

ABSTRACT

Cardiovascular health issues are among the leading causes of fatalities across the globe. Despite massive advancements in the research on heart tissue and connected blood circulation systems, complexity of Heart still has many unlocked myths. Inter-disciplinary study including Computational Fluid Dynamic Models alongside emerging Diagnostic techniques coupled with state-of-the art algorithms based on predictive models are important components of Clinical Decision Support Systems nowadays. Numerous imaging technologies are being employed to study the heart function; however, there is still a need of enhanced resolution for better visibility of lesion development / growth in Coronary Arteries. Optical Coherence tomography is one of such kind emerging imaging modality being practiced worldwide to visualize the intra-coronary plaques along with their tissue type in order to initiate the proactive measures after high definition diagnostic process. Typical OCT machines are catheter based which pulls back to generate intracoronary video using variable light source. These videos are observed by the clinicians to highlight the Minimum Lumen Diameter (MLD) for identifying the plaque. High resolution OCT frames have marked the birth of a new research domain aimed at automating the diagnostic process. Automation of Frequency Domain OCT can provide a better alternative for the plaque characterization than manual detection. Artificial Intelligence has evolved by leaps and bounds during the past decade, finding its utility in almost all data oriented and automation domains. Machine and Deep Learning techniques are now being employed to Biomedical Imaging for better insight and highly reliable diagnosis of various diseases. Deep Learning based Intra-Coronary plaque classification using FD - OCT in patients having stenosis can prove instrumental in early identification and thus treatment of CAD (Coronary Artery Disease). In this research problem, an endeavor has been made to utilize the Dataset of patients having stenosis obtained through FD – OCT at Galway Institute in developing a reliable Deep Learning Based Classifier to characterize the Vulnerable and Non-Vulnerable Plaques. Further, to capitalize on the study a custom Neural Network Architecture has been proposed using a customized Neural Network as Feature extractor and SVM (Support Vector Machine) for classification. Another venue explored during the course of research was to design a predictor / estimator based on Deep Learning based Regression Model to estimate the value of FFR merely through the FD –OCT frames as input. Python IDEs with cloud and local hardware resources have contributed towards achieving the research goals i.e. achieving $> 90\%$ classification accuracy on the proposed Model and < 0.40 Mean Squared Error for the Regression Model. Major impediment in further optimization of the results lies in the paucity of clean cardiovascular disease data, as being encountered by most of the researchers venturing the domain of Heart Diseases.