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Ph.D. DISSERTATION DEFENSE

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Title:	Deep Learning-based Segmentation in Coronary Optical Coherence Tomography Images
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ABSTRACT

The presence of plaques, including lipid accumulations and calcifications, serves as a critical marker for atherosclerosis, a significant risk factor for various cardiovascular disease. Accurately identifying these plaques within coronary arteries is essential for the diagnosis and treatment of coronary artery disease (CAD). Optical coherence tomography (OCT) emerges as an advanced optical imaging technique adept at visualizing plaque characteristics such as homogeneous regions, well-defined borders, and signal-poor appearances. Deep learning-based segmentation holds promise for automating plaque identification, enhancing OCT image analysis efficiency compared to traditional manual methods, and facilitating quicker, more precise analysis. Despite these advancements, challenges in artifacts, limited magnification, and imperfect training data persist in this field. This dissertation focuses on three primary enhancements to improve deep learning-based plaque segmentation in human coronary OCT images: Firstly, enhancing OCT image quality by removing saturation artifacts that obscure critical tissue details, thereby improving visibility and enabling more precise analysis. Secondly, improving resolution capabilities for small regions through magnification techniques to better capture and characterize plaques of various sizes. Thirdly, enhancing segmentation label quality through a label correction strategy to refine training data, ensuring more consistent and accurate information for training robust deep learning models. Extensive experiments and results from this dissertation study demonstrate that these strategic enhancements successfully improve plaque segmentation in coronary OCT images, thereby advancing the development of more reliable and efficient image analysis tools and holding the potential in aiding the diagnosis and treatment of CAD. The generalizability of this study, particularly the feasibility of extending magnification and label correction techniques to broader medical image analysis contexts, are discussed and validated across diverse medical scenarios.