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3D BLOOD VESSEL CENTRELINE EXTRACTION FOR CATHETER BASED NAVIGATION

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Introduction: The human body contains a lot of different types of blood and visualization of these blood vessels are important for improving the navigation in catheter based procedures like stent graft positioning and valve replacement. Also, there is a need for fast blood vessel visualization and registration between multiple modalities, for applications involving navigation using intra-operative image modalities. Centreline based registration methods have proven to be fast enough for clinical applications and an effective way of registering multi-modal images. Here, we present a novel blood vessel centreline extraction method in 3D.

Methods: Our method consists of two parts, namely Multiscale Vessel Enhancement Filtering (MVEF) and Centreline Extraction using Vessel Direction (CEVD). Our proposed MVEF has an improved dampening of noise and better Gaussian profile at the vessel cross-sections compared to conventional MVEF. The CEVD is our novel method for tracing the peaks of the Gaussian profile of the local MVEF at the vessel cross-sections. The peaks of these Guassian profile provide the centre position of the blood vessels. The innovation of this method is in effectively finding only the connected centrelines of the blood vessels of interest.

Results: The proposed method was evaluated using both synthetic and medical images. Our proposed method was compared with Frangi's vesselness combined with thinning and is shown to be approximately 5 times faster. The results also show that our method is good in detecting only the desired blood vessels, thereby eliminating the detection of unwanted vessel-like structures.

Conclusion: Our method is shown to be much faster than the commonly used methods, though the processing time varies on the complexity and the scale of the blood vessel structures. The method also detects only the blood vessels which are connected to the users seed point which will be very useful in catheter tracking.