AbstractID: 6529 Title: Effect of threshold setting on 3D visualization and diameter measurement accuracy of blood vessels for CT derived images

Purpose: To investigate the effect on vessel sizing of varying the threshold in 3D volume-rendered CT images and to verify the results with a 2D computer simulation.

Method and Materials: 3D-rendered images of a phantom with a vessel of varying diameter and of a patient with a basilar tip aneurysm were displayed on a Vitrea 2 workstation. Vessel diameters measured from the images were plotted as a function of gray-scale threshold and actual vessel diameters measured directly from the phantom. A MatLab program was used to simulate different-size vessel image models by convolving a rect function with a Gaussian point spread function (PSF) and to investigate the effect of threshold on sizing these vessels.

Results: Plots of measured vessel diameter vs. threshold setting for varying real-vessel diameter exhibit a monotonic decrease; with the slope decreasing both for low thresholds because of the extended tail of the PSF and for high thresholds where the vessel rapidly shrinks and then disappears as the threshold exceeds the vessel gray level. For intermediate thresholds there is a greater rate of fall-off for smaller vessels below the width of the system PSF. Plots of measured diameter vs. real diameter intersect the 45 degree identity line at increasing diameters for increasing intermediate threshold. The crossing-point indicates the point where the measured diameter equals the real diameter for the given threshold. Below the crossing point, these curves demonstrate reduced measured diameter for smaller vessels and, above the crossing-point, larger values for larger vessels. The simplified 2D vessel-model simulation and workstation data follow similar trends.

Conclusion: A threshold set to accurately measure one rendered-vessel diameter will inaccurately render vessels of other diameters. Using this threshold, smaller vessels will be inaccurately small or not be visualized and larger vessels will be too large.
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