AbstractID: 11952 Title: 3D Carotid Ultrasound Imaging for Monitoring Carotid Atherosclerosis

Atherosclerosis is characterized by the development of plaques in the arterial wall, ultimately leading to heart attacks and strokes. Quantitative measurements of the progression and regression of carotid plaque burden are important in monitoring patients and evaluating new treatment options. 3D carotid ultrasound (3D US) has the potential to be an effective method to monitor the progression of carotid artery plaques in symptomatic and asymptomatic patients. To meet this challenge, we developed a 3D carotid US system that allows detailed studies of plaques in 3D. Our software includes 3D reconstruction, viewing, and segmentation of carotid plaques, surface morphology analysis, and registration software to allow quantitative tracking of plaque changes. We used our system to examine the detailed relationship between the 3D US-based measurement of plaque volume, the 3D scanning parameters, volume measurement variability, and plaque surface morphology.

In this paper, we describe the acquisition and reconstruction of 3D carotid US images, and extended concepts used in *intima-media thickness* (IMT) measurements based on 2D images to a metric we call the 3D *vessel-wall-plus-plaque thickness* (3D *VWT*), which is obtained by computing the distance between the carotid wall and lumen surfaces on a point-by-point basis in a 3D image of the carotid arteries. The *VWT* measurements can be superimposed on the arterial wall to produce the 3D *VWT* map. Since changes in plaque thickness is important in monitoring patients who are at risk for stroke, we also compute the change of *VWT* by comparing the 3D *VWT* maps obtained at two different times. To facilitate the visualization and interpretation of the 3D *VWT* and 3D *VWT-Change* maps, we developed a technique to flatten these maps in an area-preserving manner.

Learning Objectives:

1. Understand the limitations of conventional carotid ultrasound imaging
2. Understand the methods that can be used to overcome the limitations of the use of conventional ultrasound to monitor progression of carotid disease
3. Understand the advantages of 3D ultrasound images to monitor progression of carotid disease