DISCLAIMER: The following is the output of transcribing from the video recording. Although the transcription is largely accurate, in some cases, it can inaccurate. It is posted as an aid to understanding the video recording.

Augmented Reality for Robot-Assisted Prostate Surgery

Megha Kalia, PhD in Electrical and Computer Engineering
Supervisor: Prof. Tim Salcudean

Prostate cancer is the second largest cause of death among men in north America. It's a health crisis in true sense. A standard treatment of prostate cancer is a type of surgery where small instruments and cameras are sent inside the patient's body through small holes. To perform the surgery, a surgeon sits on a chair, looks at his screen displaying the camera image and very intuitively controls the surgical instruments. And this is what a surgeon sees. At the top the central blob like structure is the cancerous prostate which is encapsulated by important structures responsible for sexual function and continence function.

The goal of the surgeon is to take the cancerous prostate out while keeping the attached structures intact. However, this is not trivial simply because these structure boundaries and cancer is not visible in the camera images as you can see. The cancer is inside the prostate. And here comes my PhD, where the goal is to display the tumour locations on the camera image itself

At the bottom, on your left, you see the same set up in last settings but on a fake prostate model. Blue is the prostate. In the middle, you can see the MRI of the same prostate model and the camera is annotated for cancer by a radiologist. _And on the very right you see my augmented reality system where MRI can be seen on which in red is the visible cancer.

It's the cross section of the phantom so a surgeon can see inside of the prostate and this MRI can be controlled in real-time using the surgical instrument. Now to technical nitty gritties.

Technically, the goal is to find the alignment between the MRI and the camera. MRI is taken at a different facility than where the surgery is performed. We already know the alignment between the MRI and the robot.

Now the goal of my PhD is to estimate the alignment between robot and the camera so that I can show the MRI in correct orientation and perspective as you see in the right most image. So how did I do that? I estimated a few data points from robot's perspective, I estimated the location of the same data points from camera's perspective, and then found a mathematical mapping between the two and, boom, we had our augmented reality system that you can see here. The MRI plane can be controlled in real time using the surgical instruments and is completely inside of the patient. In fact, a previous version of this system has been tested in 12 patients so far at Vancouver General Hospital, where they showed the virtual and real side by side and I'm very happy to say, the system that started with someone's small vision years ago is ready to be tested inside of the first patient as soon as Covid situation allows it. Thank you.