Section: **Segmentierung, Registrierung**

ID: 39

Abstract-Title:
REGISTRATION OF 3D ROTATIONAL ANGIOGRAPHY TO CT/MR ANGIOGRAPHYREGISTRIERUNG VON 3D ROTATIONSANGIOGRAPHIEN MIT CT- ODER MR-ANGIOGRAPHIEN

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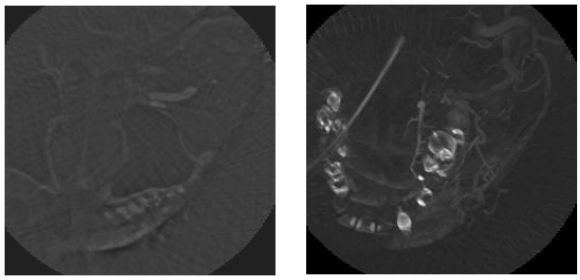
Abstract-Text:
Purpose:
For diagnostic and therapeutic purposes, multiple imaging acquisition techniques can be used in order to gain different types of information of a given anatomy. For example, in neurosurgery, angiography images are used to identify blood vessels, but computed tomography (CT) images are conventionally used for stereotaxy. Registration of the two modalities of images allows the transfer of the blood vessel coordinates to the CT stereotaxy and allows for coarse information such as bone and large tissues to be combined with detailed information such as blood vessels. Although a number of different angiography techniques exist, CT angiography (CTA) or magnetic resonance angiography (MRA) data have conventionally been used in vascular neurosurgical procedures. However, CTA and MRA often do not provide sufficient information to get a clear understanding of the blood vessels and therefore, the relatively new technique of 3D rotational angiography (3DRA) has recently been preferred. The introduction of 3DRA (Figure 1), which allows tomographic reconstruction, made possible the registration of these images onto other modalities such as CT and MRI, which was not possible with 2D projective X-ray angiography. The registration of 3DRA onto other modalities allows visualization of vascular details not visible in other images giving a better understanding of the structure of blood vessels essential to surgical interventions. In this work, we describe a framework for registration of angiography images. Method:
Using the ITK Segmentation and Registration Toolkit we developed a Mutual Information (MI) based image registration algorithm (Figure 2). Our method, allows for an optional initialization step which can either be user driven, i.e. using user-chosen anatomical landmarks, or automatic, using image moments. For registration of 3DRA to MRA or CTA images, the presence of the angiography information in the CTA or MRA image, which provides some overlap information of the major vessels, can be exploited by using the points on the major vessels as landmarks for the registration. The initialization step can be considered the final registration or used as the input for the MI registration algorithm. The algorithm can use either a rigid transformation, when there is negligible distortion in the 3DRA, or allow for linear distortion, by using an affine transformation. Results:
For registration of 3DRA to CTA or MRA, initial results show that due to the relatively high noise level and presence of background structures (which result from inhomogeneous

surrounding tissue), a landmark based registration works best. Our method also allows for registration between MR and CT, and results show that when registering different CTA or MRA angiography to different CT or MRI images an automatic rigid registration with no initialization step is sufficient (Figure 3).

Conclusion:
The registration of images from differing modalities gives more information as to a given patient anatomy. Registration of 3DRA images to CTA or MRA combines detailed information of the vascular system to information about bone and tissue. In our work we have developed a successful multi-modal medical image registration framework for the registration of angiography images. Our preliminary results look promising and the next step of this work will be to perform further empirical testing.

Bild 1/JPG



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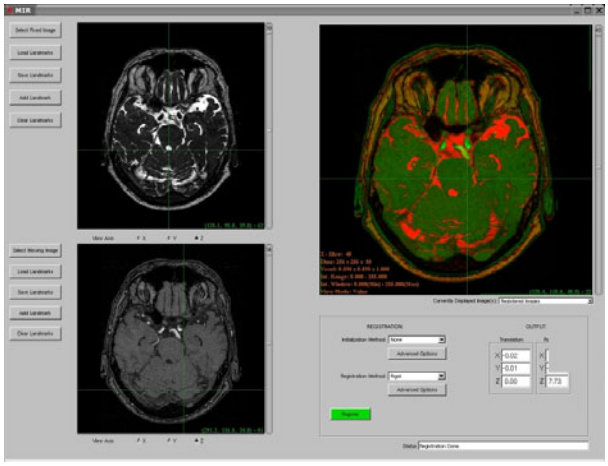

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