Definition of Tubular Anatomic Structures from Arbitrary Stereo Lithographic Surface

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Background:

An accurate description of anatomies and dynamics of vessels is crucial to understand their characteristics and improve surgical techniques, thus it is the basis, in addition to surgeon experience, on which stent design and operation procedures rely. The process of producing this description is user intensive, and recent improvement in image processing of medical 3D imaging allows for a more automated workflow. However, there is a need to bridge the gap from a processed geometry to a robust mathematical computational grid.

Objectives:

Develop a new method for defining tubular anatomic structures from arbitrary Stereo Lithographic Surfaces, in order to reduce time-consuming manual and user intensive modeling.

Methods:

By sequentially segmenting a tubular anatomic structure, here defined by a stereo lithographic (STL) surface, an initial centerline is formed by connecting centroids of orthogonal cross-sectional contours along the length of the structure. Relying on the initial centerline, a set of non-overlapping 2D cross sectional contours are defined along the centerline, a centerline which is updated after the 2D contours are produced. After a second iteration of producing 2D contours and updating the centerline, a full description of the structure is created.

Results:

Our method for describing vessel geometry shows good coherence to existing method. The main advantages of our method include the possibility of having arbitrary triangulated STL surface input, automated centerline definition, safety against intersecting cross-sectional contours and automatic clean-up of local kinks and wrinkles.

Conclusions:

Validation analysis has shown that the developed method is suitable for segmentation of arbitrary 3D surface input and coheres well with existing method for certain applications. Further work includes improving the method and interface for intuitiveness and speed, as well as applying the method for comparative statistical analyses of larger data sets. The method forms an important part in better understanding the vascular system to identify abnormalities related to disease and how stents and surgery affect the native vessels.