Augmented Reality Endoscopic System

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ABSTRACT

PROBLEM

During endoscopic otorhinolaryngeal surgeries it is difficult to distinguish the anatomical landmarks once the anatomy is flooded with blood. Augmenting the endoscopic video stream with surgeon-selected preoperatively segmented anatomical landmarks will help the surgeon get reliable anatomical orientation and make these surgeries safer.

METHODS

In order to display guidance information on the display, the endoscope image has to be calibrated and registered to a tracking system. An optical tracking device is used to position both patient and endoscope. A new intraoperative calibration and registration procedure has been developed, which takes less than 10 minutes. Preoperative planning software with CT/MRI oriented interface is used to segment out the relevant, surgery specific, critical structures which are used to overlay intraoperatively. In addition, the endoscope video stream is annotated with the important landmarks and a proximity-alarm system is included.

RESULTS

The accuracy is calculated by looking at the difference of several contours in both real and overlay image, obtaining a mean between 1-2mm. The landmark-based system improves the orientation and is able to guide the user through the internal structures.

CONCLUSION

The authors have developed an Augmented Reality (AR) endoscope system with easy-to-implement calibration and registration procedures. Initial results show that it helps making the procedure safer and accurate. It is now in the process of being tested in the clinical setup.

SIGNIFICANCE

In endoscopic otorhinolaryngeal surgeries, dexterity of the surgeon is compromised since space is limited, the operating instruments are long and the operating area is viewed as a two-dimensional domain. Having an AR system in such surgeries will make these surgeries less stressful and safer. Our system provides the surgeon with highly accurate augmented reality images (1-2 mm), and improves his orientation with a landmark-based guidance.

INTRODUCTION

An augmented reality (AR) system has been developed to enhance the surgical view and further enable surgeons to view hidden critical structures such as pathologies (e.g. tumors), risk regions or sensitive structures (e.g. arteries or nerves).

RESULTS

Accuracy is calculated by assessing difference between several contours in both real and overlay image. Mean error was consistently around 1-2 mm between these contours. A first cadaver test has been performed in order to validate calibration and registration procedures, as well as to measure the accuracy and guidance. The anatomical landmarks selected by the surgeon were overlaid on to the endoscope image, and they proved to be accurate enough to guide the surgeon through during the surgical procedure (figure 2).

DISCUSSION

In endoscopic otorhinolaryngeal surgeries dexterity of the surgeon is compromised since space is limited, the operating instruments are long and the operating area is viewed as a two dimensional domain. Having an AR system in such surgeries will make these surgeries less stressful and safer. Our system provides the surgeon with highly accurate augmented reality images (1-2 mm), and improves his orientation with a landmark-based guidance.