Fluorescein angiogram is a medical procedure that helps the ophthalmologists to diagnose proper treatment or monitor the status of the retinal blood vessels. The research is motivated by blood vessel segmentation of the retina. Retinal vessel segmentation has been a major challenge and has long drawn the attention of researchers for decades due to the presence of complex blood vessels with varying size, shape, angles and branching pattern of vessels, and non-uniform illumination and huge anatomical variability between subjects. In this thesis, we introduce a new computational tool that combines deep learning based machine learning algorithm and a signal processing based video magnification method to support physicians in analyzing and diagnosing retinal angiogram videos for the first time in the literature. The proposed approach has a pipeline-based architecture containing three phases—image registration for large motion removal from video angiogram, retinal vessel segmentation and video magnification based on the segmented vessels. In image registration, we align distorted frames in the video using conventional approaches. In the next phase, we use baseline capsule based neural networks for retinal vessel segmentation. We moved away from traditional convolutional network approaches to capsule networks in this work. This is because, despite being widely used in different computer vision applications, convolutional networks suffer from poor learning ability to understand the orientation, have high computational times due to additive nature of neurons and, loose information in the pooling layer. Although having these drawbacks, we used deep learning methods like U-Net and Tiramisu to measure the performance and accuracy of SegCaps. Lastly, we applied Eulerian video magnification to magnify the subtle changes in the retinal video. In this phase, magnification is applied to segmented videos to visualize the flow of blood in the retinal vessels.

Major: Computer Science

Educational Career:
Bachelor's of Computer Science and Engineering, BS, 2015, Future Institute of Engineering and Management

Committee in Charge:
Ulas Bagci, Chair, Computer Science
Hassan Foroosh, Department of Computer Science, University of Central Florida
Sang-Eun Song, Department of Mechanical and Aerospace Engineering, University of Central Florida

Approved for distribution by Ulas Bagci, Committee Chair, on October 24, 2018.

The public is welcome to attend.