COMPARISON OF 3D VOLUME REGISTRATION TECHNIQUES APPLIED TO NEUROSURGERY

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Introduction: Image guided surgery requires that the pre-operative data used for planning the surgery should be aligned with the patient during surgery. For this surgical application a fast, effective volume registration algorithm is needed. In addition, such an algorithm can also be used to develop surgical training presentations. This research tests existing methods of image and volume registration with synthetic 3D models and with 3D skull data. The aim of this research is to find the most promising algorithms in accuracy and execution time that best fit the neurosurgery application.

Methods: Medical image volumes acquired from MRI or CT medical imaging scans provided by the Indiana University School of Medicine were used as Test image cases. Additional synthetic data with ground truth was developed by the Informatics students. Each test image was processed through image registration algorithms found in four common medical imaging tools: MATLAB, 3D Slicer, VolView, and VTK/ITK. The resulting registration is compared against the ground truth evaluated with mean squared error metrics. Algorithm execution time is measured on standard personal computer (PC) hardware.

Results: Data from this extensive set of tests reveal that the current state of the art algorithms all have strengths and weaknesses. These will be categorized and presented both in a poster form and in a 3D video presentation produced by Informatics students in an auto stereoscopic 3D video.

Conclusions: Preliminary results show that execution of image registration in real-time is a challenging task for real time neurosurgery applications. Final results will be available at paper presentation. Future research will focus on optimizing registration and also implementing deformable registration in real-time.

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