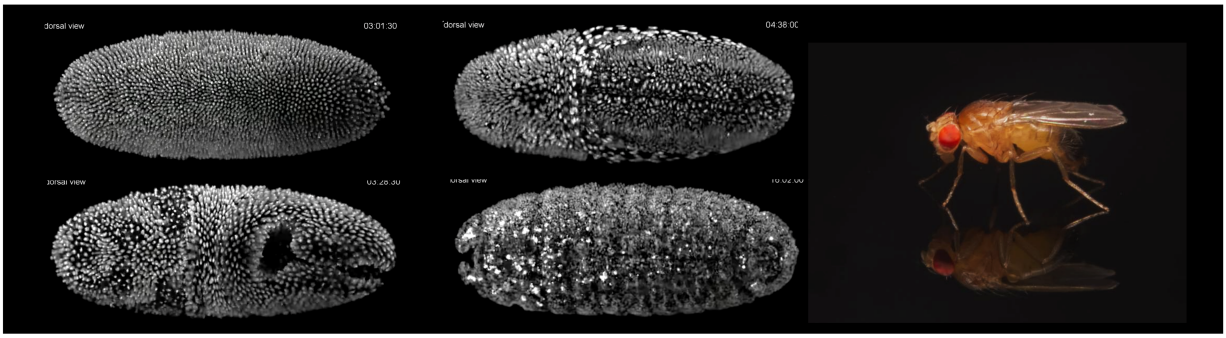
ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

CRL
Computational Robotics Lab

Master Thesis

FlyGNN: Graph Neural Networks for Understanding Gastrulation in Drosophila Melanogaster



Introduction

Gastrulation is a critical phase in early embryonic development, where cells undergo complex, coordinated movements to form the fundamental layers that give rise to an organism's body structure. Understanding the mechanisms of gastrulation in Drosophila (fruit flies) can provide insights into broader biological processes and developmental disorders.

Combining cutting-edge machine learning with developmental biology, this project aims to harness the power of Graph Neural Networks (GNNs) to model and analyze the complex cell-cell interactions and movement patterns during Drosophila gastrulation. GNNs are particularly well-suited for this task as they can represent individual cells as nodes and their interactions as edges, making it possible to capture the dynamic spatial relationships within the developing embryo.

Tasks

- Develop GNN-based models to simulate and analyze the cellular interactions during gastrulation.
- Leverage real-world biological datasets (temporally dense 3D reconstructions) to train and validate your models.
- Investigate how specific cellular behaviors, such as migration and shape changes, contribute to the overall morphogenetic process.
- Explore how GNNs can offer new insights into the factors driving successful or abnormal gastrulation.

Requirements

- Strong interest in machine learning, particularly in graph-based methods.
- Proficiency in Python and experience with machine learning frameworks (e.g., PyTorch, TensorFlow).
- Familiarity with developmental biology or an interest in learning about the biological processes behind gastrulation.

Remarks

This thesis is overseen by Prof. Dr. Stelian Coros and is supervised by Dr. Bernhard Thomaszewski.

Contact

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