction during Snail1-dependent tissue separation. *J. Cell Biol.* 208(6): 839–856. DOI: 10.1083/jcb.201409026.
    **This paper has been featured in a JCB Biosights video, been chosen as part of a JCB Journal Club package, had a commentary article written about it by David Wilkinson, and been recommended in Faculty Opinions as being of special significance in its field by Patrick Tam and Ira Daar.*

Conferences and Workshops

- **Parent, S. E.***, A. E. E. Bruce, R. Winklbauer. (Jul. 26–30, 2019). A biophysical analysis of cell-cell adhesion in the *Xenopus* gastrula. Presented at: Society for Developmental Biology 78th Annual Meeting. Boston, MA. (International conference; poster presentation).
- **Parent, S. E.***, A. E. E. Bruce, R. Winklbauer. (Jul. 13–17, 2017). Exploring tissue separation at Brachet's Cleft at the level of individual cell pairs. Presented at: Society for Developmental Biology 76th Annual Meeting. Minneapolis, MN. (U.S. conference; poster presentation).
- **Parent, S. E.***, A. E. E. Bruce, R. Winklbauer. (Aug. 4–8, 2016). Exploring the mechanobiology of Brachet's Cleft at the level of individual cell pairs. Presented at: Society for Developmental Biology 75th Annual Meeting.

Boston, MA. (International conference; poster presentation).
- Participation in Connaught 3D Bioprinting Workshop. (Aug. 2016).
- 5 other oral presentations of results at departmental and institutional events

**Presenting author.*

Community Service

- Hosted Prof. Ray Keller as a visiting speaker (Oct. 5, 2017)
- Reviewed 2 papers with Prof. Winklbauer for *Biophysical Journal* and *Mechanisms of Development*