# Data Integration During Robotic Ultrasound-Guided Surgery

Seminar by Andrew Wang

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## Project statement

Our project seeks to develop a new user interface for the Da Vinci surgical system console to allow greater data integration in order to provide the surgeon with more patient information during the surgery (Figure 1). The new interface will include the integration of live ultrasound feed and an

image browser to view saved ultrasound images. Other features would include the ability to view preoperative images and construct 3D models of organs and other anatomical structures from those images. We will also perform a clinical user study to determine the surgeons' response to the new layout and features.

## Paper Selection

Bartosz F. Kaczmarek, S. S., Firas Petros, Quoc-Dien Trinh, Navneet Mander, Roger Chen, Mani Menon, Craig G. Rogers (2012). “Robotic ultrasound probe for tumor identification in robotic partial nephrectomy: Initial series and outcomes.” International Journal of Urology.

Craig G. Rogers, M. R. L., MD; Akshay Bhandari, MD; Louis Spencer Krane, MD; Daniel Eun, MD; Manish N. Patel, MD; Ronald Boris, MD; Alok Shrivastava, MD; Mani Menon, MD (2009). “Maximizing Console Surgeon Independence during Robot-Assisted Renal Surgery by Using the Fourth Arm and TilePro.” Journal of Endourolgy 23(1): 115-121.

These papers were selected for their studies on the advantages of ultrasound guided laproscopies and emphasis on surgeon autonomy. As my team members have already covered the state of the art in the procedure and the potential benefit in overlays, I have chosen papers which may aid in our maximum deliverables which would allow the surgeon to stay in the Da Vinci console throughout the entire procedure.

Bartosz ’12 Figure 2

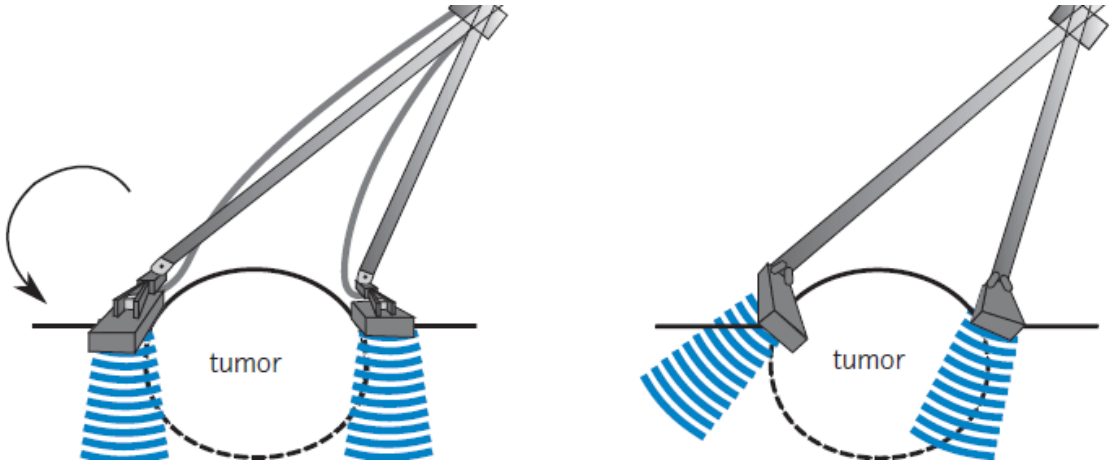
Paper 1: Tumor Identification

Summary

Intraoperative laparoscopic ultrasonography has already been shown to improve the efficacy of tumor excisions. However, while operating the da Vinci console, the surgeon would require an assistant to position the ultrasound probe. The authors conducted a study to show that the surgeon is able to utilize the modalities of an intraoperative ultrasound probe from the console without the need of an assistant.

Methods

The study was conducted over 22 consecutive partial nephrectomy (RPN) patients. A robotic probe is fit to grasp a thin flexible cable to which the ultrasound cable is attached. This allows for the surgeon to easily maneuver the probe during the procedure. This allows for great flexibility in probe control as shown below and allows for immediate visual feedback for the surgeon who is in the console.




Bartosz ’12 Figure 3

Result

The new setup allows for the surgeon to remain in the console while guiding the ultrasound probe. This is increases the efficiency of locating the tumor as the physician may control the probe while receiving the real-time ultrasound image. This is also more accurate than an assistant operating the probe by hand.

Relevance

The authors allow for the simultaneous feedback control of the ultrasound probe with their own implementation of TilePro. We hope to develop a similar system to allow us to display additional information without impeding any of the surgeon’s current modalities.

Assessment

The paper was very insightful about the benefits of surgeon autonomy. There was comment about how surgeon feedback could be incorporated into the console. The statistics of the tests were clearly documented. However, the paper did not thoroughly cover the exact implementations of its methods. The clinical studies also were not well explained and did not give any individual datum.

Paper 2: Maximizing Surgeon Independence

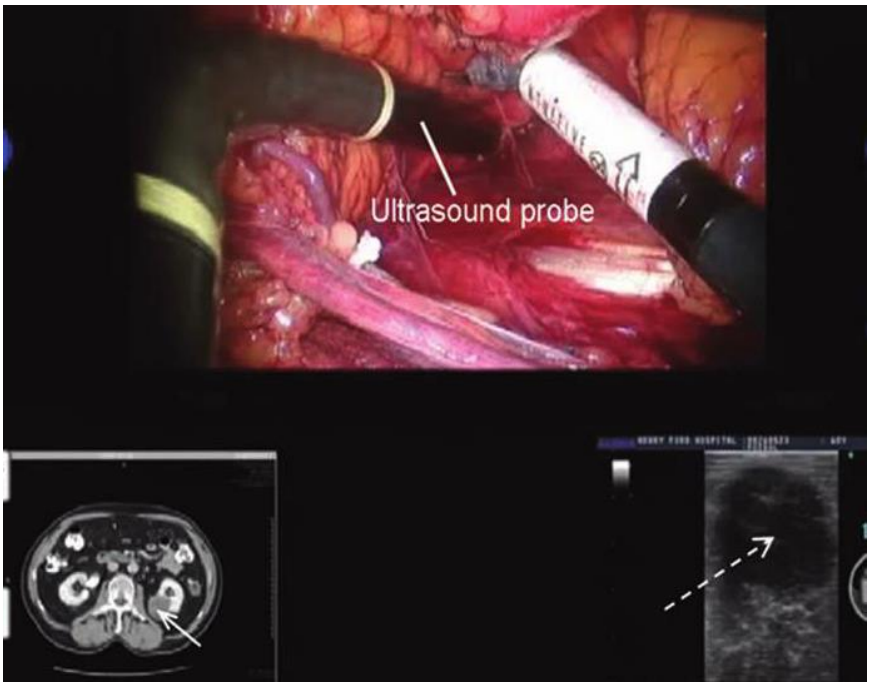
Summary

In order to improve the efficacy of ultrasound guided laparoscopies on the da Vinci surgical system, a fourth arm and TilePro is used to improve surgeon autonomy. The authors devised a function for an additional robotic arm to provide kidney retraction to secure the organ. An augmentation to the da Vinci interface was also implemented using TilePro to display pre-operative data from within the console.

Methods

The fourth arm could be used by preference of the surgeon for more difficult body types (it is advantageous to punch fewer holes into a person's abdomen). For example, a smaller body, less prominent hip bones or more challenging kidney tumors could often warrant this modality. This extra arm could be used to move the kidney and secure it and other tissues with clips. The authors used TilePro to augment the interface such that it could display preoperative CT images as shown below.

This way, the surgeon would not need to leave the console and access another computer in order to view preoperative data.




Rogers '09 Figure 5

Result

The fourth arm was always successful at securing the kidney whenever it

was used. However, the arm was unable to be used on a large number of obese patients due to space issues. The TilePro interface successfully facilitated the surgeon in tumor localization. It also allowed the surgeon to access hospital data without leaving the console.

Relevance

Though the fourth arm is less relevant, the TilePro implementation is of great interest to us. We are trying to develop a TilePro interface that not only displays data but also allows for its collection and manipulation. We could potentially use their setup as a skeleton for ours.

Assessment

The authors clearly explain their implementation of the fourth arm and TilePro. They also provided detailed information about why they believe that their methods allow for greater surgeon independence. As with everyone else's paper, the clinical studies could have been better documented.

Future Work

Our project is the future work that the authors could have followed up with. We wish to develop an interface that can display, acquire and manipulate data intraoperatively while in the console without hindering the surgeon.

Conclusion

The authors describe methods which improve surgeon autonomy and allow the surgeon to remain in the da Vinci console while minimizing his dependence on assistants. Their insight gives us a stepping stone for us to improve on existing interfaces. This allows us to better plan our steps to improve the efficacy of ultrasound guided laparoscopic surgeries.