

## Section: Segmentierung, Registrierung

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### Abstract-Title:

EIN QUANTITATIVER VERGLEICH DER GENAUIGKEIT ZWEIER  
SEGMENTIERUNGSMETHODEN FÜR AUTOMATISIERTE INTRAOPERATIVE  
REFERENZIERUNG IN DER HNO-CHIRURGIEA QUANTITATIVE COMPARISON OF  
THE ACCURACY OF TWO SEGMENTATION METHODS FOR AUTOMATED  
INTRAOPERATIVE REGISTRATION IN ENT-SURGERY

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### Abstract-Text:

Purpose:

The accuracy of the segmentation is vital for the quality of the registration and the reliability of the surgical navigation. There is no standardized approach for evaluating the accuracy of a segmentation method. The study provides a quantitative comparison of the quality of a pure grayvalue segmentation of the occipital bone, triangulated with marching cubes and a deformable model segmentation, taking the triangulation from the first method as an initial input. The two segmentations are compared to an expert manual segmentation, taken as a „ground truth“. Materials & Methods:

The occipital bone was segmented manually from CT-datasets of the head in the open source product 3D-Slicer and approved by experts, to be taken as a “ground truth”. A threshold value of 420 HU was used to delineate the bony skull. The surface was reconstructed from the resulting binary images with the marching cubes algorithm. Then, the triangulated mesh, output from the threshold segmentation was input into a deformable model. The two segmentation methods were implemented in a software program, based entirely on open-source C++ packages: ITK for the image processing filters, VTK for the visualization routines and FLTK for the GUI. The accuracy was evaluated in two ways: based on the stopping criteria of the deformation, and through the method, described by Udupa et al, where the segmentations were saved as binary images and overlaid with the “ground truth”. The differences in the areas of the segmentations and the “ground truth”, as well as their intersections were used as evaluation criteria. The morphological operations on the segmentations were carried out in Mat Lab. Results:

The deformable model implementation in ITK was incorporated in a small open-source based program, allowing the user to set the operational parameters and perform all the steps of the segmentation in an interactive manner. Thanks to the open-source nature of ITK, the stopping criteria of the deformation (reaching a global minimum of the gradient forces) could be taken from the deformable model and displayed in the GUI. A graphical overlay of the segmentations with the ground truth was generated in 3D-Slicer for a visual comparison of the accuracy. The area differences of the segmentations to the „ground truth“ were quantified and used for accuracy evaluation. Conclusion:

Marching cubes is a triangulation method, providing excellent visualization of structures in medical imaging. The surface of the occipital bone, resulting from its combination with a

threshold segmentation is meant for a future application in an automatic registration procedure, including an A-mode ultrasound measurement of the occipital bone. The segmentation is improved by a deformable model, based on the gradient of the CT-image.