The CAS system nurse

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Abstract. *Minimally invasive surgery has become a widely used surgical technique that improves patients safety and optimizes health resources. However Computer Aided Surgery systems in their simplest form present a considerable cognitive load on the surgeon as pre-operative data cannot be displayed intra-operatively. More advanced modelling and tracking techniques such as VR are typically bound to pre-operative training. We list some of the main difficulties these techniques face in an intra-operative scenario, and present an interim hardware+software solution where a new job profile, the CAS system nurse can overcome many of the listed problems using our proposed system.*

Keywords

Laparoscopic surgery, 3D reconstruction, navigation, tracking, computer assisted surgery system nurse.

1 Introduction

A typical laparoscopic surgery uses small incisions in the abdomen, surgical tools and an endoscopic camera are inserted through trocars and the operation is guided by looking at the camera´s video image on a screen. Ideally one could superimpose pre-operative 3D data over the live video to assist the surgeon locating where critical arteries are for example during a kidney tumor removal. Unfortunately the following problems are still the object of much research today:

- 3D model representation, as material such as fat tissue is removed in real-life the model if represented with metaballs has precision problems [1] when reflecting change, organs such as the liver can bend more than 90 degrees presenting some problems with finite element representations.
- Image modalities that create new meshes on the fly significantly increase the set-up cost.
- The limited field of view of the camera can make the task of tracking and registration quite difficult.

2 Proposed solution

Our proposed solution (Figure 1) has three main components:

- *hardware: i)* Quad-Core PC with video capture card *ii)* graphics acceleration card for volume textures *iii)* video switch safety box *iv)* wireless keyboard/mouse *v)* displays [4].
- *software:* (integrated viewport solution using ITK [2] to display pre-operative CT data [3], resection maps, live video, ultrasound, 3D reconstructions with alpha blending of arteries.
- *new job profile:* the CAS system nurse that undergoes training to recognize organs in standard laparoscopic surgery so as to recognize, manually rotate, align and zoom the 3D reconstructed models to coincide with the orientation of organs seen in the video feed. The nurse can perform several view-model transformations commands asked by the surgeon, such as loading pre-operative data, rotating the 3D model and for example

changing the transparency of a 3D model. Sub-volumes can be selected and deleted so as to reflect the current organ geometry.

In our Quad-Core system, one core is dedicated to handle the video capture card, another core handles ultrasound, another handles the 3D data viewport, and the remaining core is dedicated for general OS tasks.

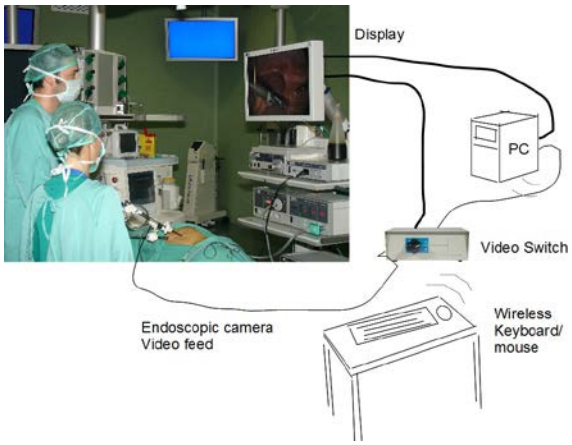

Fig. 1. The CAS system set-up.

3 Conclusion

Although we intend to show the 3D models in a viewport separate from the video viewport, surgeons are confident that the last cognitve translation that is required can be easily performed as several relative spatial queues in the pre-operative data are available and no rotation is necessary.

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