

### **Ultrasound-Based Image Guidance for Robot-Assisted Laparoscopic Radical Prostatectomy: Initial in-vivo results**

**Omid Mohareri** - University of British Columbia  
**Caitlin Schneider** - University of British Columbia  
**Troy Adebar** - Stanford University  
**Mike Yip** - Stanford University  
**Peter Black** - University of British Columbia  
**Christopher Nguan** - University of British Columbia  
**Septimiu Salcudean** - University of British Columbia  
**Simon DiMaio** - Intuitive Surgical Inc  
**Jonathan Seroger** - Intuitive Surgical Inc  
**Dale Bergman** - Intuitive Surgical Inc

This paper describes the initial clinical evaluation of a real-time ultrasound-based guidance system for robot-assisted laparoscopic radical prostatectomy (RALRP). The surgical procedure was performed on a live anaesthetized canine with a da Vinci SI robot. Intraoperative imaging was performed using a robotic transrectal ultrasound (TRUS) manipulator and a bi-plane TRUS transducer. Two registration methods were implemented and tested: (i) using specialized fiducials placed at the air-tissue boundary, 3D TRUS data were registered to the da Vinci stereo endoscope with an average TRE of  $2.37 \pm 1.06$  mm, (ii) using localizations of the da Vinci manipulator tips in 3D TRUS images, 3D TRUS data were registered to the kinematic frame of the da Vinci manipulators with average TRE of  $1.88 \pm 0.88$  mm using manual tool tip localization, and average TRE of  $2.68 \pm 0.98$  mm using an automatic tool tip localization algorithm. Registration time was consistently less than 2 minutes when performed by two experienced surgeons after limited learning. The location of the TRUS probe was remotely controlled through part of the procedure by a da Vinci tool, with the corresponding ultrasound images being displayed on the surgeon console using TilePro. Automatic tool tracking was achieved with angular accuracy of  $1.65 \pm 1.24$  deg. This work demonstrates, for the first time, the *in-vivo* use of a robotically controlled TRUS probe calibrated to the da Vinci robot, and will allow the da Vinci tools to be tracked for safety and to be used as pointers for regions of interest to be imaged by ultrasound.

**Presenting Author:** Omid Mohareri