STEVENS
INSTITUTE OF TECHNOLOGY
1870

Ph.D. DISSERTATION DEFENSE

Candidate:	Tianqi Fang
Degree:	Doctor of Philosophy
School/Department:	Charles V. Schaefer, Jr. School of Engineering and Science / Department of Biomedical Engineering
Date:	Monday, April 20th, 2026
Time/Location:	2:30 p.m. / McLean 510
Title:	Computational Methods and System Control for Optical Coherence Tomography in Dynamic and Functional Bioimaging
Chairperson:	Dr. Shang Wang, Department of Biomedical Engineering, School of Engineering and Science
Committee Members:	Dr. Hongjun Wang, Department of Biomedical Engineering, School of Engineering and Science Dr. Simon Mahler, Department of Biomedical Engineering, School of Engineering and Science Dr. Hong Man, Department of Electrical and Computer Engineering, School of Engineering and Science

ABSTRACT

Optical coherence tomography (OCT) provides unique imaging scale and speed that allow for dynamic and functional studies of biology on the tissue and cell levels. This dissertation centers on OCT-based technical development for studying the embryo transport process inside the oviduct (or fallopian tube) and also for achieving photothermal imaging and bioprinting.

Understanding how the mammalian oviduct transports preimplantation embryos toward pregnancy is key to uncovering the functional cause of oviduct-related reproductive disorders, such as tubal ectopic pregnancy. Toward this end, this dissertation focuses on computational analysis based on *in vivo* 4D (3D+time) imaging of the mouse oviduct and establishes novel methods to assess the dynamics of the embryo transport process. Specifically, a new 3D particle streak velocimetry method is developed for quantitative imaging of the fast, bi-directional embryo movement inside the oviduct, and a semi-supervised, AI-assisted image processing pipeline is developed to efficiently characterize the oviduct contractile strain and function. These methods lay the groundwork for high-throughput dynamic studies of the oviduct biomechanics *in vivo*.

The other part of this dissertation contributes to the optical system development for photothermal cell imaging and high-resolution photothermal stereolithography bioprinting. In particular, two system control programs are designed, built, and applied for laser beam scanning, which enable photothermal OCT imaging of targeted cells in 3D and OCT-guided photothermal stereolithography bioprinting.