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# Neuste Ergebnisse und neue Ansätze für die Erweiterte Realität in der Chirurgie

## Recent results und new approaches in augmented reality in surgery

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### Introduction

The first phase of the project „Augmented reality in surgery" is practically completed. This young project in the SFB 414 contains the realisation of glasses- and projector-based augmented reality systems for the precise transfer of preoperatively defined planning data by direct visualisation onto a non-fixed patient. With these two systems cutting trajectories, tumours, risk areas and natural landmarks can be shown. We present the recent results of the first clinical evaluations and point out the possibilities as well as the disadvantages of our systems. In addition we present our new ideas and challenges for the next period of this project to avoid the disadvantages.

### Material

For the realised projector-based system a common video projector and two FireWire-cameras are used for markerless registration, navigation and augmentation. The glasses-based system takes the see-through head-mounted-display Sony Glastron for the overlay of planning data and additional information into the operation situs of the surgeon. For tracking of the glasses and the patient a optical navigation system (NDI Polaris) is applied. With artificial landmarks on a bite splint the registration of the patient is realised.

### Results

In the last year five operations took place at the University Hospital Dpt. of Oral and Cranio-Maxillofacial Surgery in Heidelberg with these two augmented reality systems. It

was possible to easily transfer the planning data onto the patient and to visualise the position of tumour structures. In picture 1 and 2 the precise overlay during two different operations of the projector-based system are shown. To check that precision and to provide confidence into the system additional information (landmarks) were projected onto the patient. In picture 1 the border of a titanium plate are visualised and in picture 2 an ear surrounding line is drawn. The clinical evaluation of the systems points out some disadvantages. The recent prototype of the projector-based augmented reality is too large and too inflexible for permanent clinical use. In addition the registration method by surface scanning is vulnerable to point failures in the environment and it takes to much time for a manual removal of those points. Ablation and swelling processes are unconsidered, too. The glasses-based system shows high dependencies in precision of the user during evaluation. A standard calibration process, which is user independent, must be established. On the hardware side the luminance and the field of view of the recent head-mounted-display are not satisfying.

## Conclusion

With the precision of both systems for augmented reality in surgery it is now possible to support the surgeon in selected operations. General assistance is only possible with new systems, which are smaller and more flexible on the projector side as well as brighter and with a wider field of view on the head-mounted-display side. In the following three years we want to realise such systems for general and permanent clinical use. The concepts of these new systems will be presented during the talk.

Picture 1: Augmentation of a titanium plate and cutting lines
Picture 2: Augmentation of an ear surrounding line and a target symbol for a tissue extraction