## PhD Oral Defense

**Date: 3 August 2021 (Tuesday)** **Time: 10:00 am**

## Thesis Title

**Morphological Segmentation and Analysis of *Caenorhabditis elegans* Embryo Based on Deep Learning**

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## Abstract

The invariant development and transparent body of the nematode *Caenorhabditis elegans* enable the complete delineation of cell lineages throughout its development. Despite extensive studies on cell division, cell migration and cell fate differentiation, cell morphology has not yet been systematically characterized in any metazoan, including *C. elegans*. Although recent advances in confocal microscopy have promoted in vivo four-dimensional imaging of the *C. elegans* embryo throughout the embryogenesis, the large quantity of volumetric image data makes the visual identification of meaningful morphological changes cumbersome. In this study, we performed high-throughput analysis of *C. elegans* to capture the diversity of morphological features. A semi-automatic workflow was designed to efficiently construct 3D embryo dataset at the early stage. In order to leverage the segmentation performance on densely packed cells, a deep learning based pipeline CShaper was proposed to recognize fluorescently labeled membranes through a distance regularized learning process. Thereafter, 19 *C. elegans* embryos were segmented and standardized up to 350-cell stage. By analyzing this large-scale morphological atlas of *C. elegans* cells, we demonstrate the cell-fate asymmetry regarding cellular shapes, which paves the way to deciphering several biological processes in both developmental and cell biology, such as cell-cell communication and morphogenesis.