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Introduction to group project

Developing a sensing area visualisation tool for laparoscopic drop-in gamma probe

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Introduction

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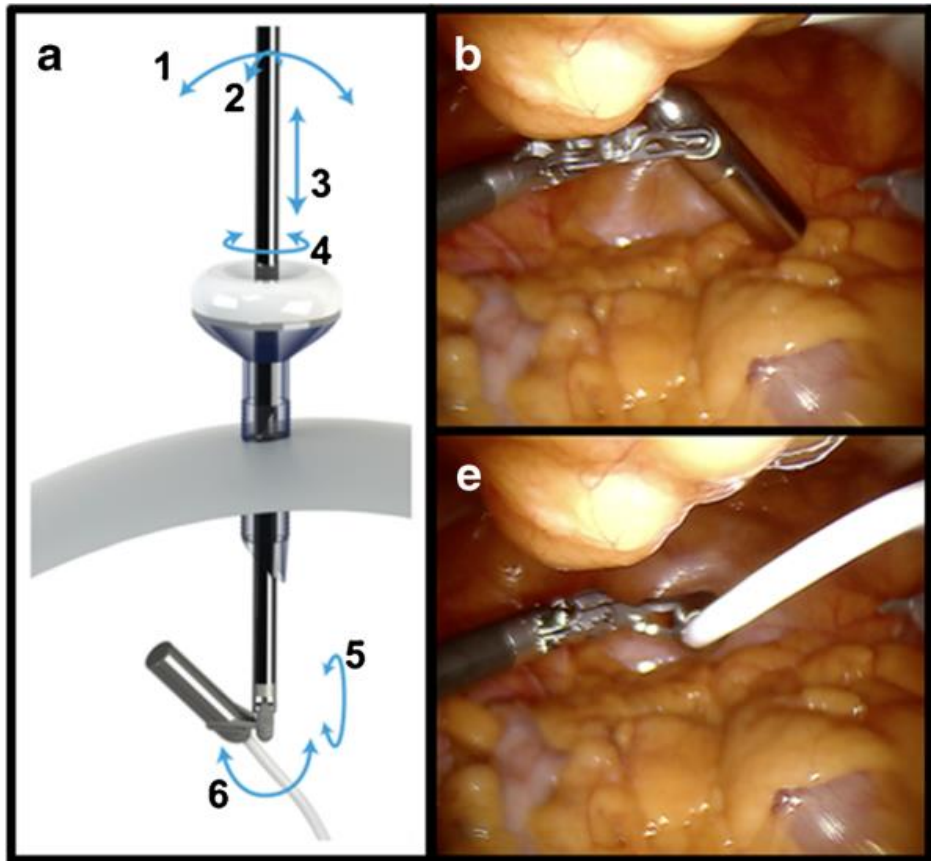
- Prostate cancer [1]
  - 12K deaths during the last two years in the UK
  - Robotic-Assisted Surgery (RAS)
  - Sentinel Lymph Node (SLN) Mapping
- Drop-in gamma probe [2]
  - Designed for RAS
  - The radioisotope is injected and accumulated at SLN
  - Detect the hot spot
  - Distinguish cancerous tissue from the background
- Sensing area
  - 3cm away from tissue surface
  - Hard to perceive
  - Visualisation tool



The manoeuvrability of the drop-in gamma probe and its in-vivo usage during RAS [3]

[1] "Prostate cancer statistics," *Cancer Research UK*, May 14, 2015.
[2] S. P. Povoski *et al.*, "A comprehensive overview of radioguided surgery using gamma detection probe technology,", Jan. 2009.
[3] P. Meershoek *et al.*, "Robot-assisted laparoscopic surgery using DROP-IN radioguidance: first-in-human translation,", Jul. 2018.

Project skeleton

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1. Implement and test the real-time probe-tracking algorithm
   - Where is the probe

2. Reconstruct the phantom tissue surface from the laparoscopic image
   - Where is the tissue

3. Detect the intersection between the probe's longitudinal axis and the phantom point cloud
   - Where is the area

4. Visualise the sensing area in augmented reality

Method: Probe tracking

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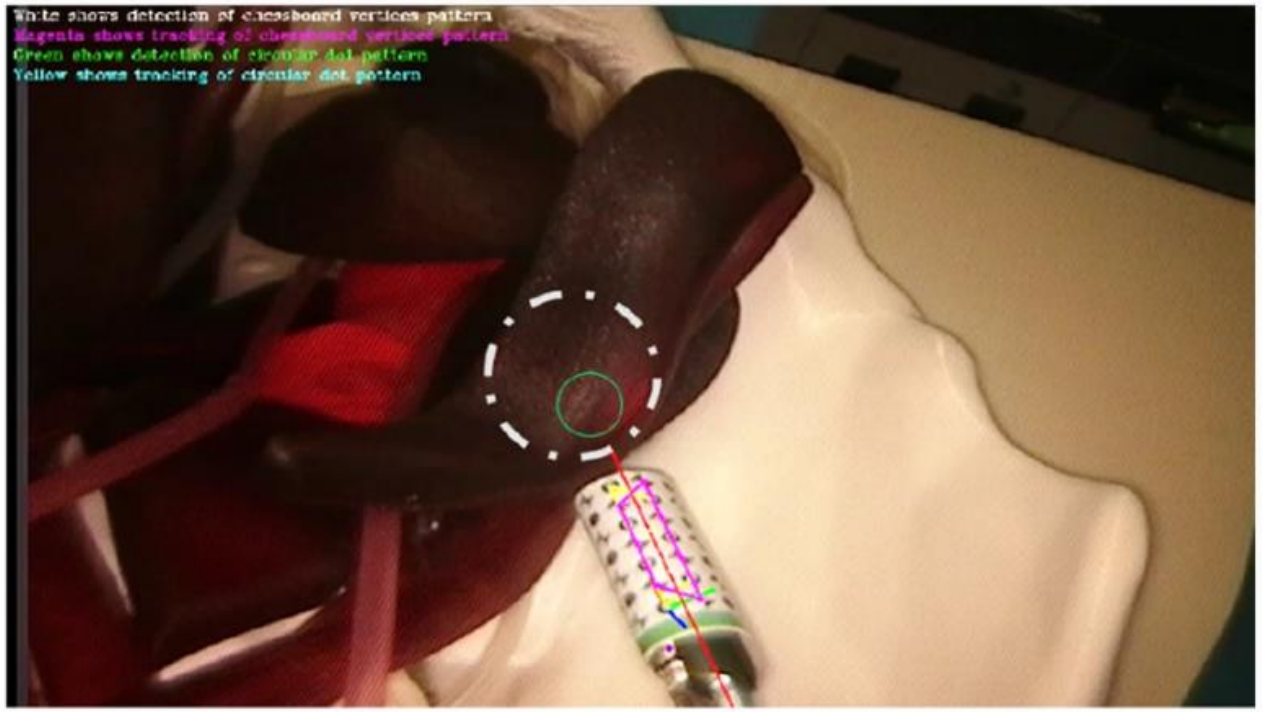
- Optical pattern detection
  - Attach marker
  - Previous research [4,5]
  - Advantages: no extra tracking instrument
  - Difficulty: curved surface

- TODO
  - Determine the appropriate marker
  - Implement the tracking algorithm
  - Export the estimated pose

- Helpful suggestions
  - Attempt to find available source codes
  - Start from the simplest one



Ex-vivo drop-in gamma probe **tracking** [4]

[4] B. Huang *et al.*, “Tracking and visualization of the sensing area for a tethered laparoscopic gamma probe,” Jun. 2020.
[5] U. L. Jayarathne *et al.*, "Robust, Intrinsic Tracking of a Laparoscopic Ultrasound Probe for Ultrasound-Augmented Laparoscopy," Feb. 2019

Method: Tissue reconstruction

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- RealSense depth camera
  - RGB-D camera
  - Available supporting documents
  - https://dev.intelrealsense.com/docs/ros-wrapper

- TODO
  - Install and run the camera
  - Collect tissue geometry data (point cloud, depth map, …)
  - Publish node on ROS

- Helpful suggestions
  - Using Ubuntu + ROS
  - Check developed repositories on GitHub

Method: Sensing area calculation and visualisation

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- 3D data processing
  - Intersection of the probe axis with the tissue surface

- TODO
  - Process probe pose data and tissue surface 3D data
  - Visualise results

- Helpful suggestions
  - PyVista, Open3D, PyMeshLab…

General suggestions

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- Feel free to
  - Propose your own method
  - Discuss and move the project focus
  - Discuss the extension of the project

- Logbook and minutes
  - Keep tracking
  - OneNote

- Team working
  - Working parallelly
  - Try to participate in the project

- Development
  - Read example codes