UC San Diego
JACOBS SCHOOL OF ENGINEERING

CMRR
Center for Memory and Recording Research

Position Localization for Pain Management Therapies

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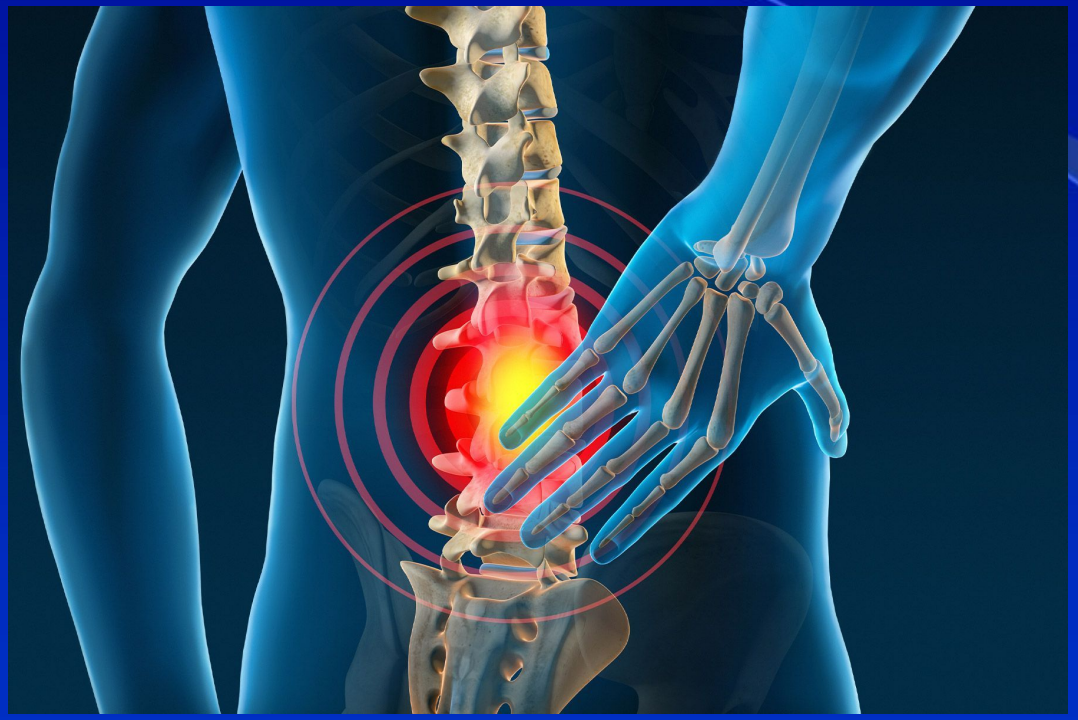
Outline

- Background
- Current Treatments and Technologies
- Clinical Challenge
- Research Approach
- Future Work

Chronic Back Pain

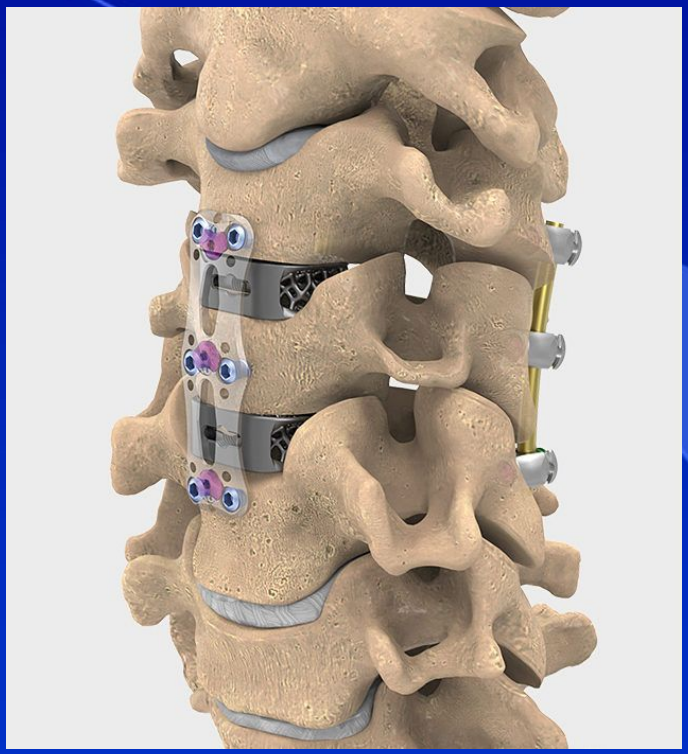


Chronic back pain is the leading cause of non-fatal health loss and disability globally

https://doi.org/10.1016/S0140-6736(18)32279-7

Current Treatments

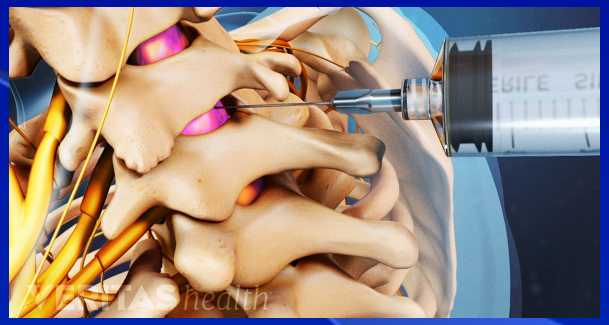
Physical Therapy
(first option)



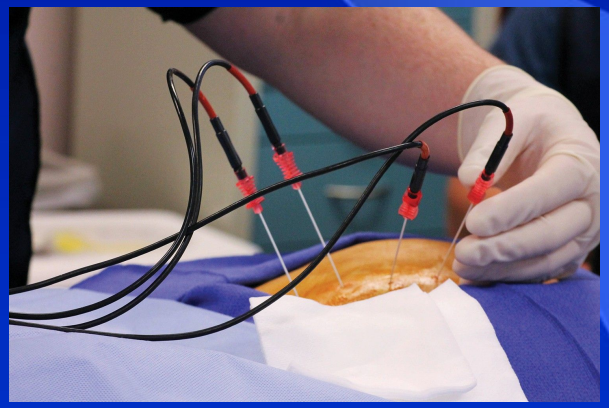
Spinal Fusion
(last resort)

Current Treatments (continued)

- Epidural Steroid Injections (ESIs)
  - Uses steroids to reduce inflammation near nerves



- Radiofrequency Ablations (RFAs)
  - Uses heat to burn nerves to stop them from sending pain signals



- Current interventional pain treatments need support of fluoroscopy scans to ensure accuracy

Existing Systems

Augmedics xvision

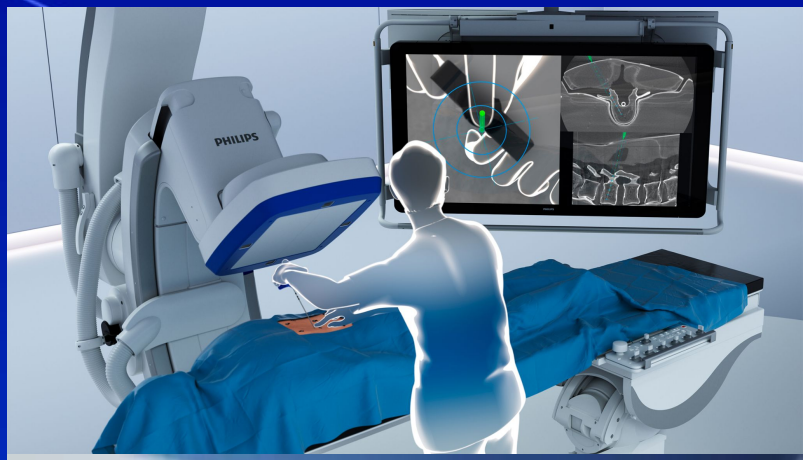
- Utilizes Microsoft Hololens
  - Built in rgb camera

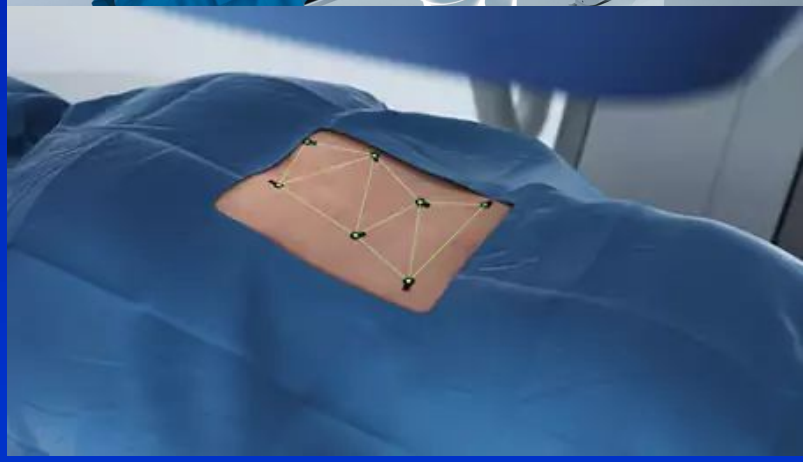
- 2D and 3D images of patient anatomy and instrument trajectory

- Requires invasive markers
- Instrument markers are bulky

Philips ClarifEye

- Cone-beam CT radiation and four optical cameras
- 8-10 non-invasive skin markers
- Preoperative CT scan
- External monitors divert physician attention





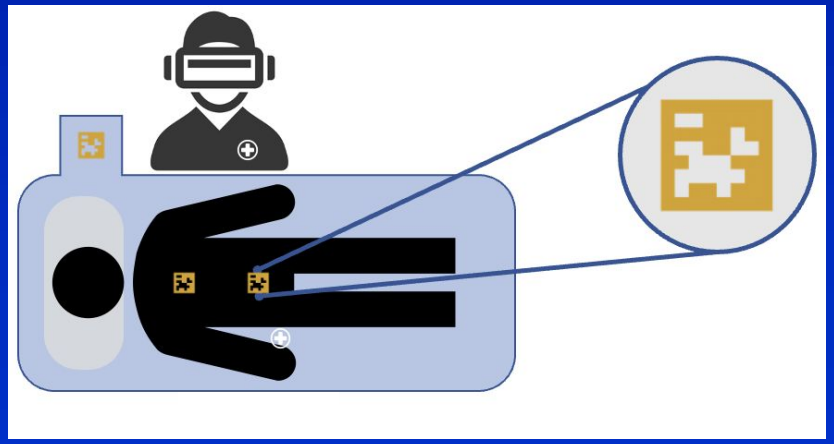
Clinical Challenge to Address

Create a non-invasive and inexpensive 3D augmented reality navigation system

- **Reduce radiation exposure**
- **Focus physician field of view**
- **Be minimally invasive**
- **Easily locate the best insertion trajectories despite different or damaged anatomies**

Talke Biomedical Lab Research Approach

- Focused on the tracking system
  - Test accuracy and feasibility of the skin markers
  - Build an XYZ Platform to conduct those tests

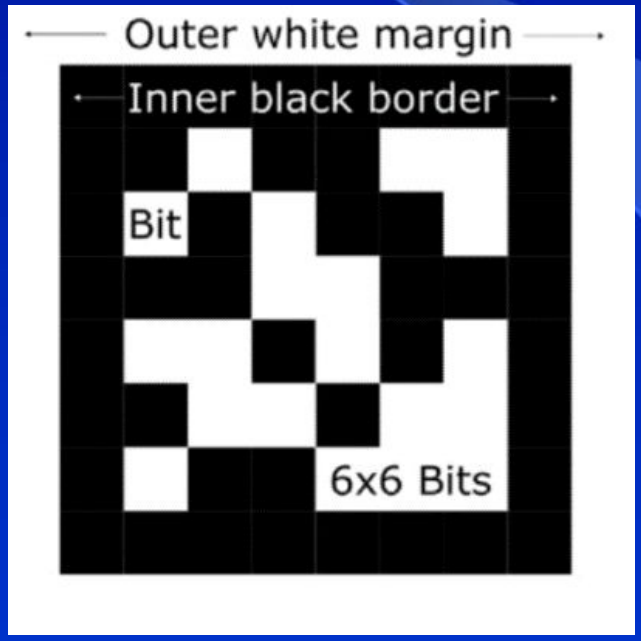


Depiction of the Skin Markers in the Operating Room

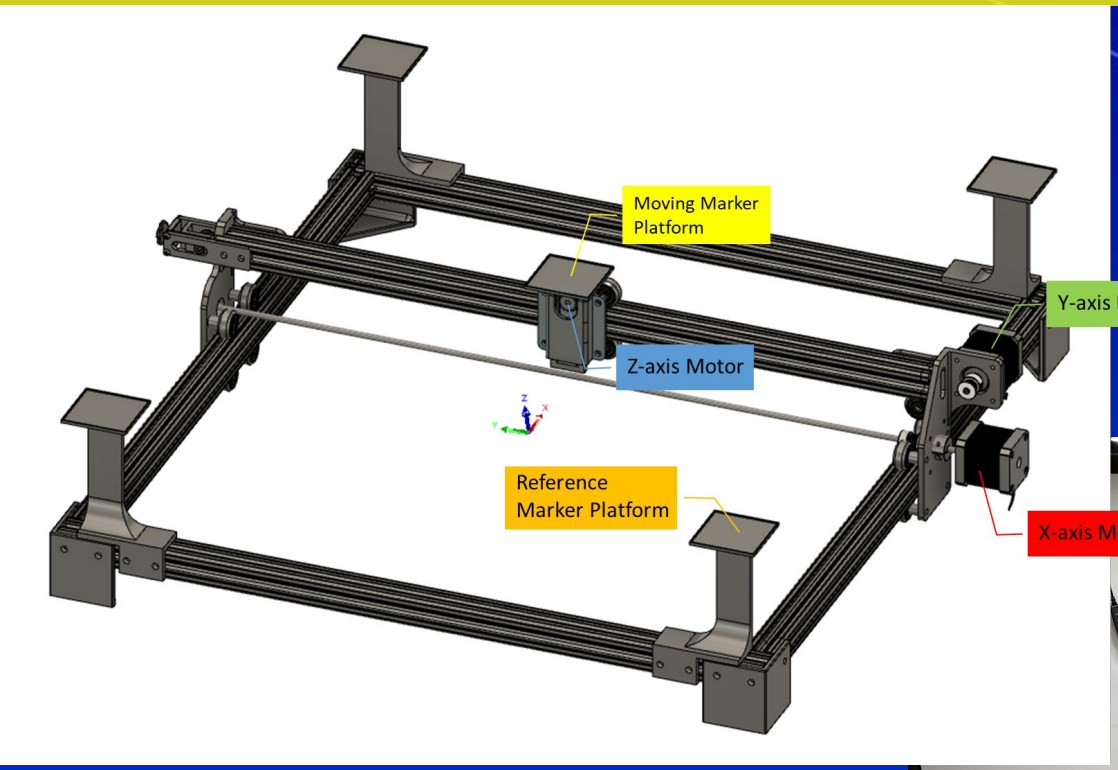
Tracking Codes

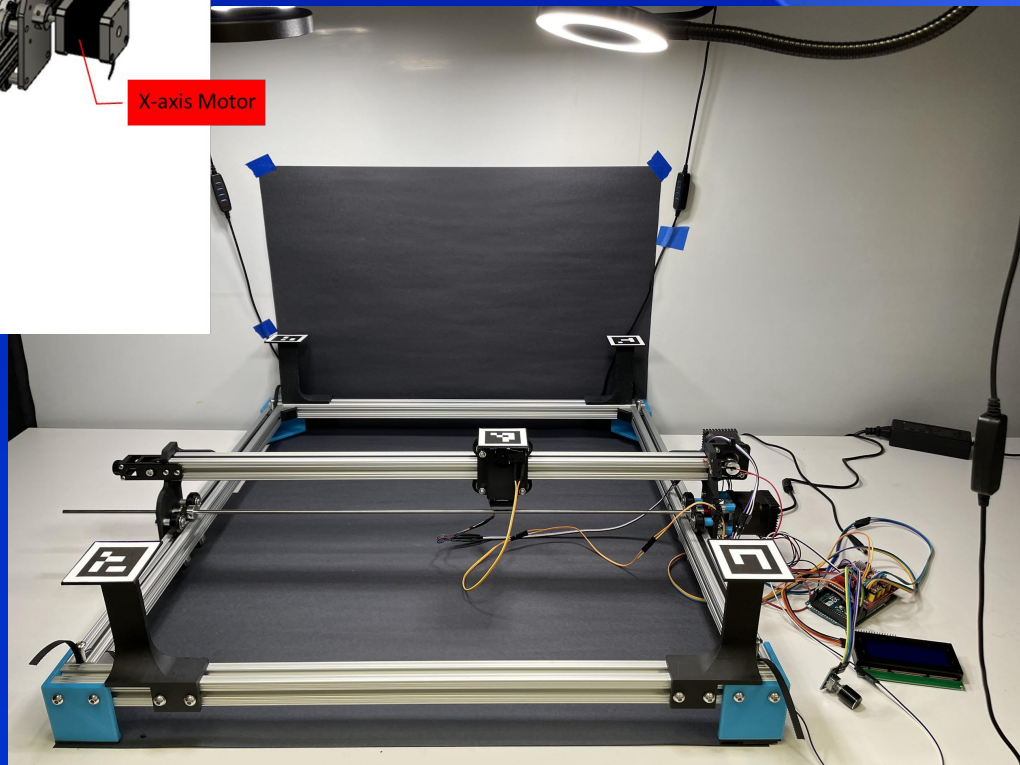
QR Code

ArUco Code

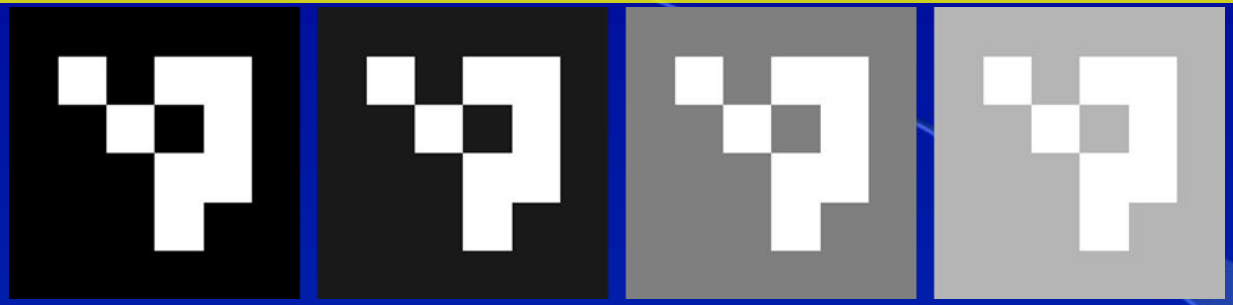


XYZ Platform

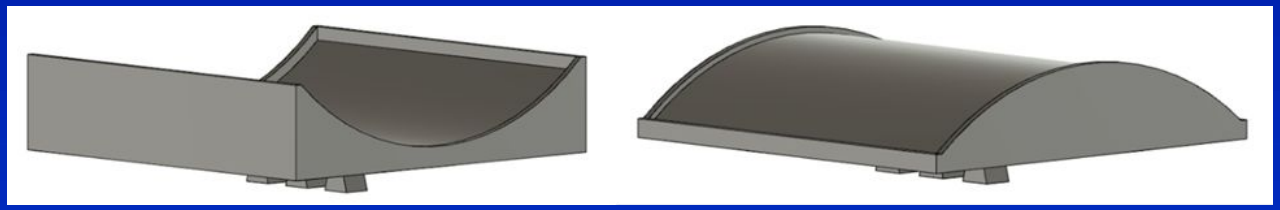




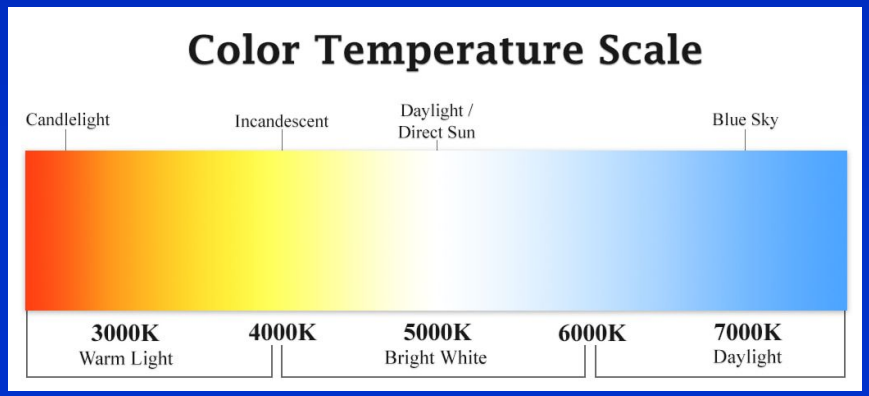
Marker Tracking Experiments



Marker Contrast

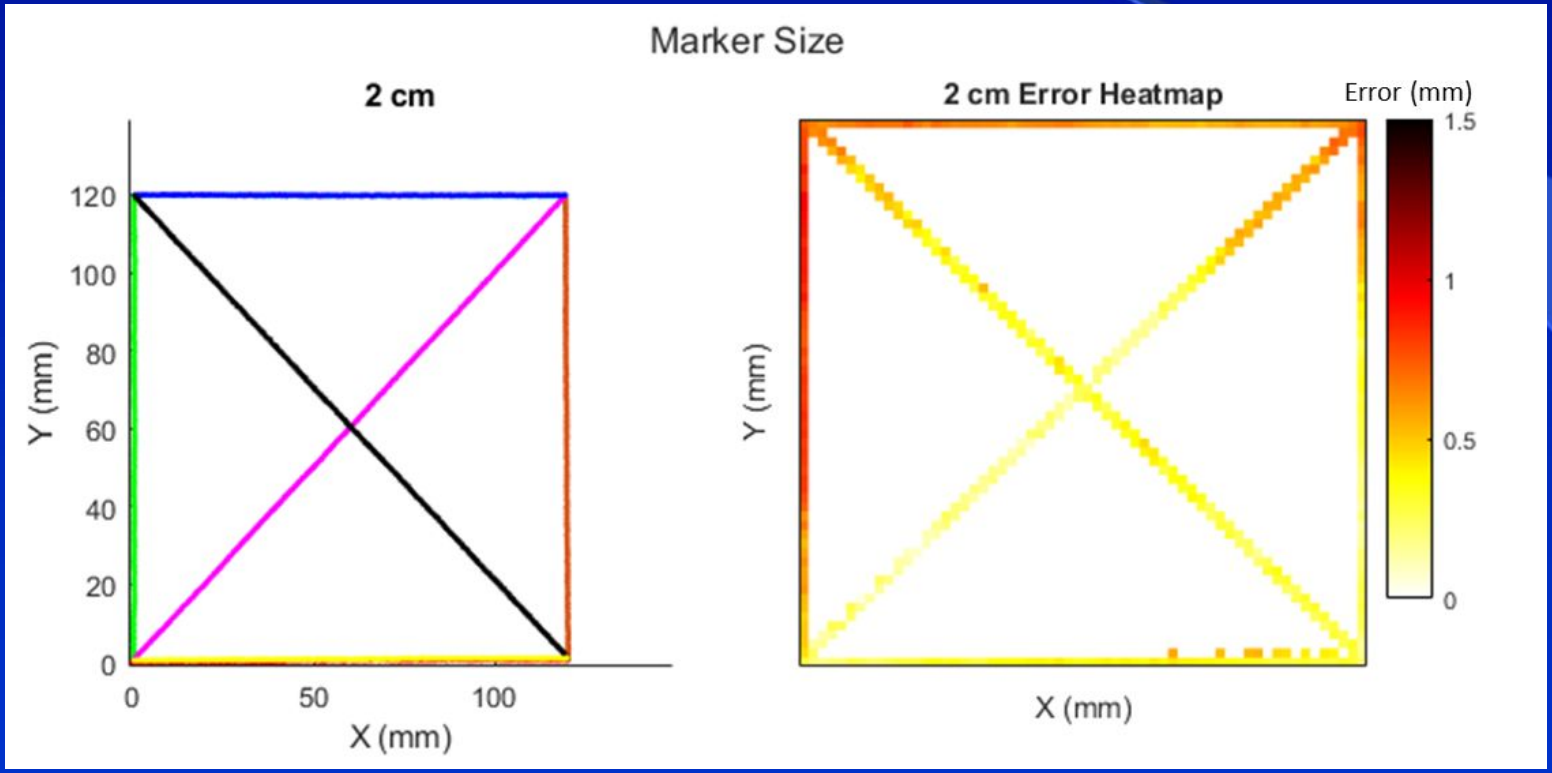


Marker Bending



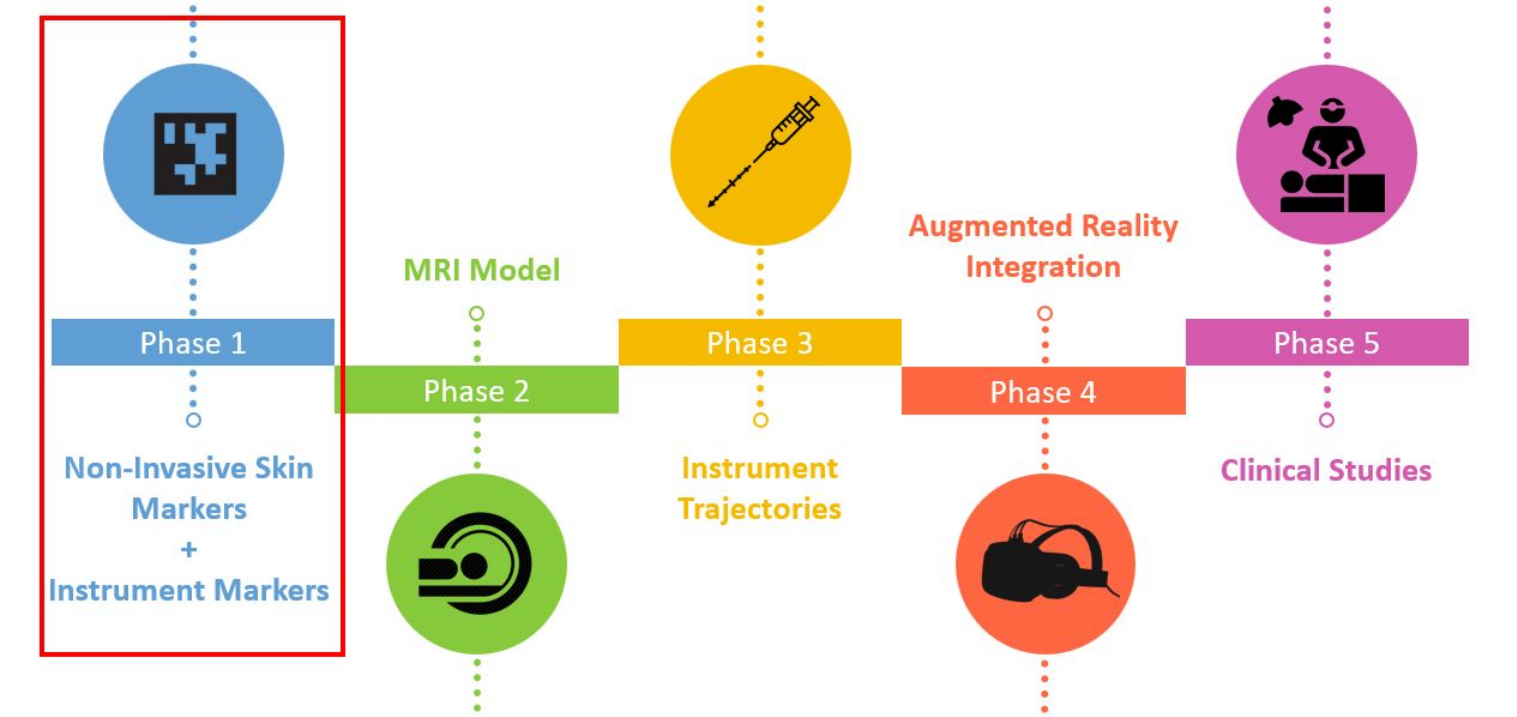
Operating Room Lighting Temperature

Marker Tracking



Post-processing Graphs of Marker Tracking Coordinates (left) and Error Heatmap (right)

Future Work



Five Phases of the Augmented Reality Navigation System Project

Summary

- Overall goal is to create a non-invasive and cost-friendly 3D augmented reality navigation system

- This year we focused on Phase 1
  - XYZ Platform
  - ArUco codes show great promise

- Want to improve pain management therapies
  - Follow up with us in the future!

Acknowledgements

Talke Lab

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Thank you!

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