Update on Ophthalmic Microsurgery Robot (OmSR) as a platform to educate and facilitate robotic surgery

Goch, Aleksandra[1,2,3,4]; Gupta, Ayushi[4]; Sarunic, Marinko[1,4]; Asaria, Riaz[3]; Stilli, Agostino[2]; Stoyanov, Danail[2]

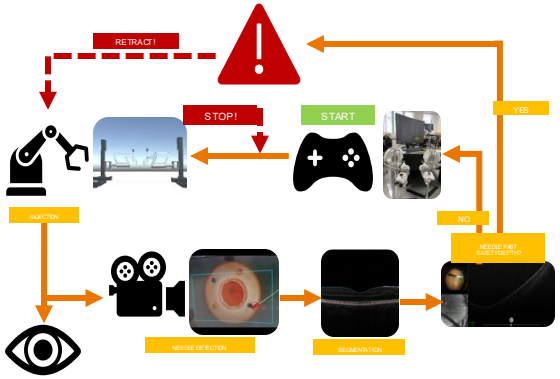
1. UCL Institute of Ophthalmology; 2. UCL Hawkes Institute; 3. NHS Royal Free Hospital; 4. NHS Moorfields Eye Hospital

Introduction

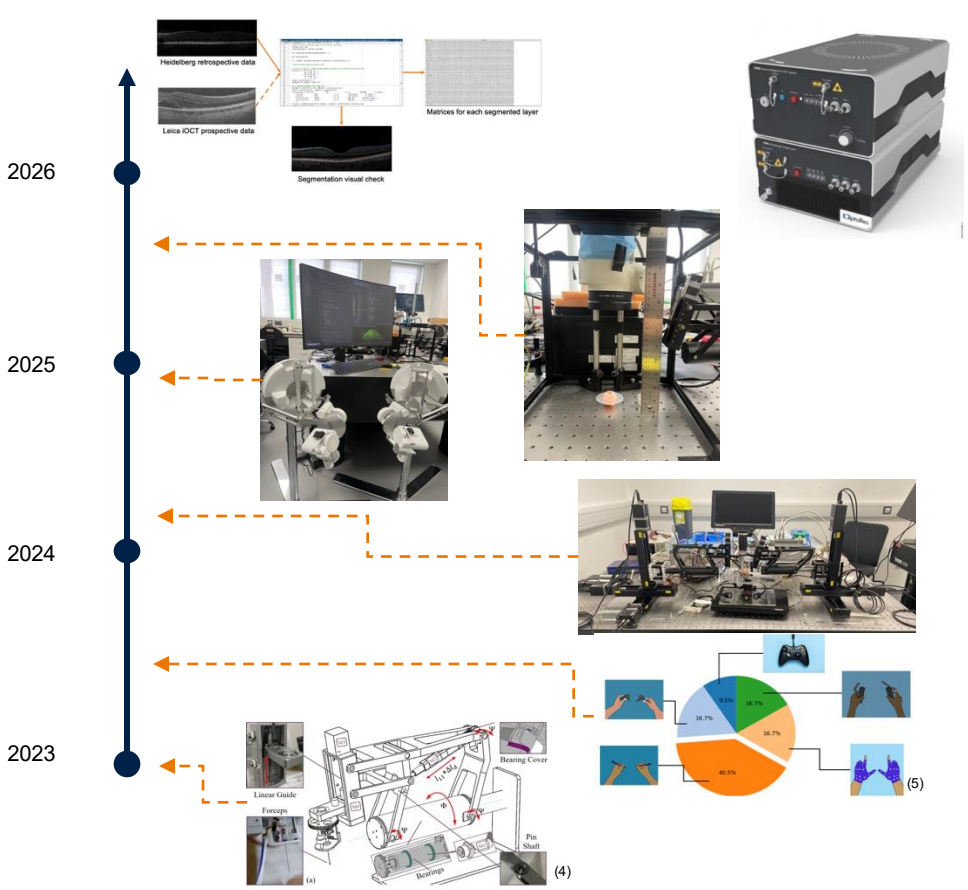
- Surgical **targets** require precision in a range of **micrometres;**
- The average globe **diameter** is **22mm**[1]**;**
- Surgeries can last **longer** if complications occur;
- Standard microscope doesn't allow for spotting **hidden obstacles;**
- There is a **gap in skill** between consultants and trainees[2];
- **Psychological factors** affect outcomes;
- **Muscles** experience **fatigue** when working with **high precision;**
- Human experience natural limb **tremor** of **frequency 10Hz** and **magnitude of 100μm**[3]**;**

Methods

Visual – **O**CT – **R**obot – **T**actile **Ex**perimental (VORTEx) Feedback Loop



Novelty



Results

- We developed a **novel safety mechanism** for the OmSR
- The VORTEx loop can be **easily integrated** with parallel systems for **improving complexity**
- The VORTEx Loop can run concurrently with other computing processes via **threading** without **optimisation** reduction
- We built a **novel swept source OCT system** using a **1.6MHz Fourier Domain Mode Locking (FDML) Laser** (Optores GmBH, Germany) with **custom integration with Leica Proveo 8** (Leica Microsystems Inc) OCT scanner head

Future Directions

- Developing platform for **telesurgery**
- Developing the **Digital Twin Simulator** for use in surgeon training
- Use in **anterior chamber** surgeries

1. D. Silver et al. "Human eye dimensions for pressure-volume relations," Invest. Ophthalmol. Vis. Sci., 2010;
2. Yamakiri et al. "Effect of surgeon-related factors on outcome of retinal detachment surgery: analyses of data in Japan-retinal detachment registry." Scientific Reports, 2022;
3. C. Riviere et al. "Characteristics of hand motion of eye surgeons," in Proc. 19th Annu. Int. Conf. IEEE Eng. Med. Biol. Soc., 1997;
4. Wang N et al. "A. Vision-and-Force-Based Compliance Control for a Posterior Segment Ophthalmic Surgical Robot." IEEE Robotics and Automation Letters. 2023;
5. Goch A et al. "User Interface for Bimanual Robotic System in Posterior Segment Surgery – Survey Study." Investigative Ophthalmology & Visual Science. 2024;

SURGICAL ROBOT VISION research group
UCL ENGINEERING Change the world
UCL Hawkes Institute
UKRI
i4health intelligent integrated imaging
NIHR Moorfields Biomedical Research Centre
Moorfields Eye Hospital NHS Foundation Trust
ROYAL FREE CHARITY
NHS Royal Free London NHS Foundation Trust