Force-Sensing Drill for Skull-Base Surgery

CIS II Checkpoint Presentation

Group #8

Harsha Mohan & Seena Vafaee

JOHNS HOPKINS

WHITING SCHOOL

of ENGINEERING

Project Overview & Motivation

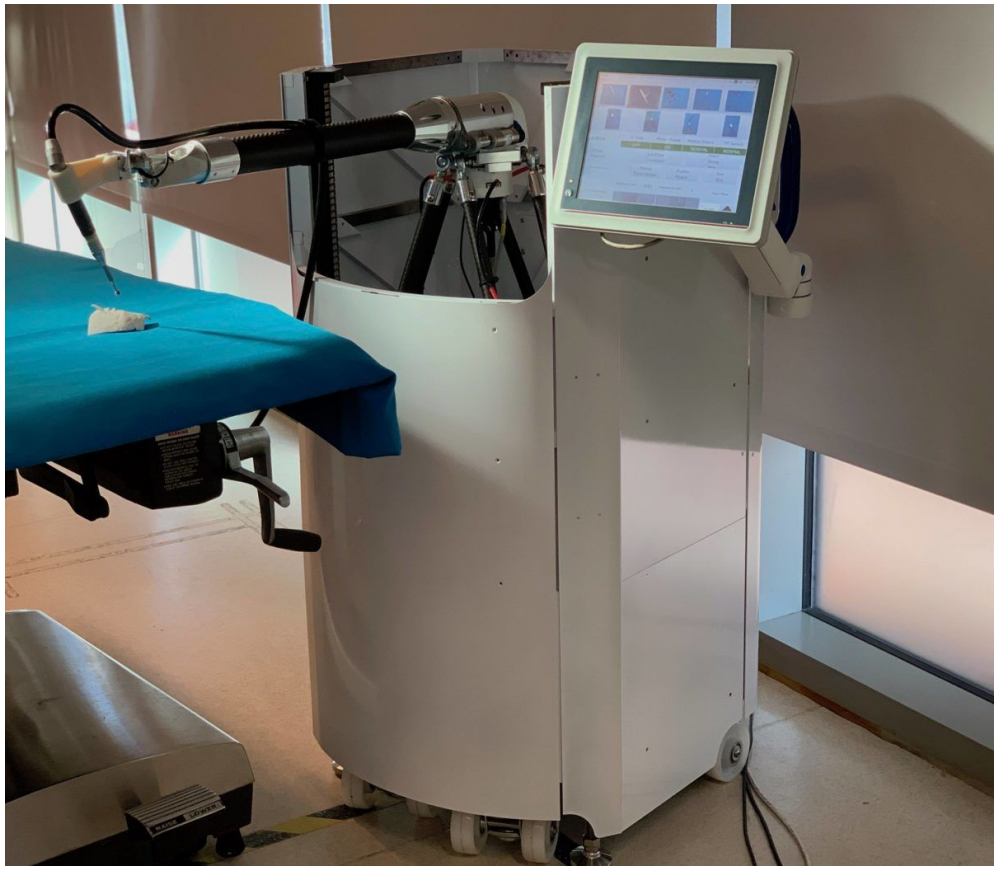
Galen offers a steady hand, but sacrifices haptic sensation

Surgeons are navigating around critical anatomy during Skull-Base Surgery

For some tasks, it is useful to modulate the tool-tissue interaction forces

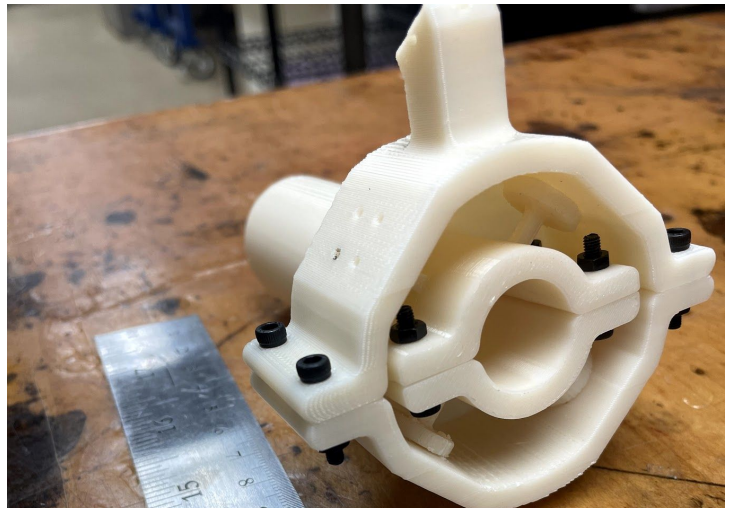
Use Case:

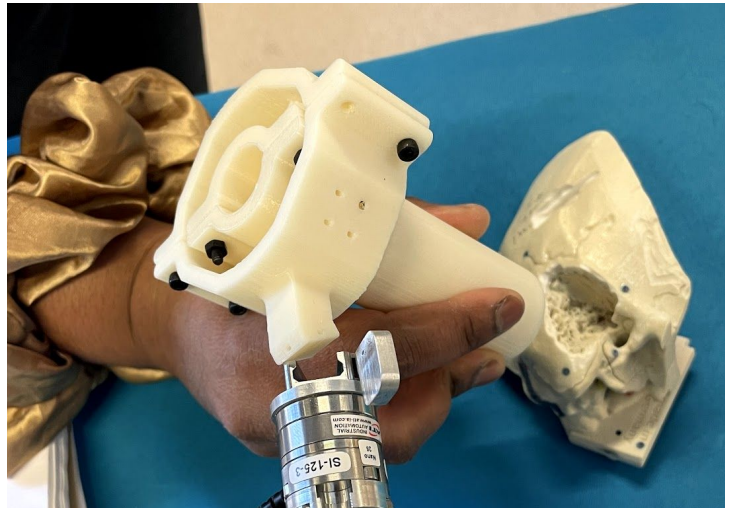
- Surgeon training and skill evaluation
- First step to provide force-feedback

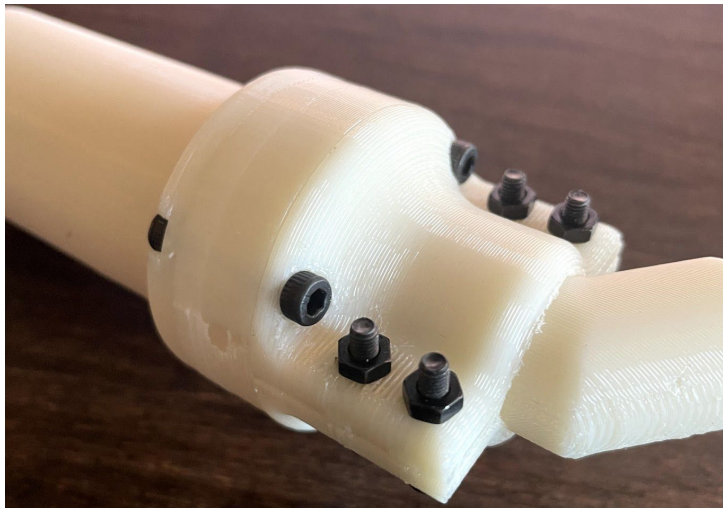


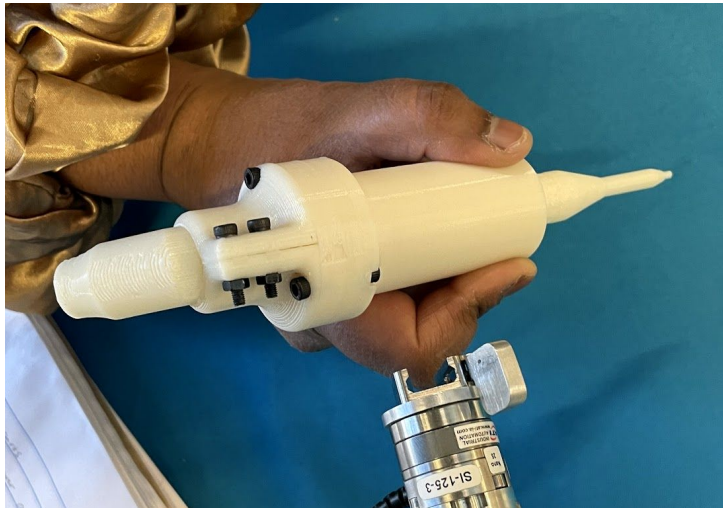
[1]

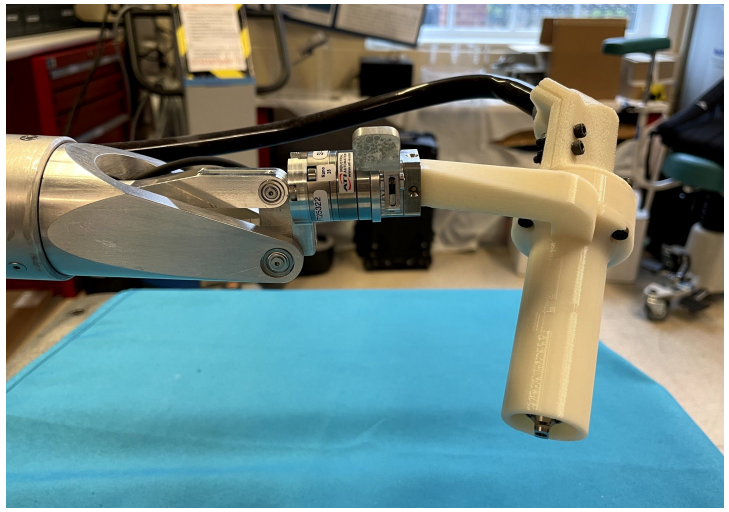
Project Progress

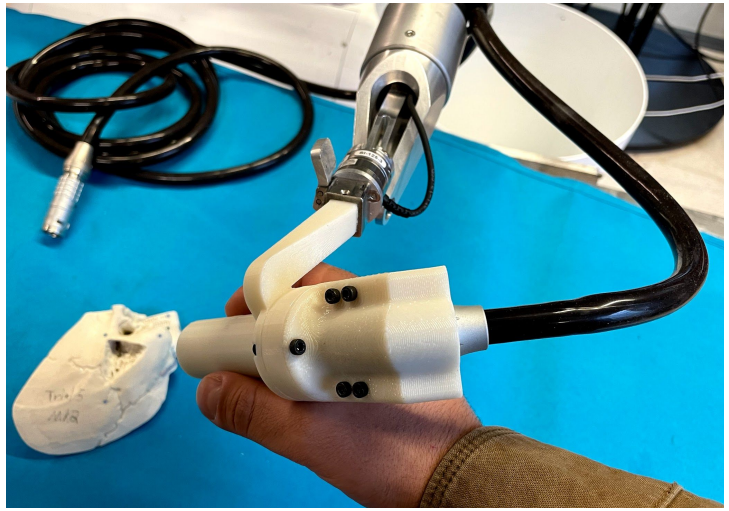








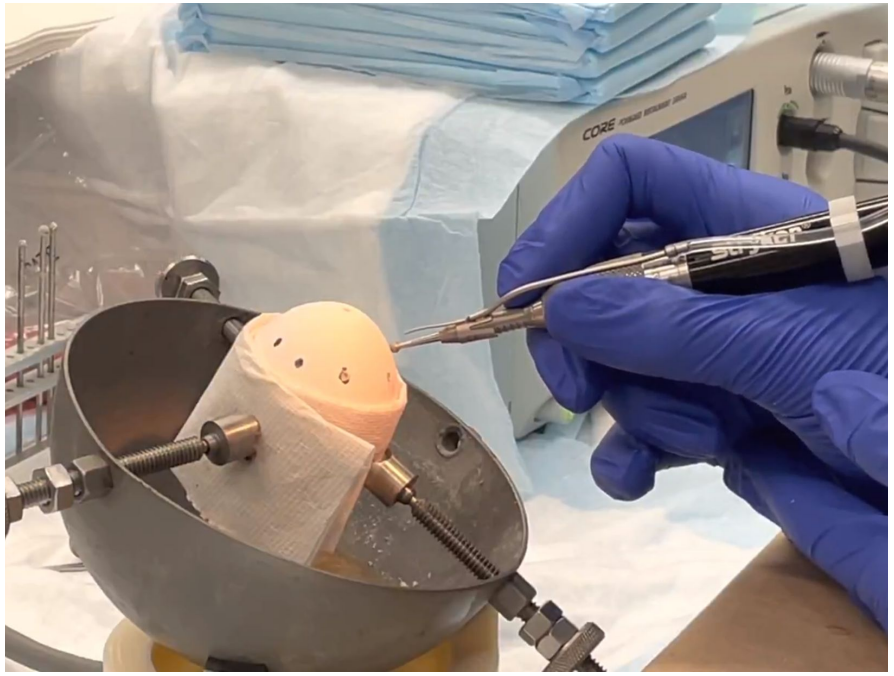




Testing/Validation Plan

- **Ergonomics**
  - *Task:* iterate dimensions and geometry based on surgeon feedback
  - *Evaluation Criteria:* field of view, manipulability, comfort

- **Eggshell drilling experiment**
  - *Task:* Drill multiple egg-shells with force-sensing adapter attached to the Galen.
    - Use same experimental setup as before (including force sensor beneath the egg)
    - Compare results
  - Evaluation Criteria:



Updated Deliverables

Minimum

1. Initial 3D-printed prototype of instrument ✅
2. Documentation with results of initial drilling experiment ✅
3. Zip file with final CAD assembly *(expected Apr 21)*
4. Final report and documentation *(expected May 10)*

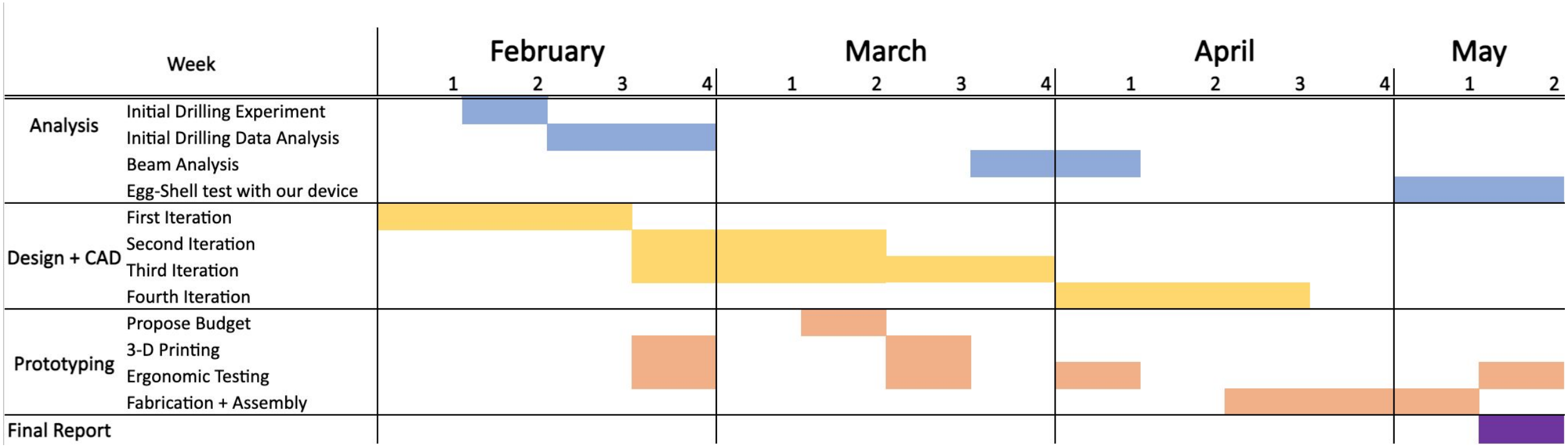
Expected

1. Complete bill of materials *(expected Apr 21)*
2. Three 3D-printed iterations of the design ✅
3. Fully assembled final prototype integrated with Galen robot *(expected Apr 21)*

Maximum

1. White paper with force readings from instrument measured during eggshell drilling experiment *(expected May 5)*
2. Repeat skull drilling experiment using our device *(TBD)*

Updated Timeline



Outstanding Dependencies

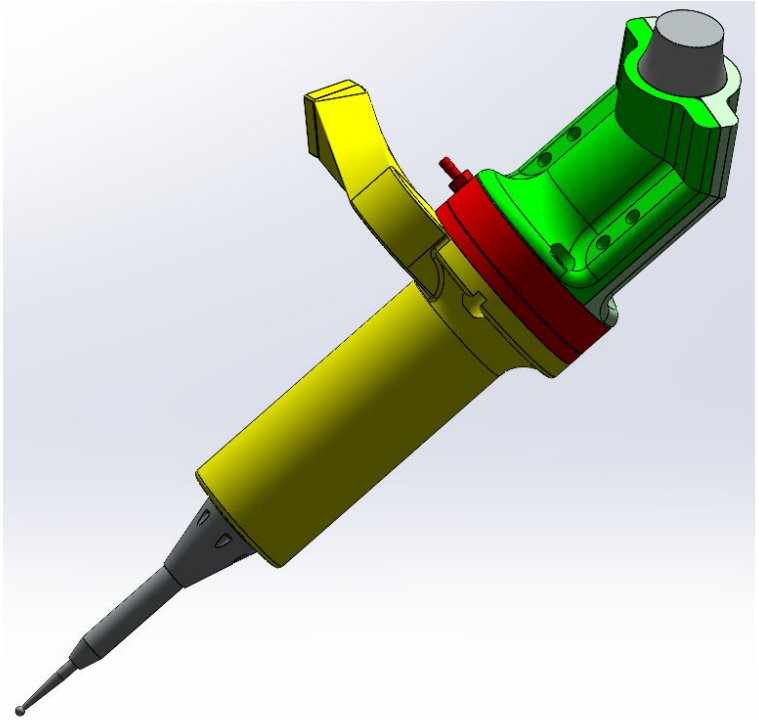
- Funding approval (Deepa submitted $8K request for fabrication)
- Need missing drill parts from J&J
- Waiting for F/T sensor to be returned from ATI

[2]

[3]

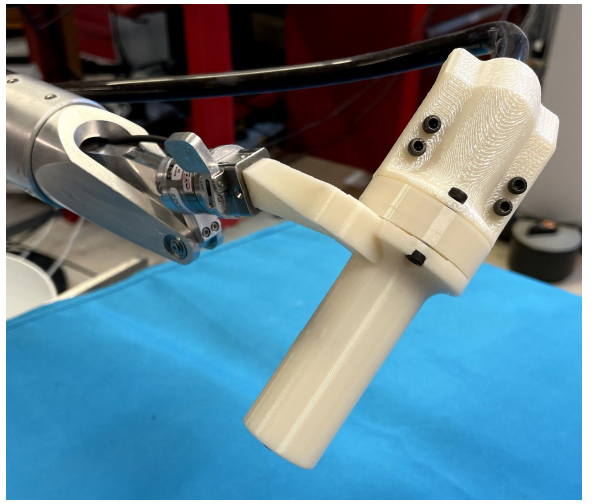
Management Plan

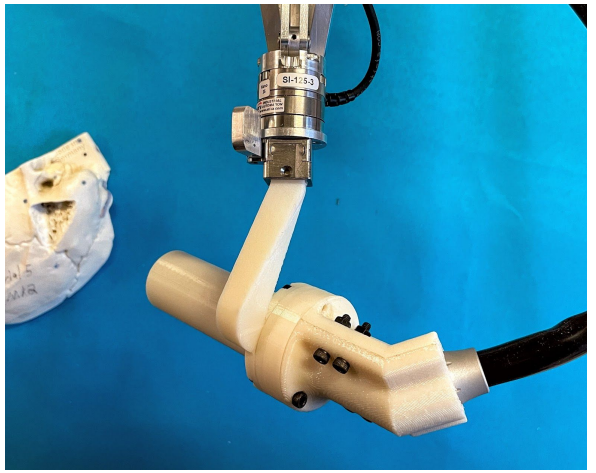
- Weekly updates at Galen meeting
- Weekly mentor meeting with Anna on Friday
  - Discuss technical aspects of design and manufacturing
- Weekly check-in with Deepa on Tuesday
  - Discuss ergonomic aspects of design
  - Discuss data from drilling experiments and next steps
- 5x weekly project-related discussions between Seena and Harsha
  - Making concrete design decisions
  - Progress updates on individual tasking



Next Steps

1. Continue to work with surgeons to get ergonomic feedback and iterate on design
2. Design additional features
    a. Specialized tool to aid changing the drill burr
    b. Attachment points/channel in grip for irrigation tube
3. Begin testing the device to confirm working principles





References

1. https://technical.ly/baltimore/2019/11/11/galen-robotics-verte-investment-opportunity-zone-fund-startups/
2. https://www.jnjmedicaldevices.com/en-EMEA/product/anspach-eg1-electric-system
3. https://www.ati-ia.com/products/ft/ft_SystemInterfaces.aspx