

## Section: Segmentierung, Registrierung

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### Abstract-Title:

SUBVOLUME VISUALIZATION BASED ON PIECEWISE 2D CT-FLUOROSCOPY TO 3D CT-VOLUME REGISTRATION VISUALISIERUNG EINES SUBVOLUMENS BASIEREND AUF DIE STÜCKWEISE REGISTRIERUNG VON 2D CT-FLUOROSKOPIE SCHICHTEN ZU 3D CT-VOLUMEN

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### Abstract-Text:

#### Purpose

Radiofrequency Ablation (RFA) of the liver is an interventional procedure applied to patients with unresectable primary liver tumors (hepatocellular carcinoma) and metastases. Our aim is to assist the needle insertion procedure by displaying high resolution contrasted pre-interventional data in the intervention room. The abdominal area poses difficulties for needle insertion due to the high movement and deformation caused by the breathing.

Moreover for automatic registration following items contribute to the complexity of this task:

- CT-Fluoro slices have low signal-to-noise ratio- no vessels or tumors are visible due to the absence of contrast- the needle will be present in the image after insertion- one slice provides much less information than a volume.

We are proposing a new method for compensating tissue deformation by displaying a small target volume in an animation sequence, based on the piecewise registration of 2D CT-Fluoro images to 3D-Volume. Method

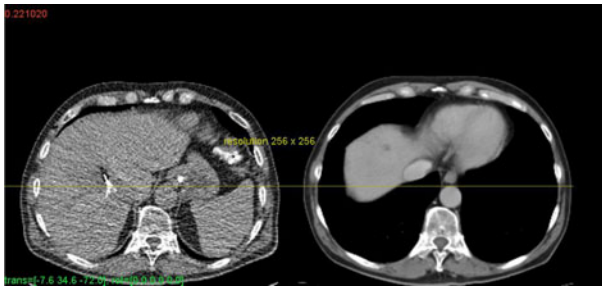
For the piecewise intensity based registration we are automatically splitting the CT-Fluoro into upper and lower part. This is done by detecting in the axial direction the organ borders starting from the center of the image. The cut is then set in the middle. The motivation for dividing the image, respectively the liver, into ventral and dorsal part, is because the two parts undergo different level of movement and deformation. During expiration the rib cage volume decreases, thus increasing the pressure on the ventral aspect of the liver. As initial pose position in the volume we are using the DICOM information from the header 'Image Position Patient' since the patient remains on the same table for the preinterventional CT-Volume scan and the intervention. (see Init.jpg) From this initial pose, the two parts of the CT-Fluoro slice are independently registered to the CT volume. In order to avoid local minima we are using a multiresolution approach. For speeding up the registration process we are optimizing only two degrees of freedom (DOF), these two being the most significant: the translation along z (cranio-caudal direction) and rotation about the x axis. (fig. 3DView.jpg) At the higher resolutions we are increasing the DOF to six, three for translation and three for rotation. The parameters estimated at each resolution are used as initialization for the next resolution. The resulting two planes (see UpperLower.jpg) of the two part registration define a subvolume containing the information of the CT-Fluoro slice. This subvolume is visualized by interpolating between these two planes. For the

visualization we are using the spherical linear interpolation for quaternions (SLERP = spherical linear interpolation). The animation sequence can be stopped and started again by the user. Results

For the registration evaluation we used two routinely acquired datasets. From each dataset we selected CT-Fluoro slices with parts of the liver being imaged often during the intervention. Two experienced interventionalists independently defined the corresponding slices in the CT-Volume. The manual navigation allowed six DOF, three for translation and three for rotation. The intersection of the defined slices by the physicians with the target volume was calculated. The results showed that the defined slices by the interventional radiologists lie in the volume or very close to it. Conclusion

For compensating tissue deformation during the intervention we performed a two pieces registration of the CT-Fluoro slice to the CT-Volume that enabled to display all the information contained in the CT-Fluoro slice in a short animation sequence. Automatic display of pre-interventional data in the intervention room would improve a lot the current workflow. Now the interventional radiologists need to move out of the intervention room to look at the pre-interventional scan.

*Bild 1/JPG*



*Bild 2/JPG*

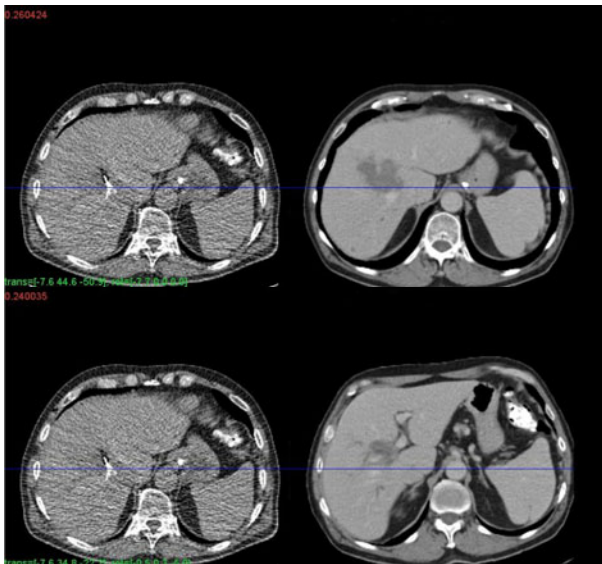


Bild 3/JPG

