Embryogenesis in *Drosophila* imaged by gradient light interference microscopy (GLIM)

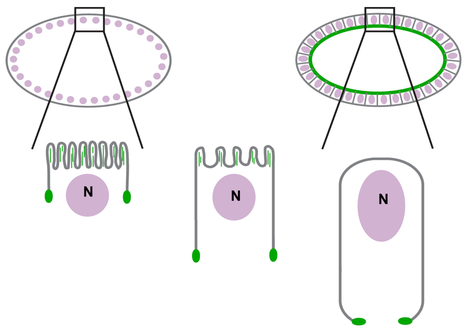
Xi Chen[1], Poonam Sehgal[2], Shrunali Jyotindrakumar Amin[2], Anna Marie Sokac[2], Gabriel Popescu[1]

[1]Quantitative Light Imaging Laboratory, Beckman Institute for Advanced Science and Technology, Department of Electrical and Computer Engineering, University of Illinois at Urbana-Champaign, USA

[2]Illinois School of Molecular & Cellular Biology, College of Liberal Arts and Sciences, University of Illinois at Urbana-Champaign, USA

Introduction

The embryo of the fruit fly, *Drosophila melanogaster*, is amongst the most powerful experimental models in biological research, often providing first insights into processes including gene expression, cell cycle control, cell fate determination, signaling and morphogenesis. We use gradient light interference microscopy (GLIM) to image the early stages of *Drosophila* embryogenesis. This label-free imaging method allows visualization of organelle dynamics, as well as cell shape change and nuclear shape change, in the context of live unperturbed embryos. We segmented the nuclei during the process of cellularization, which takes ~one hour. The nuclear count, their migration, and dry mass change were monitored throughout this cellularization. To our knowledge, this is the first time that dry mass changes of nuclei have been quantified in these embryos by label-free imaging.



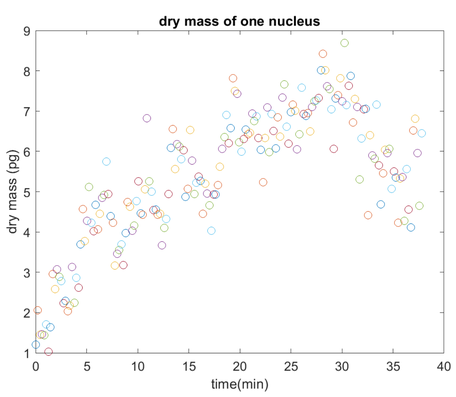
Schematic of cellularization in a *Drosophila* embryo where plasma membrane furrows (gray) simultaneously ingress between ~6000 nuclei (purple) to form a sheet of mononucleate cells. This event takes one hour; final cell length is 35 μm.

Goals

- To study cellularization, the first tissue building event in *Drosophila* embryos, with a label-free imaging method, GLIM
- To study how nuclear drymass changes with nuclear size and DNA content following genome replication in developing *Drosophila* embryos

Conclusion

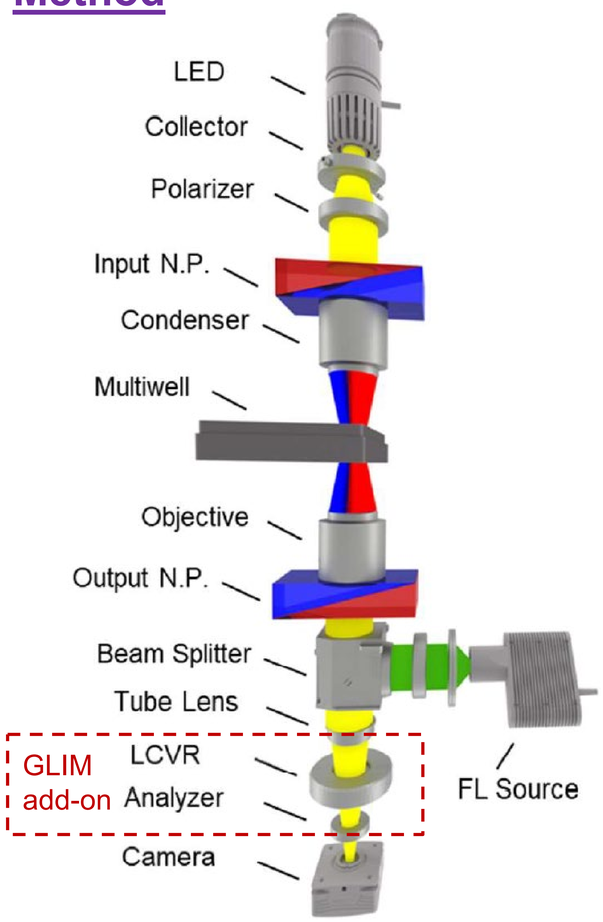
- The dry mass of the nuclei is increasing until around 30 minutes in cellularization, then decreasing.
- This increase in nuclear dry mass is coincident with both an increase in nuclear size and genome replication. Genetic and pharmacological perturbations can now be applied to ask how nuclear size change and replication contribute to the dry mass change.

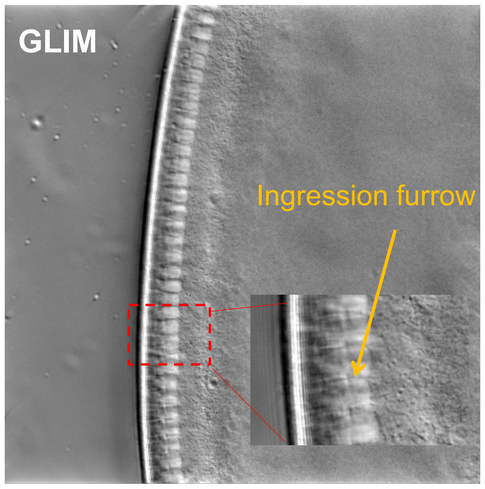


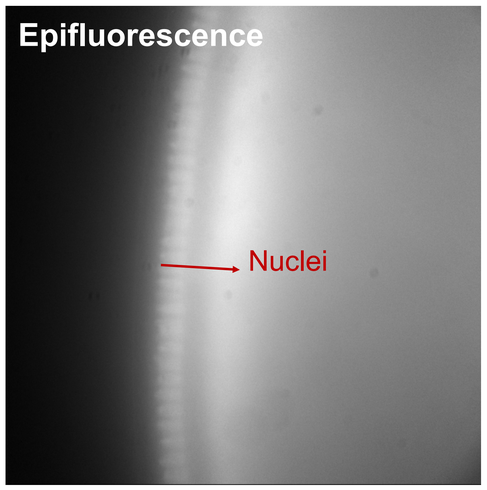
Future work

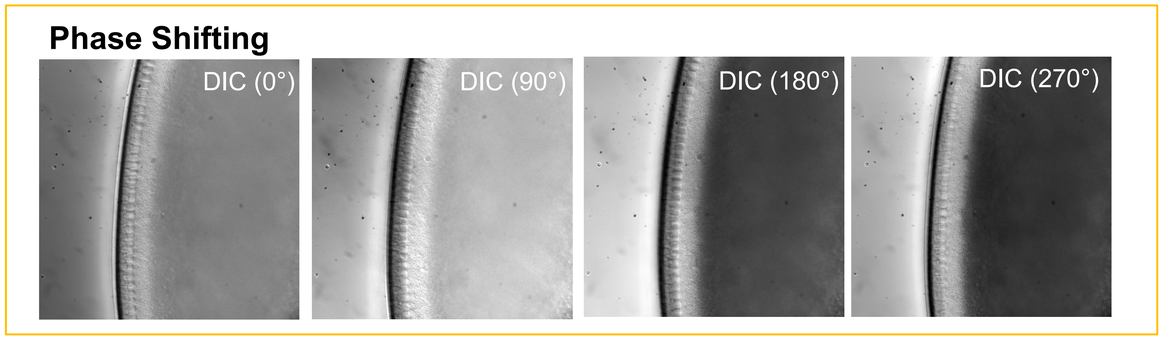
- Adding confocal capabilities to GLIM for deep tissue imaging
- Using deep learning to identify nuclei automatically

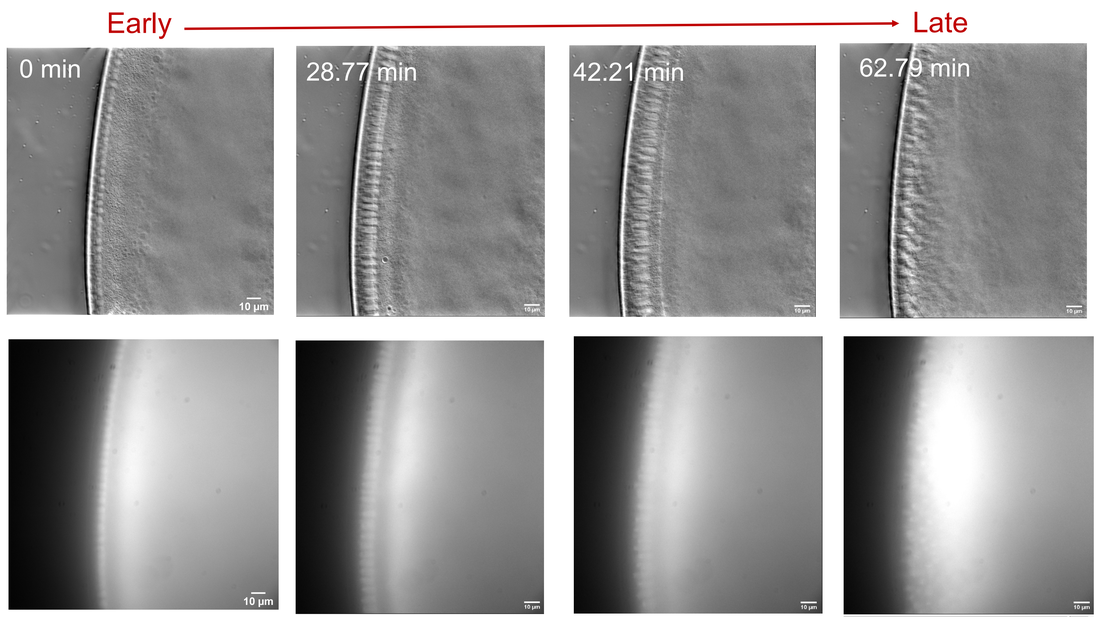
Method











References

1. Nguyen, T.H., et al., *Gradient light interference microscopy for 3D imaging of unlabeled specimens.* Nature Communications, 2017. **8**(1): p. 210.

Acknowledgments

OPTICS from image to knowledge
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