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PHD STUDENT | PROGRAM 2
ARC TRAINING CENTRE FOR JOINT BIOMECHANICS

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My interests: Robotic systems, prototype development, machine learning, computer vision.

BEng (Mechatronics, QUT)

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PROJECT OVERVIEW

Project Title: Localisation Quality Prediction in Visual Guidance for Robot Assisted Shoulder Arthroplasty

THE PROBLEM

Why are surgical robots important for shoulder arthroplasty?

- Shoulder arthroplasty is the fastest growing joint replacement procedure in the world, with growth expected to continue.
- A key factor in patient outcomes following shoulder arthroplasty, both in terms of implant longevity and shoulder function, is correct glenoid implant positioning.
- Achieving accurate implant placement is challenging due to the complex anatomy of the shoulder, very limited bone exposure, and the mobility of the bone during surgery.
- Existing surgical robotics have been shown to improve the precision and accuracy of implant positioning in other orthopaedic procedures such as knee arthroplasty but none are available for the shoulder.

Why does this need research?

The existing "gold standard" in orthopaedic surgical robots uses optical markers to track bones and guide the robots. These systems interfere with the surgical workflow and the need to directly attach markers to bones introduces new potential complications. Markerless vision-based systems are an attractive alternative to current optical marker technology. However, these are very challenging to implement because of both the absolute difficulty of the problem and the large variation in conditions between surgeries.

How can localisation system self-assessment help?

Developing the ability of vision-based guidance systems to perform self-assessment can help facilitate the transition away from marker based technology without achieving a markerless system that works in all conditions. Localisation self-assessment will give a robot the ability to actively work towards maintaining the required level of localisation performance as well as recognise situations where acceptable performance is not possible and a safe hand over to a human operator is needed.

HYPOTHESIS

Localisation system self-assessment can improve overall system performance and safety for vision-guided surgical robots while providing improved surgeon-robot collaboration.

PROJECT AIMS

The overall project goal is development of trustworthy vision-based guidance for a robotic surgical assistant in shoulder arthroplasty through the following stages:

1. Development of localisation systems that are able to self-assess their own performance and identify instances of localisation failure.
2. Leverage performance self-assessment to improve overall system performance through automatic selection of system configurations and active navigation.

OUR SOLUTION & EXPECTED OUTCOMES:

Rather than overcome the limitation of existing orthopaedic surgical robots by trying to create a ‘perfect’ markerless system that works in all circumstances, we instead focus on developing trustworthy localisation systems that self-assess their own performance and act accordingly to either maintain an acceptable level of performance or recognise the need for hand over to a human operator. Through this we aim to both improve current technology, facilitate future semi or fully markerless technologies, and improve surgeon acceptance of assistive robot technology in orthopedics.

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