Section: **Visualisierung**

ID: 4

Abstract-Title:
IMPROVING REGISTRATION ACCURACY IN MEDICAL AUGMENTED REALITY

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Abstract-Text:
The estimation of the current camera pose is one of the most important, but also one of the most challenging tasks in medical augmented reality. Without a highly accurate estimation of the position and orientation of the video camera, a spatially correct overlay of graphical information cannot be achieved. This requirement is even more crucial in medical scenarios, where the graphical objects must be correctly aligned with the patient. Many medical AR systems use specialized tracking devices, which can be of limited suitability for real-world applications. We have developed an AR framework for surgical applications based on existing medical equipment. A surgical navigation device delivers tracking information measured by a built-in infrared camera system, which is the basis for the pose estimation of the AR video camera. However, depending on the conditions in the environment, this infrared-based tracking can result in discernible overlay errors. One of the reasons for these overlay errors is the fact that the angular accuracy of the delivered tracking data is limited. Moreover, errors can be caused by a number of other factors including an inaccurately performed system calibration and an inadequate patient registration.

We have developed a hybrid tracking scheme for medical augmented reality based on a certified medical tracking system. The final pose estimation takes the inital infrared tracking data as well as salient features in the camera image into account. The vision-based component of the tracking algorithm relies on a pre-defined graphical model of the observed scene. The infrared and vision-based tracking data are tightly integrated into a unified pose estimation algorithm, which is based on an iterative numerical optimization method.
The hybrid tracking system was developed and tested with an manually modeled cube object as reference model. Good results were obtained with the hybrid scheme, and a significantly improved pose estimation was achieved under most circumstances. Several test runs were performed and evaluated. The hybrid tracking algorithm works stably except in the case of adverse environmental conditions. The hybrid tracker, which uses information from the camera image, has the typical limitations of vision-based systems. A low quality of the digital image, an inadequate definition of the reference model, excessive camera motions, and too much occlusion of the features of the reference object can have a negative impact on the tracking performance. However, we have found that the hybrid

pose estimation system usually delivered a significantly improved tracking in our experiments. This work has been supported by project VIRTUE in the focus program on “Medical Navigation and Robotics” (SPP 1124) of the German Research Foundation (DFG).

Bild 1/JPG

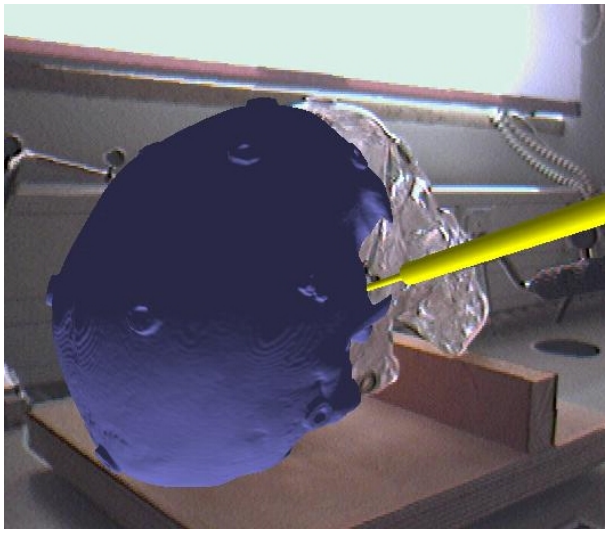

Bild 2/JPG

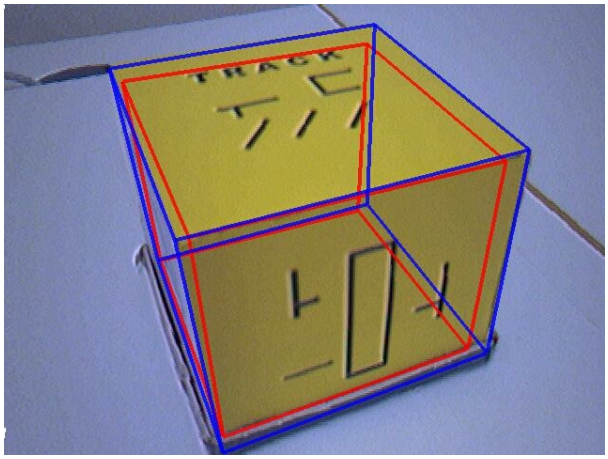

Bild 3/JPG