Section: **Segmentierung, Registrierung**

ID: 2

Abstract-Title:
FIRST RESULTS OF ACCURACY OF VIRTUAL LIVER CUT CLASSIFICATION FOR AUTOMATIC LANDMARK EXTRACTION

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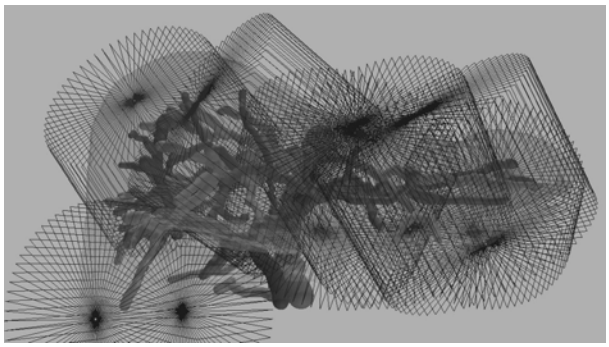
Abstract-Text:
Purpose
In the context of liver surgery, non-rigid registration of intraoperative ultrasound (IOUS) and preoperative planning data is crucial. To achieve a fast and robust registration result an initial rigid registration based on vessel landmarks is needed. Today these landmarks are acquired in a manual picking process by the surgeon while scanning the whole liver to build the ultrasound volume. The objective is to automate the process of landmark finding and therefore save time and improve accuracy. Our approach is based on the classification of ultrasound slices into a set of virtual cuts, generated from the preoperative data, to find the landmarks and to get a link between the coordinate system of the IOUS and the preoperative data. Method
We are working with preoperative MRT/CT processed by MeVis to get the liver surface and vessels. To get coordinates where the IOUS head could be placed, the segmented liver surface is used. These base points are used to generate cuts through the preoperative data to simulate possible ultrasound images at that position (see fig.1). The cut images contain only vessels and not liver tissue nor bile ducts (see fig.2). Empty images are discarded. For every base point rotations at different angles and a morphological operation is performed. From the generated cuts eight features are extracted describing the cut. The features are: number of blobs, mean area, mean compactness and mean roundness of the blobs, mean distance between the blobs, standard deviation of blob center from the image\'s center of gravity as well as mean angle and mean distance from the cut origin to the blob center. The resulting feature vectors are used as sample set for the KNN classification. A genetic algorithm is used to estimate the optimal weights for the feature vector and number of neighbors. The translation and rotation accuracy is determined by performing a leave-one-out classification for every feature vector of the sample set. Results
The rotation angles, the morphological operations as well as the weights and number of neighbors has been evaluated as influence factor for translation and rotation accuracy. The best results can be achieved with a close-dilate operation before the feature extraction, which provide a smooth feature vector change at vessel bifurcations. Furthermore the rotation angles are important for a good accuracy. The finer the rotation around a base point, the better the accuracy is. The following results are based on a rotation of 180 degree with a granularity of 0.1 degree. The estimated weights show that the number of objects in the image is crucial for a correct classification whereas the mean area has just a small impact for the classification. The optimal number of neighbors depends on the

sample set and is either one or two. We achieved a mean translation accuracy of 0.13 mm with a standard deviation of 3.329 on 13 base points that are spread over the liver surface. The median of the translation error is 0 mm. The mean orientation error is 0.1 degree with a standard deviation of 0.5. Conclusion

It could be shown that it is possible to determine the position and orientation of base points of virtual cuts through a liver model with high accuracy on the basis of image features and KNN classification. In the next step we will improve performance of the cut generation and weight estimation process. We also started to segment intraoperative ultrasound images and to classify these images into the cut sample set.

Bild 1/JPG



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