Announcing the Final Examination of Shihao Zhang for the degree of Master of Science

Time & Location: April 2, 2018 at 4:15 PM in ENG I 288
Title: Design and Motion Control of a Four Degree of Freedom Robotic Needle Guide for MRI - Guided Intervention

In the past several MRI compatible robotic needle guide devices for targeted prostate biopsy have been developed. The large and complex structure have been identified as the major limitations of those devices. Such limitations, in addition to complex steps for image to device registration have prevented widespread implementation of MRI-guided prostate biopsy despite the advantages of MRI compared to TRUS.

We have designed a compact MRI-guided robotic intervention that can eliminate complicated registration steps along with the capability to have angulated insertion to avoid damage to any anatomical feature along the needle path. The system consists of a novel mechanism driven Robotic Needle Guide (RNG). The RNG is a 4-DOF robotic needle manipulator mounted on a Gross Positioning Module (GPM), which is locked on the MRI table. The RNG consists of four parallelly stacked disks with an engraved profile path. The rotary motion and positioning of the discs at an angle aids in guiding the biopsy needle. Once a clinician selects a target for needle insertion, the intervention provides possible insertion angles. Then, the most suitable angle is selected by the clinician based on the safest trajectory. The selected target and insertion angle are then computed as control parameters of RNG i.e. the discs are then rotated to the required angle. Insertion is followed by quick confirmation scans to ascertain needle position always.

Major: Mechanical Engineering

Educational Career:
Bachelor's of Mechanical Engineering, BA, 2015, Central Michigan Unviersity

Committee in Charge:
Sang-Eun Song, Chair, Mechanical & Aerospace Engineering
Ulas Bagci, Center for Research in Computer Vision
Yunjun Xu, Mechanical & Aerospace Engineering

Approved for distribution by Sang-Eun Song, Committee Chair, on March 19, 2018.

The public is welcome to attend.