A Cloud-Based Centerline Algorithm for Studierfenster

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INTRODUCTION

We extended an existing web-based tool called Studierfenster (http://studierfenster.icg.tugraz.at/) for this contribution, which was built by students from TU Graz, with a semi-automatic aortic centerline calculation functionality. Studierfenster is a tool that renders three-dimensional volumes, defined by the user, and allows the user to perform multiple tasks on that volume (Fig. 1). The functionality added to Studierfenster consists of two parts. The first part calculates the initial centerline of the aorta from a CTA scan. Therefore, the user needs to provide two seed points inside the aorta. The output of the initial centerline calculation is a Dijkstra's shortest path between the first and the second seed point within the aortic vessel. The second part of this contribution, integrates a centerline smoothing algorithm developed by Alvarez et al., which further smoothes the initial centerline. Our tool provides a robust centerline calculation that can even work for cases where the contrast of the CTA is not sufficient for a segmentation-based centerline calculation of the aorta.

Fig. 1. Screenshot of the current Studierfenster (http://studierfenster.icg.tugraz.at/) landing page. The centerline calculation can be accessed via the Medical 3D Viewer (red ellipse).
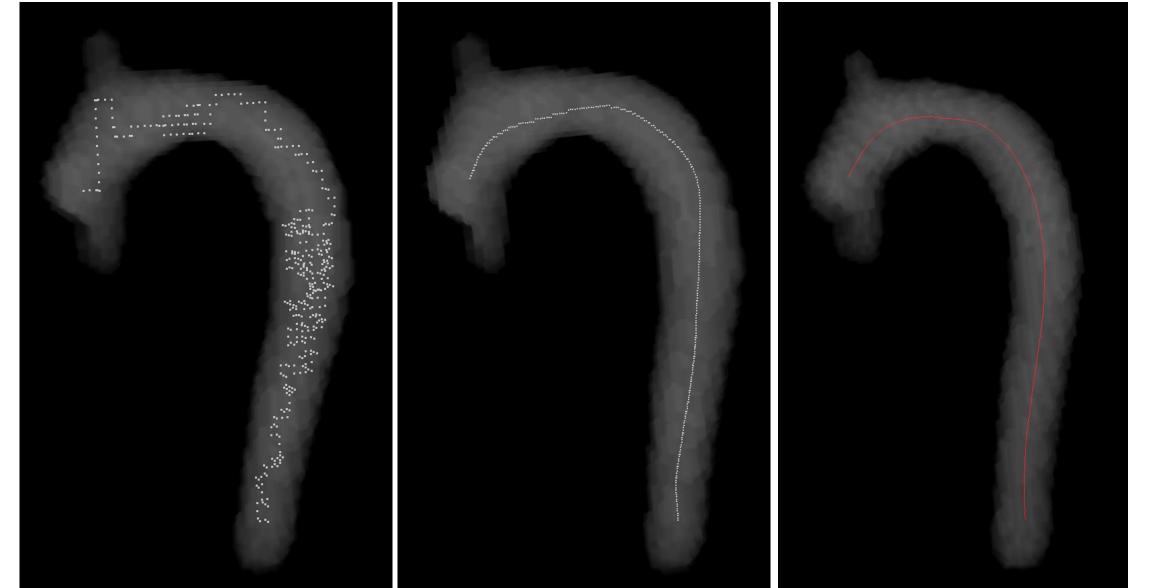
METHODS

The centerline module is built upon Studierfenster, which is a client-server based platform. The module consists of two steps, the first step is to compute an initial centerline by setting two seed points within the aorta. As a second step the initial centerline is smoothed. The workflow of the centerline calculation is shown in Fig. 2. In Fig. 3 the result of the initial centerline calculation (left) and the smoothed centerline (right) is shown within the Studierfenster platform.

Fig. 2. The centerline workflow providing different entry points for the calculation of either an initial centerline or just smoothing an uploaded initial centerline.

Fig. 3. The initial centerline (left) and the smoothed centerline (right) both calculated and visualized within the Studierfenster platform.

RESULTS

Qualitative (Fig. 4) and quantitative (Fig. 5 & Tab. 1) evaluation of the online system tested on the CAD-PE Challenge dataset.
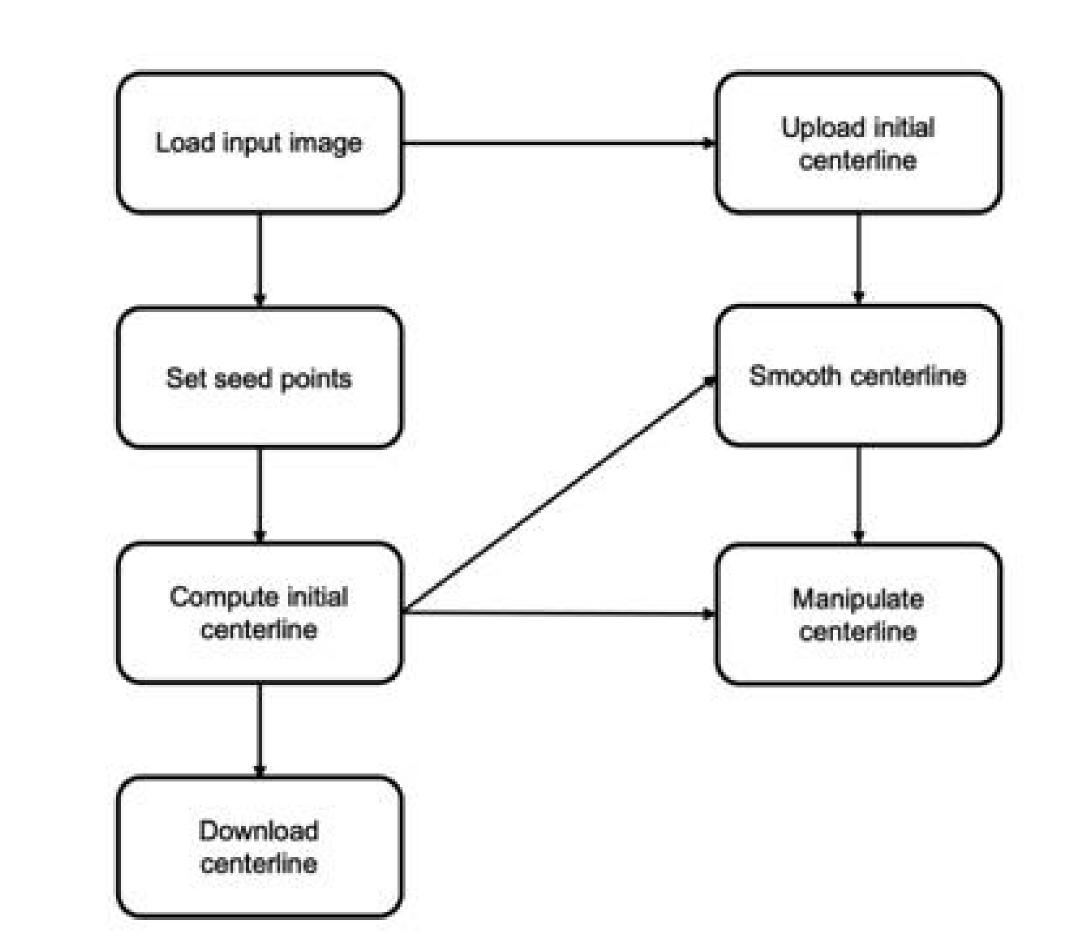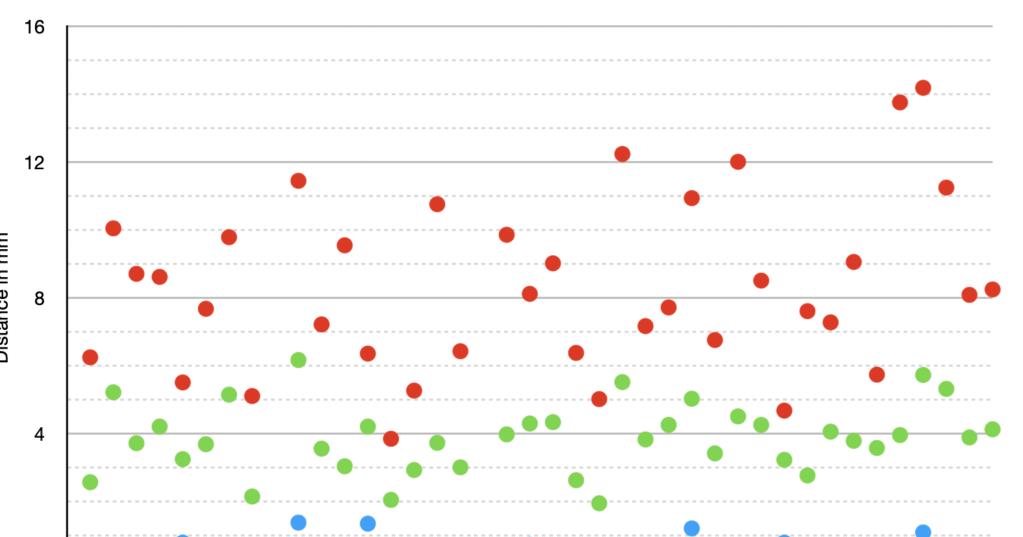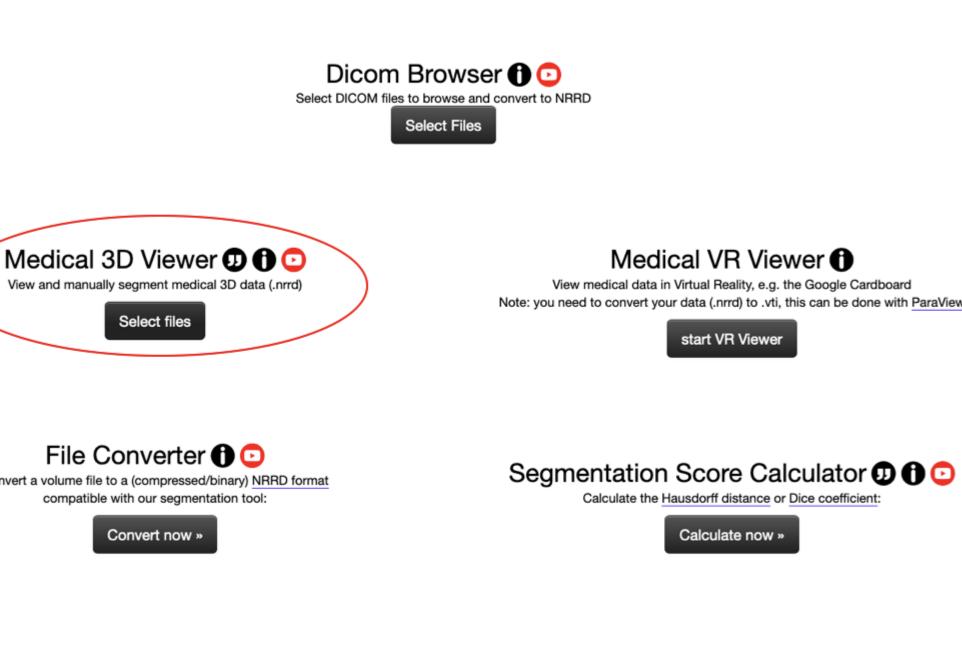

Fig. 4 A visualization of the initial centerline (left), the smoothed centerline (middle), and the reference centerline (right) of data sample 001.
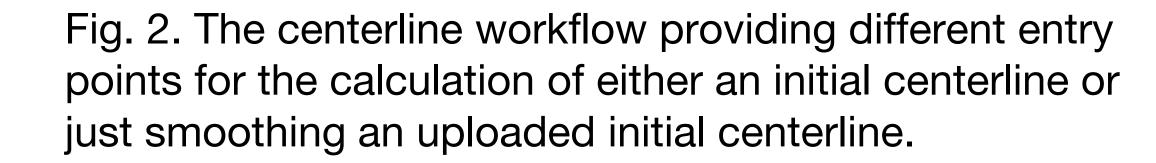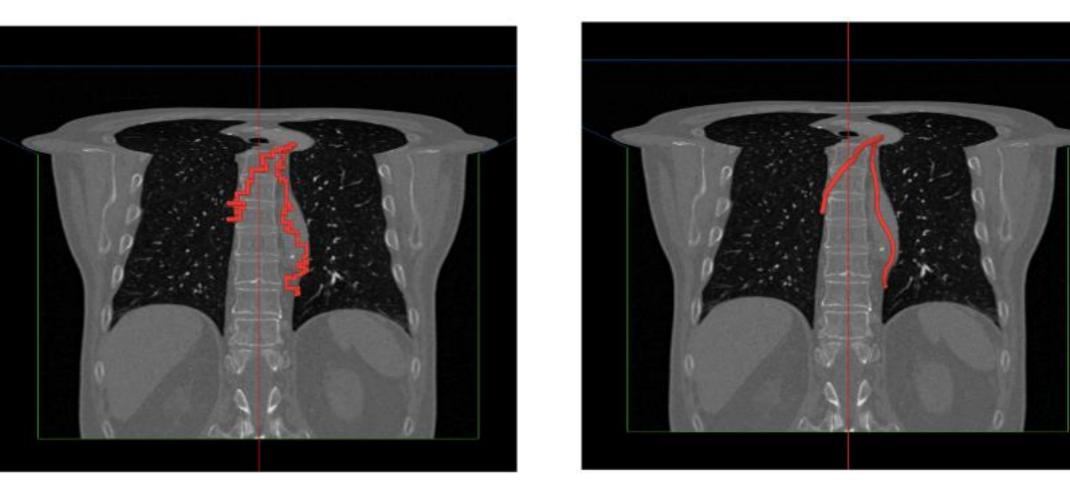

Fig. 5 A graph displaying minimum, maximum and mean distance in mm between smoothed and reference centerline for all data samples.

Minimum	Maximum
0,14 mm	14,18 mm
μ: 3,86 mm, σ: 0,99 mm	

Tab.1 This table shows the most significant distance measurements.

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