Design and Development of a Test Bench for Validation of Patient-Specific Aneurysm Training Phantom Models

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Introduction

SurgeonsLab AG developed a physical simulator able to reproduce the experience of clipping an intracranial aneurysm based on a patient-specific 3D-printed model of the skull, brain, and arteries. This simulator could not only be used to train residents but also prepare surgeons for the intervention on a patient in need of surgery. And further improvement of the phantom model pathology accuracy could improve success of the actual surgery on the patient, since for small differences in an aneurysm a different kind of clip or approach will be used. Currently the assembly and accuracy evaluation of the phantom model is based on a human visually comparing it to the 3D patient data visualized on a separate screen

Materials and Methods

This thesis aimed to develop a test bench based on visual guidance that helps the user when assembling a model and takes over cross-validation between the virtual patient data and the physically assembled phantom model.

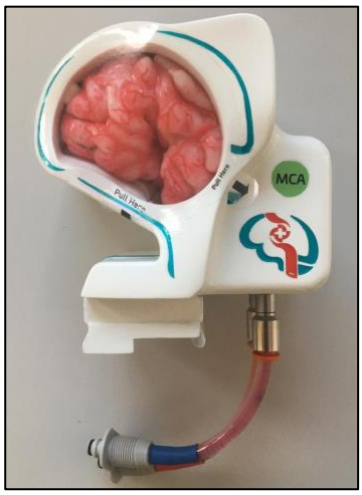

Fig. 1 Example of an assembled patien- specific aneurysm training phantom model.

The visual guidance was implemented as augmented reality on top of a video stream. The contours of the patient data were registered and overlayed on top of the phantom model. The accuracy evaluation is done with intersection over the union IoU. the higher the region of overlap between the patient data and the model, the better the accuracy of the assembly.

Results

A software that gives the user to assemble the phantom model contours for the pathology placement. Automated cross-validation of the patient data with the assembled model.

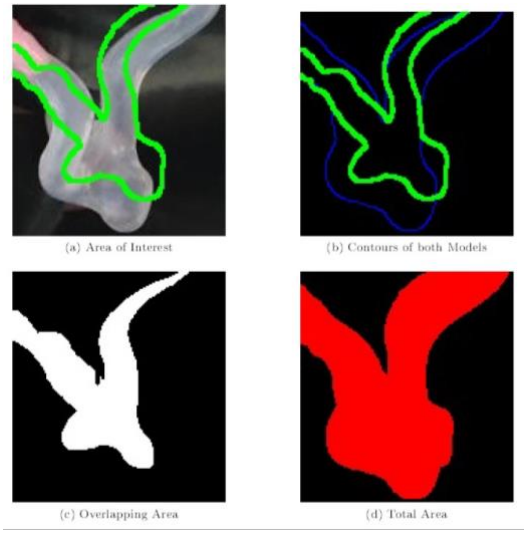

Fig. 2 Subfigure a is a snapshot of the area of interest. Subfigure b shows the detected contours of the the phantom model and the patient data. The lower two images show the overlapping and the total area to calculate the IoU.

Discussion

This project was the first step in the direction of an assembly test bench with an image-guided overlay and integrated accuracy evaluation of a patient-specific phantom model. It is a simple approach that does not need a large setup or expensive equipment and is easily portable. However, further experiments and adjustments need to be done to evaluate the practicality and usefulness of this approach.

References

K. A. Gavaghan, M. Peterhans, T. Oliveira-Santos, and S. Weber, A portable image overlay projection device for computer-aided open liver surgery,
on Biomedical Engineering, 2011.

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