Virtual views controlled by surgical tools for computer assisted interventions

T Vaughan[1], T Ungi[1], A Lasso[1], G Gauvin[2], CJ Engel[2], J Rudan[2], G Fichtinger[1]
[1]School of Computing, Queen's University, Kingston, Ontario, Canada
[2]Department of Surgery, Kingston General Hospital, Kingston, Ontario, Canada
Consortium Affiliation: CANCER

INTRODUCTION: Virtual views are commonly used in computer assisted systems to show the placement of instruments relative to target anatomy [1]. A skilled technician creates the view by aligning it with the surgeon's perspective. The surgeon and the technician typically communicate with one another and iterate on the precise placement of the view until it is satisfactory to the surgeon. This can be a lengthy process, since the operating room is a loud environment, and the technician can be confused by verbal ambiguities. Our objective was to give the surgeon direct control of the view, without complicating the procedure with additional instruments.

METHODS: In our approach, we turn a surgical instrument (*e.g.* cauterizer) into a pointing device. The virtual view is aligned with the instrument in real-time, so the surgeon can point the view wherever he or she desires and adjust it at an interactive rate. Once the view is established, the screen position of the surgical target (*e.g.* tumor) is monitored by the computer. If the surgical target moves outside the range of the screen, the virtual view will automatically pan to compensate. We are evaluating this approach in breast lumpectomies at Kingston General Hospital in Kingston, Ontario. All software was implemented in the open source SlicerIGT package (www.slicerigt.org) for the 3D Slicer platform [2] (www.slicer.org). We used the PLUS toolkit [3] (www.plustoolkit.org) to read sensor position and orientation information from our surgical instrument (cautery) and surgical target (tumor).
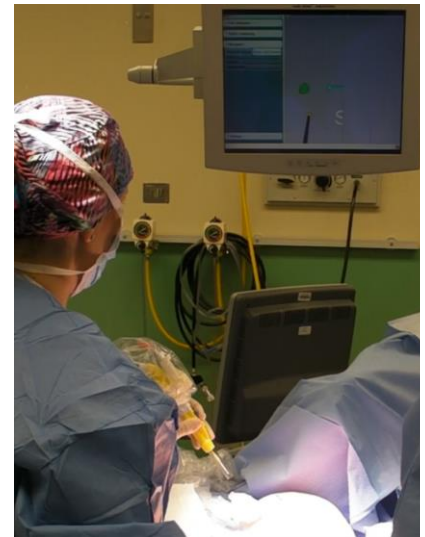

RESULTS: Surgeons have used instruments to control views in 15 patient lumpectomy cases [1] so far. We later implemented the feature to monitor the screen position of the tumor and automatically pan the virtual view as necessary. This feature has been used in 12 patients so far. The regular technician for breast lumpectomies estimated that over 50 manual interactions had been eliminated per patient case.

CONCLUSIONS: We have shown that the surgeon can intuitively control virtual views in the operating room without using any extra hardware. Our approach will continue to be used in computer assisted breast lumpectomies.

A surgeon uses a cauterizer to create a view.

REFERENCES:
[1] Ungi *et al.* Navigated breast tumor excision using electromagnetically tracked ultrasound and surgical instruments. IEEE TBME. 2016. Available online.
[2] Pieper S, *et al.* 3D Slicer. In IEEE ISBI 2004 Apr 15 (pp. 632-635). IEEE.
[3] Lasso *et al.* PLUS: open-source toolkit for ultrasound-guided intervention systems. IEEE TBME. 2014. 61(10):2527-37.