Carotid artery bifurcation modelling from patient CT angiography and ultrasound techniques

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Background: Blood flow simulation of the common carotid artery bifurcation is an undergoing research project with topography based on CT angiography and velocity information given by ultrasound techniques. Methods: The segmentation algorithm is based on the echogenic characteristics of the left and right carotid arteries for the identification of their boundaries, through all the slices acquired from a CT angiography. Initially, it requires the definition of two centroids, defining the region of the common carotid artery (CCA). Through the application of morphological and segmentation operators, the structural information of the boundary walls of the CCA is saved and the algorithm proceeds with the calculation of two new centroids, based on the information resultant from the segmentation. The calculated centroids will be used in the definition of a new region in the next slice, proceeding with the same calculations for the posterior segmentation. In the separation of the CCA into the internal and external arteries (ICA and ECA), the algorithm calculates the centroids for each feature, resulting in a total of four centroids that will be used in the posterior slice. The calculations proceed till the last slice of the acquisition. Results: All the contours from each slice were saved and represented in a volume, obtaining a correct delineation of the bifurcation for both left and right carotid arteries in a total of 63 slices. Finally, the surface of the model of both left and right carotid arteries are built, by creating a Delaunay triangulation for all possible set of points considering from successive slices. After the meshing of the created volumes blood flow simulation is performed using a developed finite element code. Conclusion: The segmentation algorithm has proven to be highly efficient allowing an accurate topography necessary for the correct interpretation of the simulated carotid artery bifurcation hemodynamics.