

An Indian-Australian research partnership

Project title: *Dynamics and control of parallel robotic manipulator with end effector constraints*

Project number: IMURA0106

Monash University supervisor: Dr. Chen Chao

Monash University contact: Dr. Chen Chao chao.chen@eng.monash.edu.au

IITB supervisor: Dr. P.S. Gandhi

IITB contact: Dr. P.S. Gandhi gandhi@me.iitb.ac.in

Research Academy theme:

*Advanced computational engineering, simulation and manufacture
Biotechnology and Stem Cell Science*

The research problem

Robotic manipulators are recently being developed and applied to medical applications such as retinal surgery (vitrectomy, retinal vein drug injection and so on), neural surgery because the application needs stability of tool within less than a few microns (which only highly skilled surgeon in small part of his age can demonstrate). These applications typically put constraints on the end effector in a way demonstrated in the Figure. Parallel manipulators have inherent advantages over their serial counterparts in that all the actuators can be on a fixed platform thereby enhancing the stiffness and robustness of manipulator. Further, the very limited workspace of parallel manipulator meets the safety requirement of surgical robots. These advantages come along with complexity in dynamics of these manipulators. Surgical robots will typically have additional constraints on these manipulators. Under these constraints the manipulation becomes even more complex. Successful design of parallel robots in these applications needs resolving problem of dynamics and control of parallel robotic manipulators with constraints on end effector.

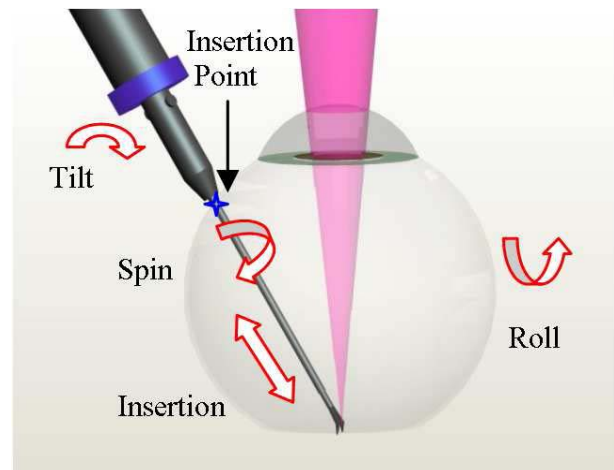


Figure: Constraints in retinal surgery on robotic manipulator (source: Proc of 2007 IEEE International Conference on Robotics and Automation, Rome, Italy.)

Project aims

Our central goals: first to develop mathematical equations of dynamics of a parallel robotic manipulator with end effector constraints and develop techniques to characterize the dynamics and develop controllers to perform end effector manipulation. Next to demonstrate the effectiveness of the proposed techniques for designing and controlling a parallel robotic manipulator for retinal surgery application. Development both in theory and experiments would be done toward this end goal.

Expected outcomes

The project is expected to solve the problem of design and development of parallel manipulators with end effector constraints. These would be mainly useful for surgical applications of various types and in addition other industrial robotic applications.

This Project is an ideal stepping-stone for a rewarding academic or industrial career in the area of robotics applied for various surgical needs. It will provide student in depth training on dynamics, control and simulation of robotic manipulators and their practical development. It is an excellent opportunity to work with surgeons in

medical institution to understand their needs and incorporate them in the development. The project may result into a product that can be unique in itself and having potential for commercialisation.