Enhanced Haptics & Environment-Detailing for Virtual Reality Training of Minimally Invasive Surgery

AggiE_Challenge Fall 2015

Faculty Mentors

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Introduction

- **Haptics** is the science of applying touch (tactile) sensation and control to interaction with computer applications.

- The word *haptic*, from the Greek: ἁπτικός (*haptikos*), means "pertaining to the sense of touch."

- **Haptic technology** refers to the technology which *recreates* the sense of touch by applying *forces, vibrations, or motions* to the user.
General Applications

- In Large Aircrafts forces on the control surfaces are simulated on cabin controls to get a sense of the external forces acting on the plane.

- Commercial applications include Video games, Personal computers, Mobile devices, Virtual reality and more recently wearable technology
Haptic Interaction with a deformable object
Basic Haptic System
Applications in Medicine

- Useful for training in minimally invasive procedures and remote surgery

- Dentistry, Temporal bone surgery, Laparoscopy, Interventional Radiology etc.
Research Focus

- Focus of this project is to research haptics in bone drilling simulation

- Our Aim is to create realistic and perceivable force and vibrations feedback using a haptic device to simulate bone drilling
Key Challenges

- Study the forces and vibrations produced in bone cutting and develop a rendering algorithm to simulate these forces and vibrations.

- Understand the human perception to different frequency and intensity of vibrations and model the haptic system accordingly.
Approach

- We divided the team into three groups, Team A, B and C

- Team A is dedicated to experimentation. Their aim is to characterize force and vibrations produced during bone drilling

- Team B will design perception study setup to do psychophysical studies to understand the human perception to vibrations

- Team C will develop concepts to mount vibration actuators on the haptic device stylus.
Team – A

- Designed the Setup for Perception Studies

- Recorded Forces and Vibration Data from the Studies

- Team A is yet to do analysis find the relationship between the cutting parameters and the force and vibration data.
Experimental Setup

Experimental Setup Showing the Cutting tool and work piece being cut

Figure shows the drilled portion of workpiece
Team – B

- Designed a perception study setup to do psychophysical studies to understand the human perception at different vibration intensities and direction.

- The data will be used to modify the haptic signal sent to device.

- Team B also designed the circuit and equipment necessary for these studies.

- The setup includes digitally controlled waveform circuit and amplifier circuit.
Experimental Setup

Perception studies Setup

Concept for the Perception studies Setup (TEAM - B)
Signal Generator Circuits designed for perception studies setup

By this Circuit We will be able to control the amplitude and frequency of vibration felt on the aluminum stylus.
Team - C

- Team-C developed concepts to mount vibration actuators on the haptic device stylus

- By mounting the vibration actuators on the stylus we can create a system that produces not only forces but also vibrations

- Next step is to fabricate and test the stylus mountings.
Integrating work from all teams

- The work from all three teams will be used to realize the final product.

- The results of Team A provides us the data regarding force and vibration produced during bone drilling,

- Team – B providing data regarding the frequencies or combination of frequencies that are perceivable by humans during bone drilling.

- We use this data to simulate the vibration and forces on a haptic device with the vibration actuator mounts designed by team-C
Overview of Work For Next Semester

- Analysis of Force and Vibration data recorded by Team-A

- Find the relationship between the cutting parameters and the force and vibration data

- The Setup for the psychophysical studies ready to use and the experiments with the help of human subjects will be conducted next semester

- To fabricate and test the stylus mountings designed by Team-A
AGGIE CHALLENGE TEAM

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Graduate student mentor: Avinash Danda (MEEN)

Undergraduate Student Team

Austin Cantrell         Team - A MEEN
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