Understanding how active fluid flow shapes embryos

Sebastian Gonzalez[1], Dillon Cislo[2] ,Dr. Sebastian Streichan[3]
University of California Santa Barbara[1], Department of Physics
Center for Engineering and Science Partnerships

Introduction

- Currently, we posses qualitative understanding of the processes that govern developmental activity. However, there are still unanswered questions regarding the dynamics that dictate an organism's shape.
- Through analyzing the flow of an active fluid we seek to explain embryonic development

Methods

Multiview light sheet microscope

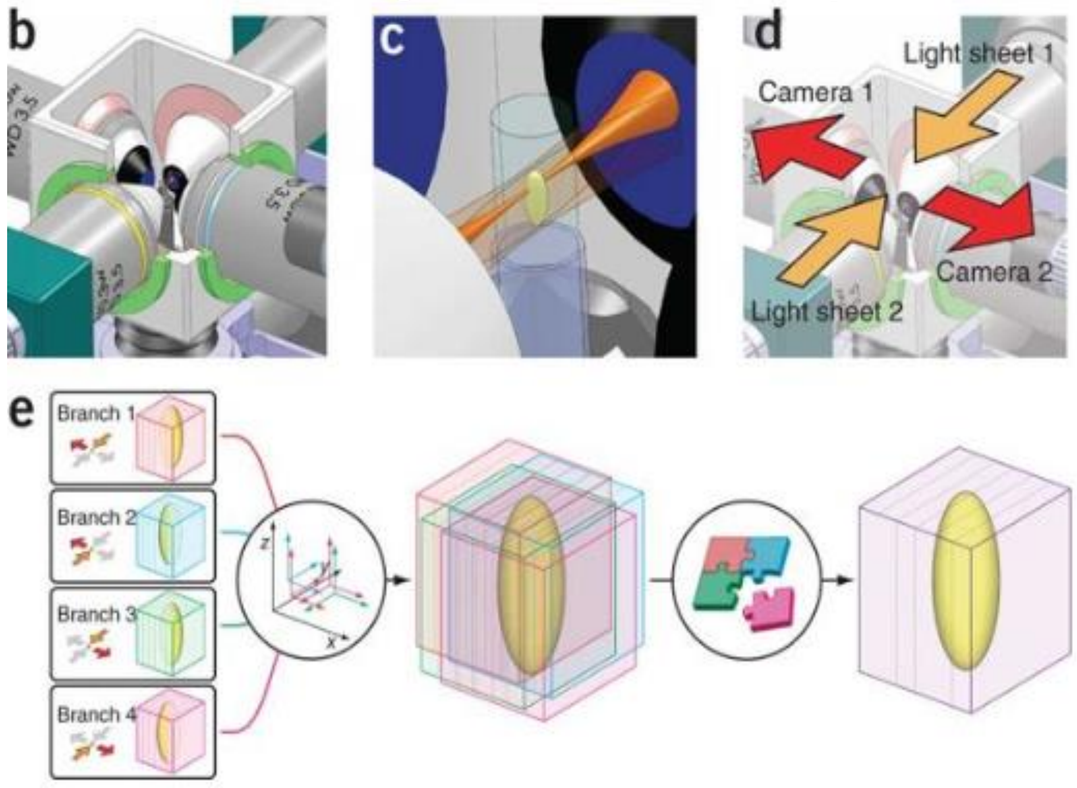


Figure 1. Visual explanation of Multiview SPIM microscope operation
Krzic, Gunther, Saunders, Streichan and Hufnagel .(2012). Multiview light-sheet microscope for rapid in toto imaging. *Nature Methods*, Vol. 9, p. 730-733.

Particle Image Velocimetry (PIV)

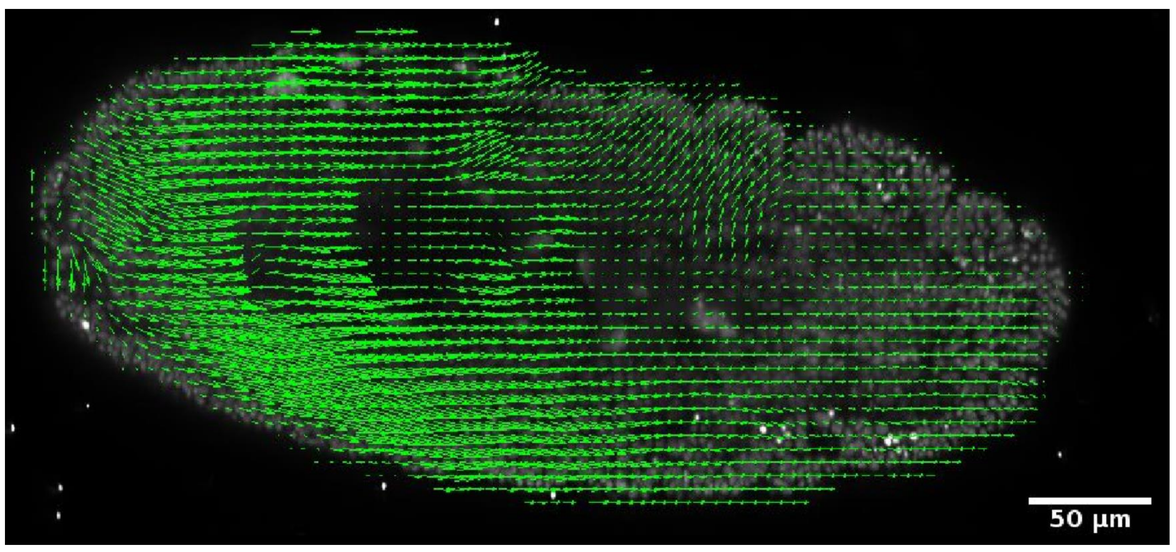


Figure 2. Velocity field (xy – plane) of embryo at 280th min of development (above)

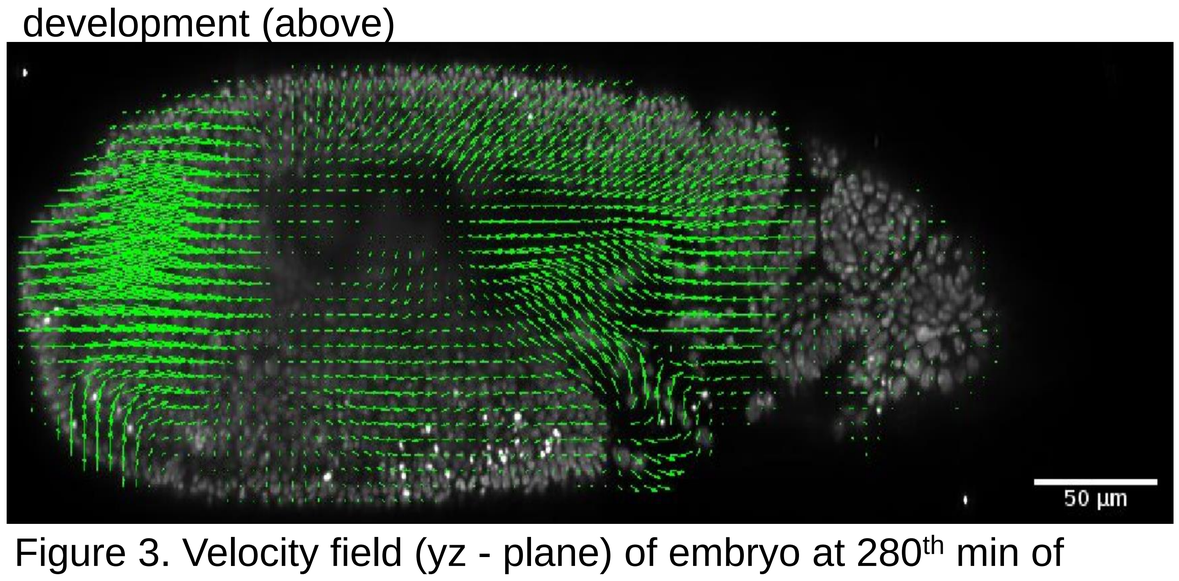


Figure 3. Velocity field (yz - plane) of embryo at 280th min of development (above)

Visualizing the fluid flow

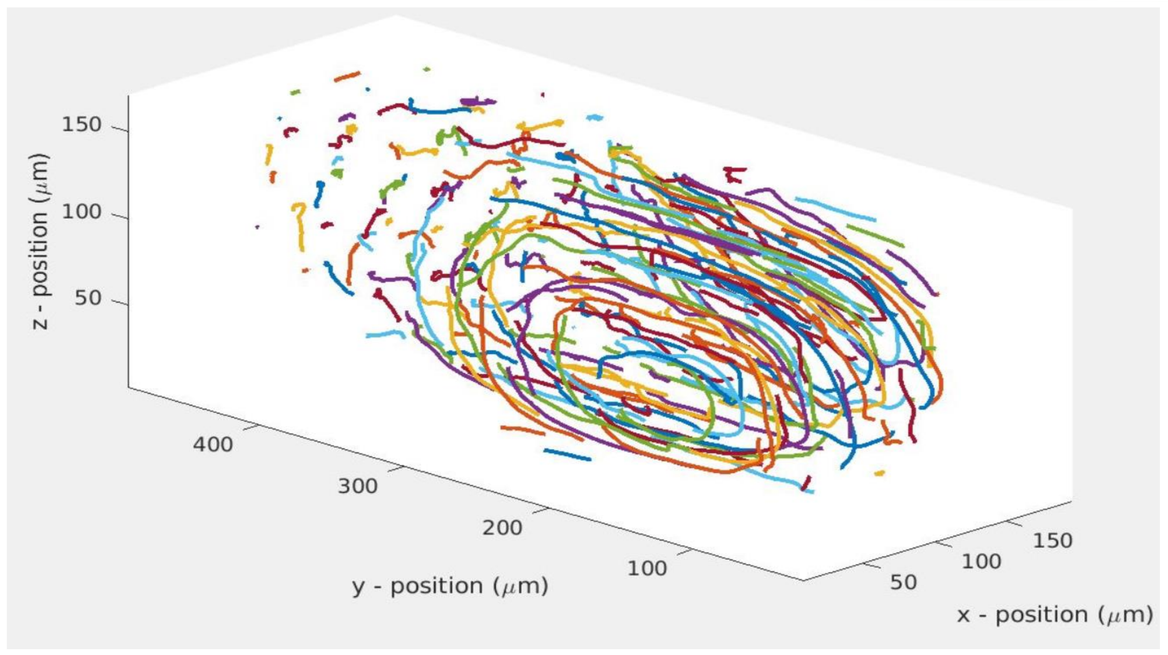


Figure 4. Integrated flow lines between the 280th and 300th min of embryonic development (above)

- Streamlines enable visualization of fluid, here can see very easily how cells swirl in the posterior region of the embryo

Average vorticity of fluid predicts germ-band extension and contraction

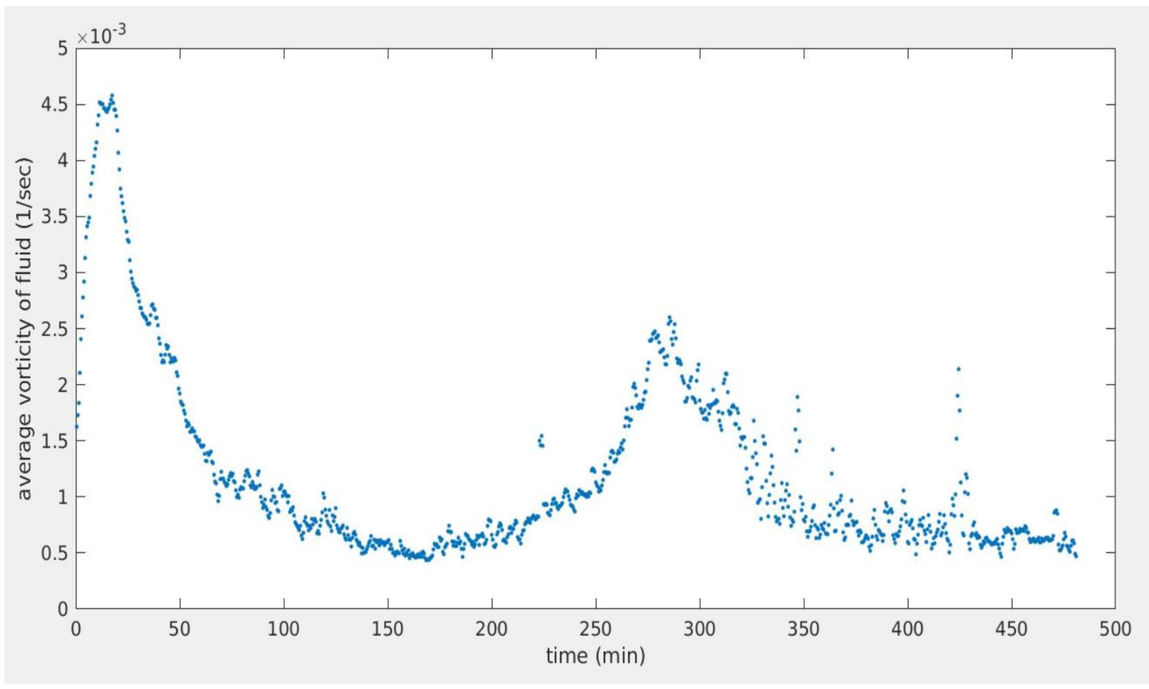
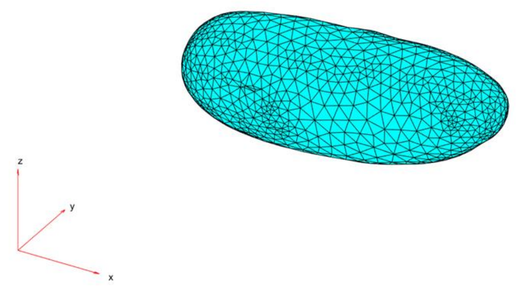


Figure 5. Graph of average vorticity of fluid at different minutes of development.

- We observe how the average vorticity of the fluid signals germ-band extension and contraction

Further steps



- Implement Finite Element Method
- Interpret calculations
- Are the surface and bulk dynamics coupled?

Figure 6. Mesh designed to discretize the embryo structure and later implement it in Finite Element Method

Acknowledgements

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