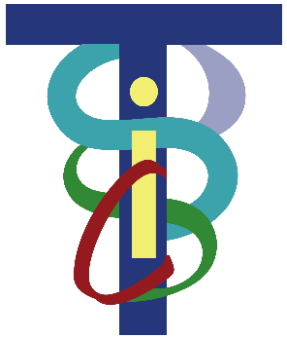

NSF Engineering Research Center
for Computer Integrated Surgical
Systems and Technology

MICRON RANGE-OF-MOTION VISUALIZATION

Check Point Presentation Team-14

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The Johns Hopkins University

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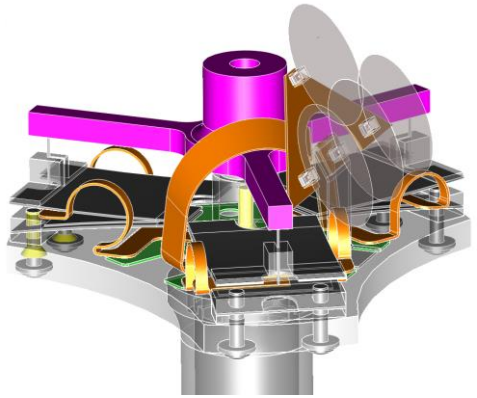
WHITING
SCHOOL OF
ENGINEERING
THE JOHNS HOPKINS UNIVERSITY

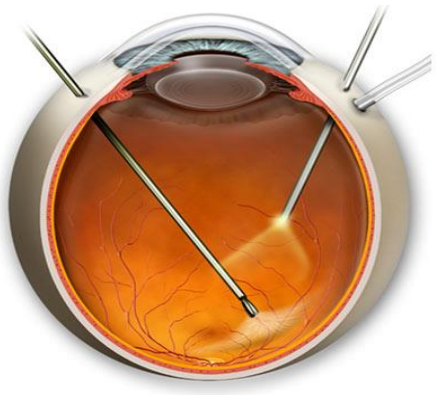
CONTENTS

Summary
Background
Progress
Deliverables
Dependencies
Timeline
Reading Lists

SUMMARY

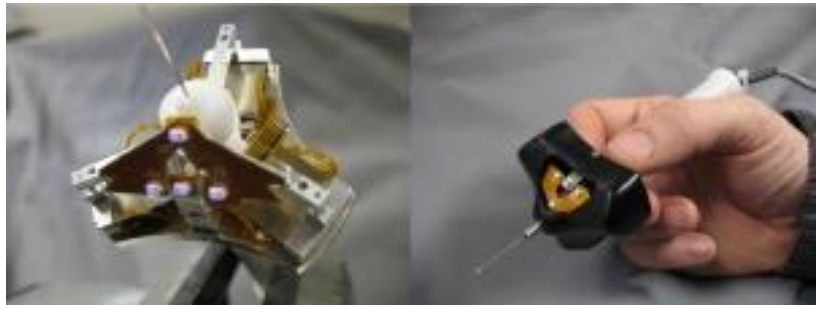
- Need :- Surgeons don't always know the position of the micron in its range of motion
- Goal :- Develop a visual alert assistance system for the surgeons dealing with very small anatomy.

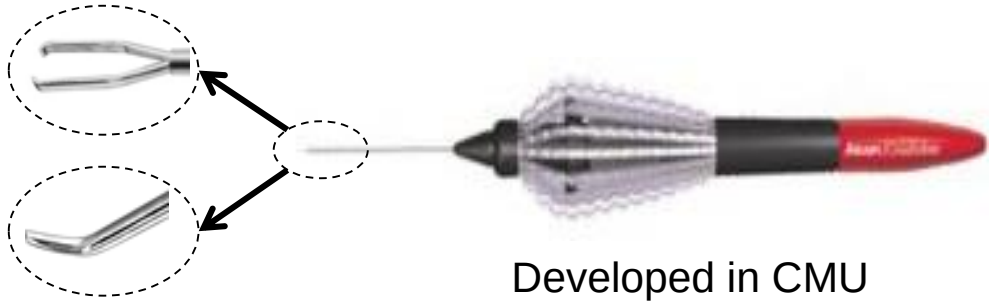




MICRON

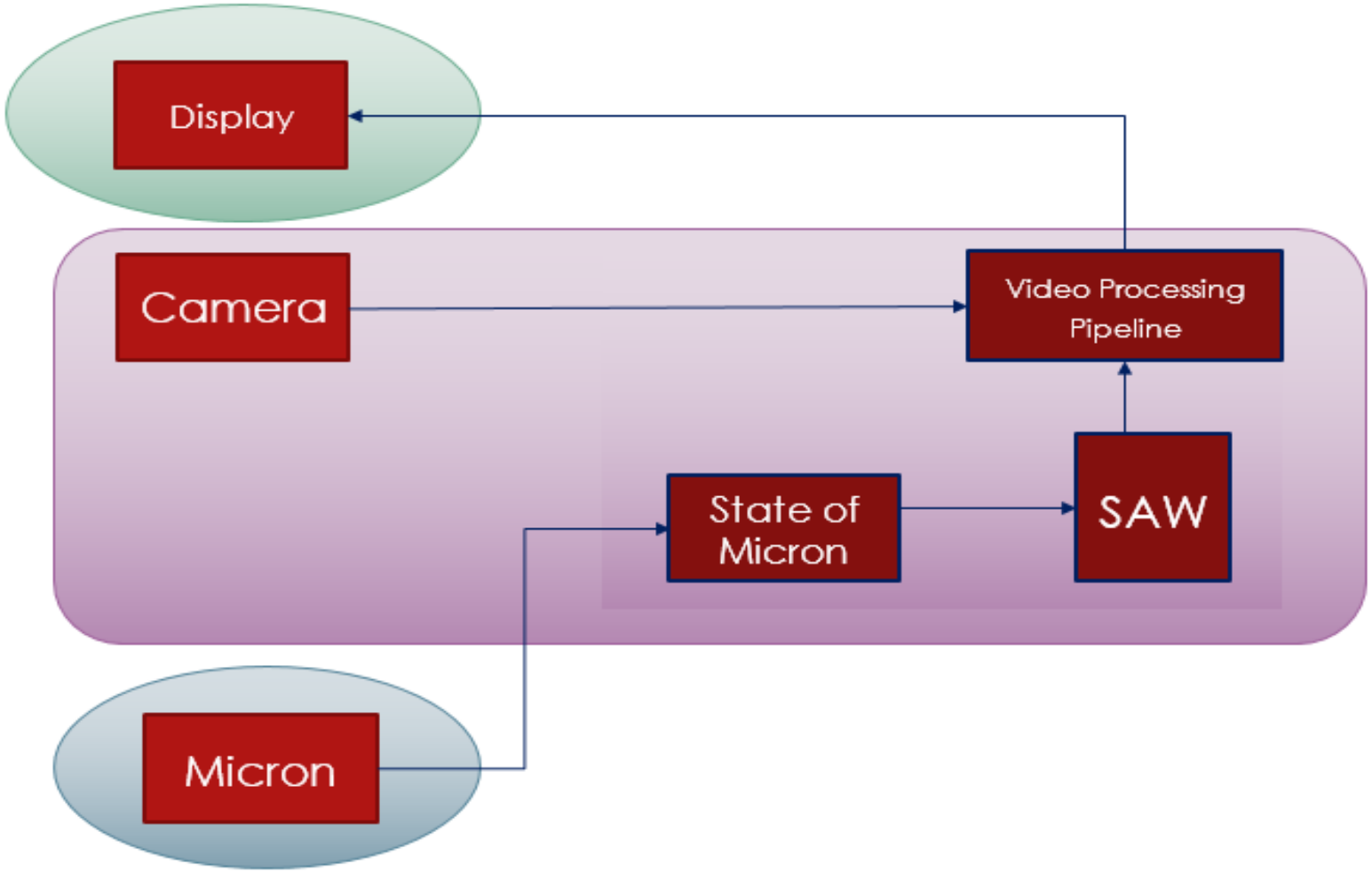
- Tremor Cancellation
- Move actively to compensate



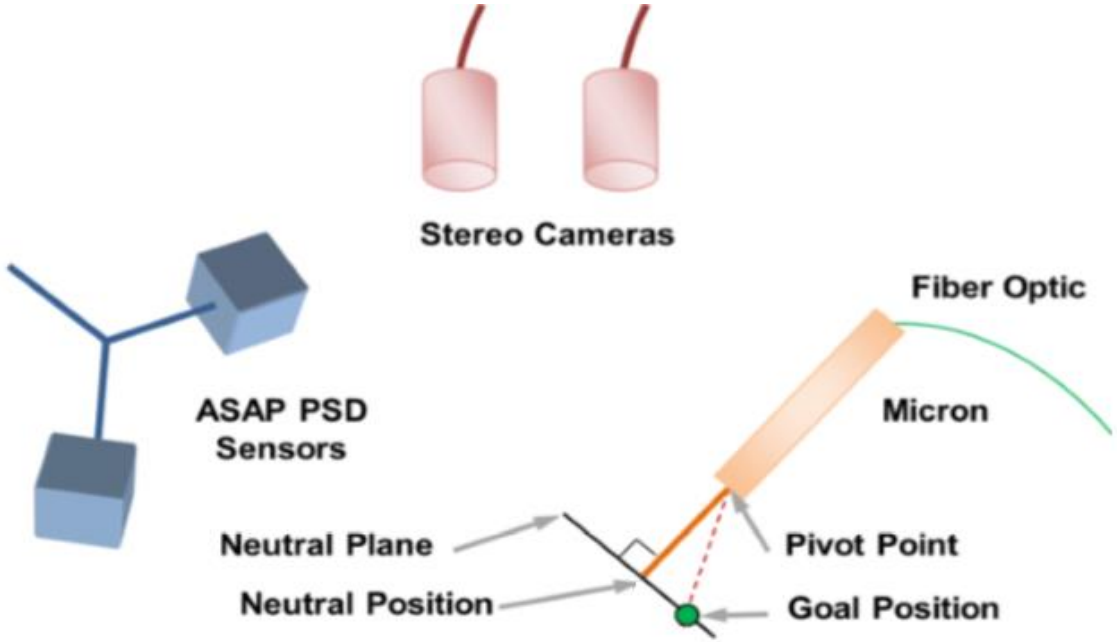


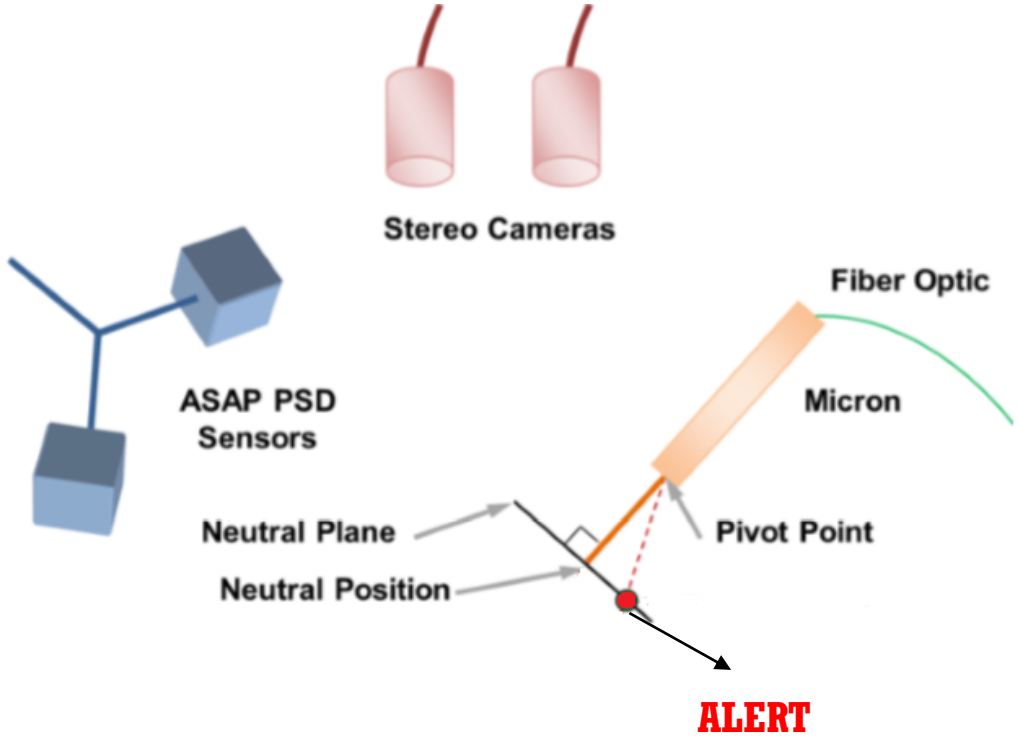
Developed in CMU

HARDWARE


Display
Camera
Video Processing Pipeline
State of Micron
SAW
Micron

SOLUTION

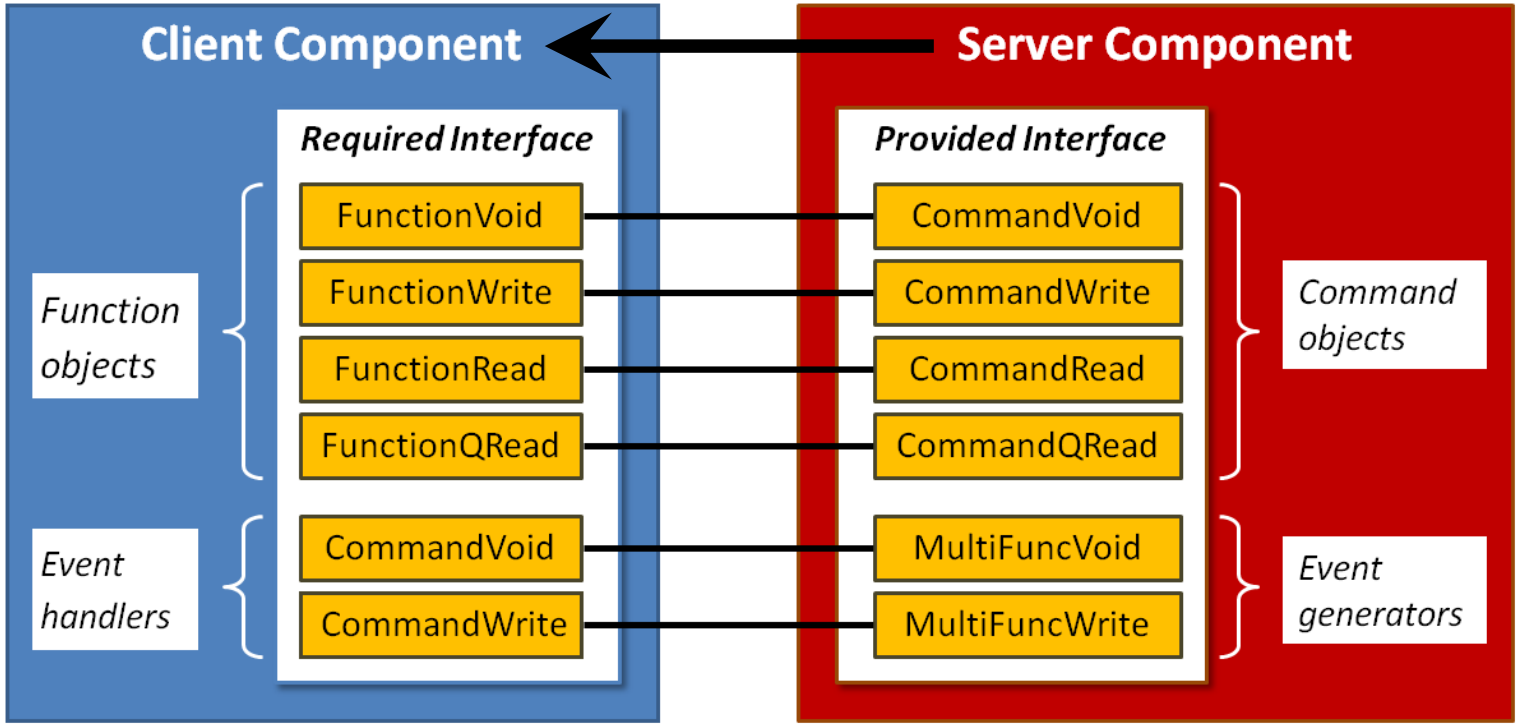

Stereo Cameras
Fiber Optic
ASAP PSD
Sensors
Micron
Neutral Plane
Pivot Point
Neutral Position
Goal Position


Stereo Cameras
Fiber Optic
ASAP PSD
Sensors
Micron
Neutral Plane
Pivot Point
Neutral Position
ALERT

CURRENT PROGRESS

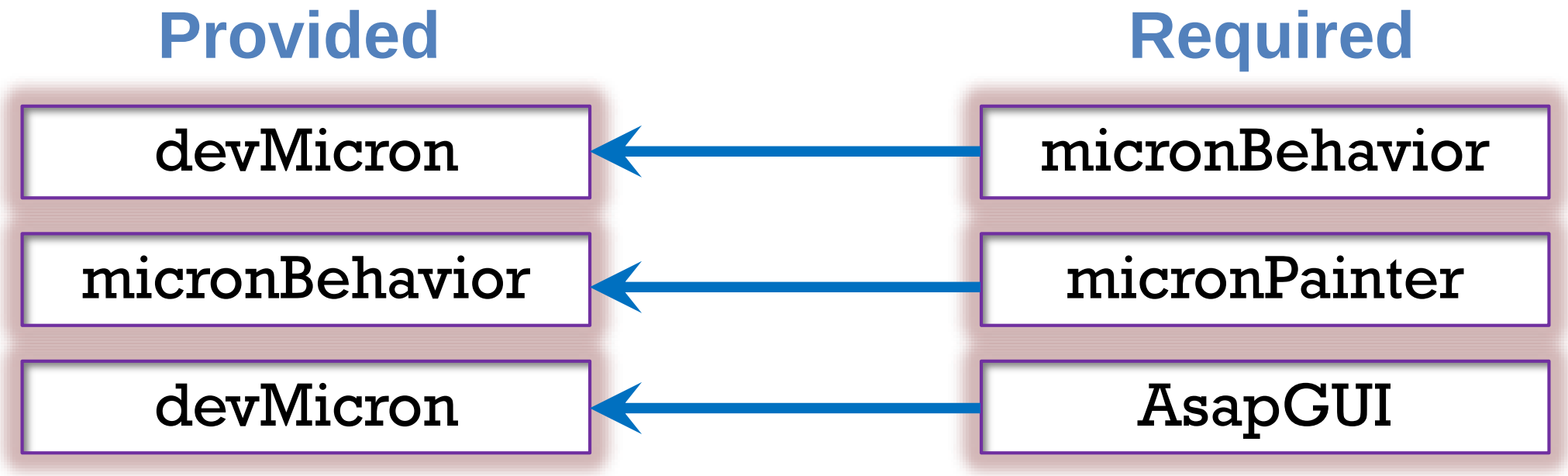
- Internal Component Connections
- Dummy Source
- Random Data
- Transformation between Frames
- Add Overlays
- Get motion Information from Micron

INTERNAL COMPONENT CONNECTION

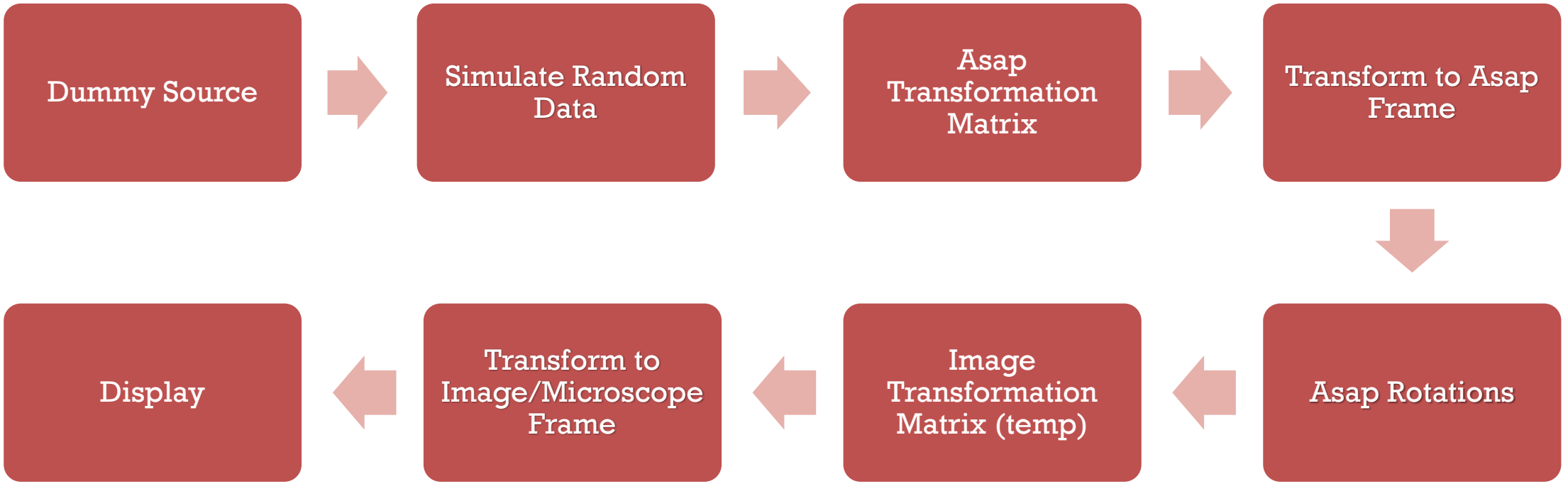


Source : https://trac.lcsr.jhu.edu/cisst/wiki/cisstMultiTaskTutorial

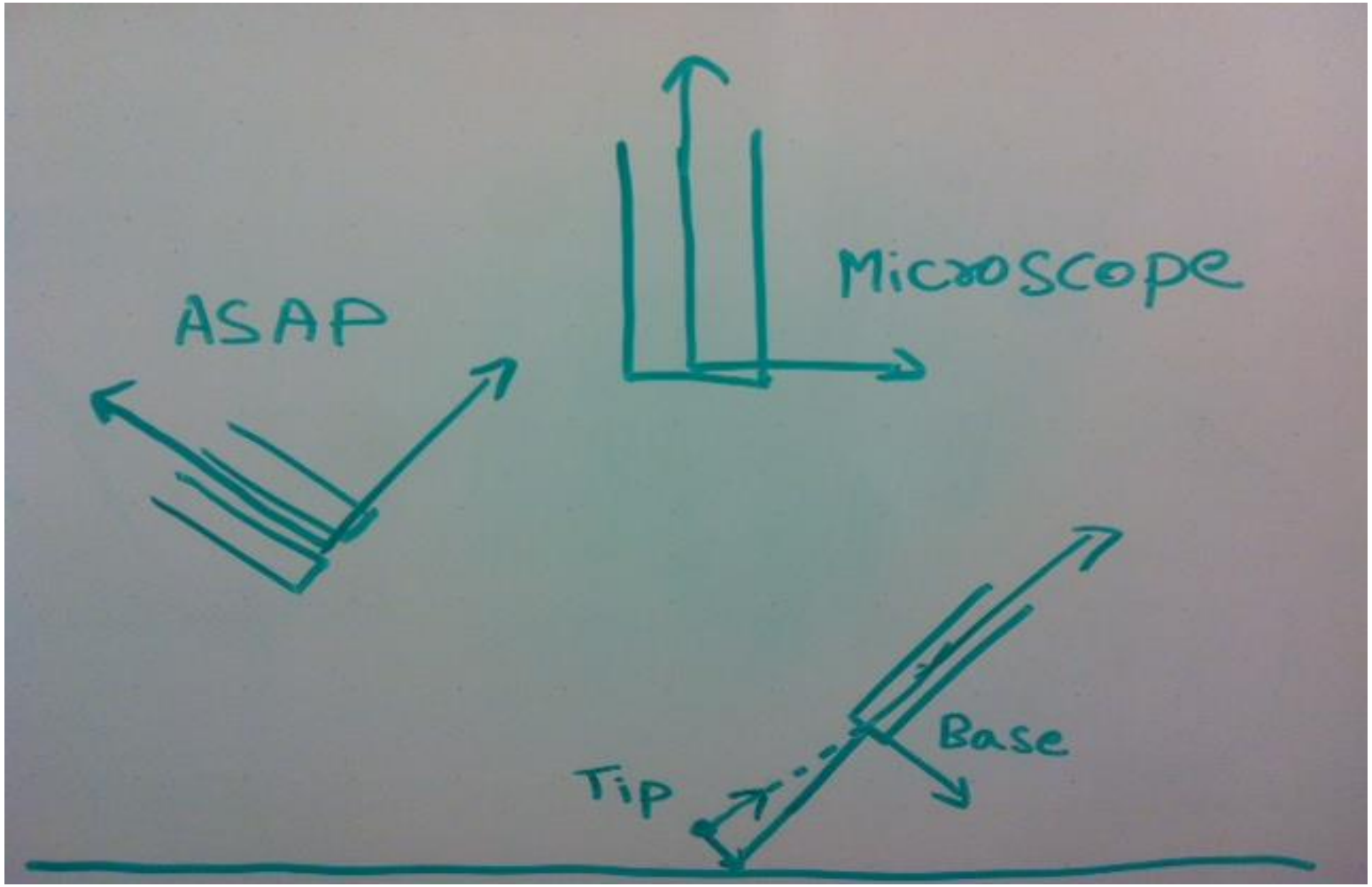
MY CONNECTIONS



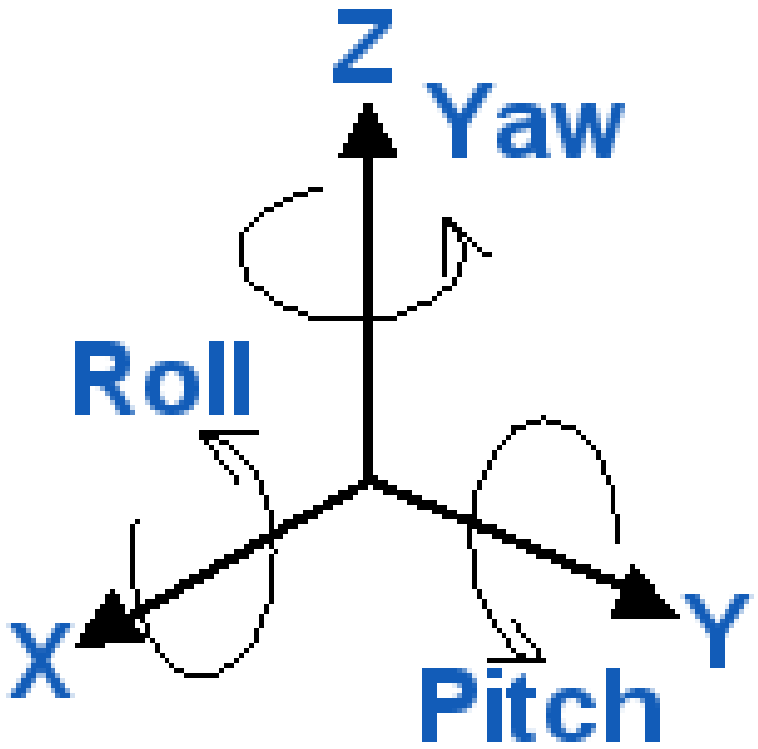
GUI FLOW DIAGRAM



FRAMES



ASAP ANGLES

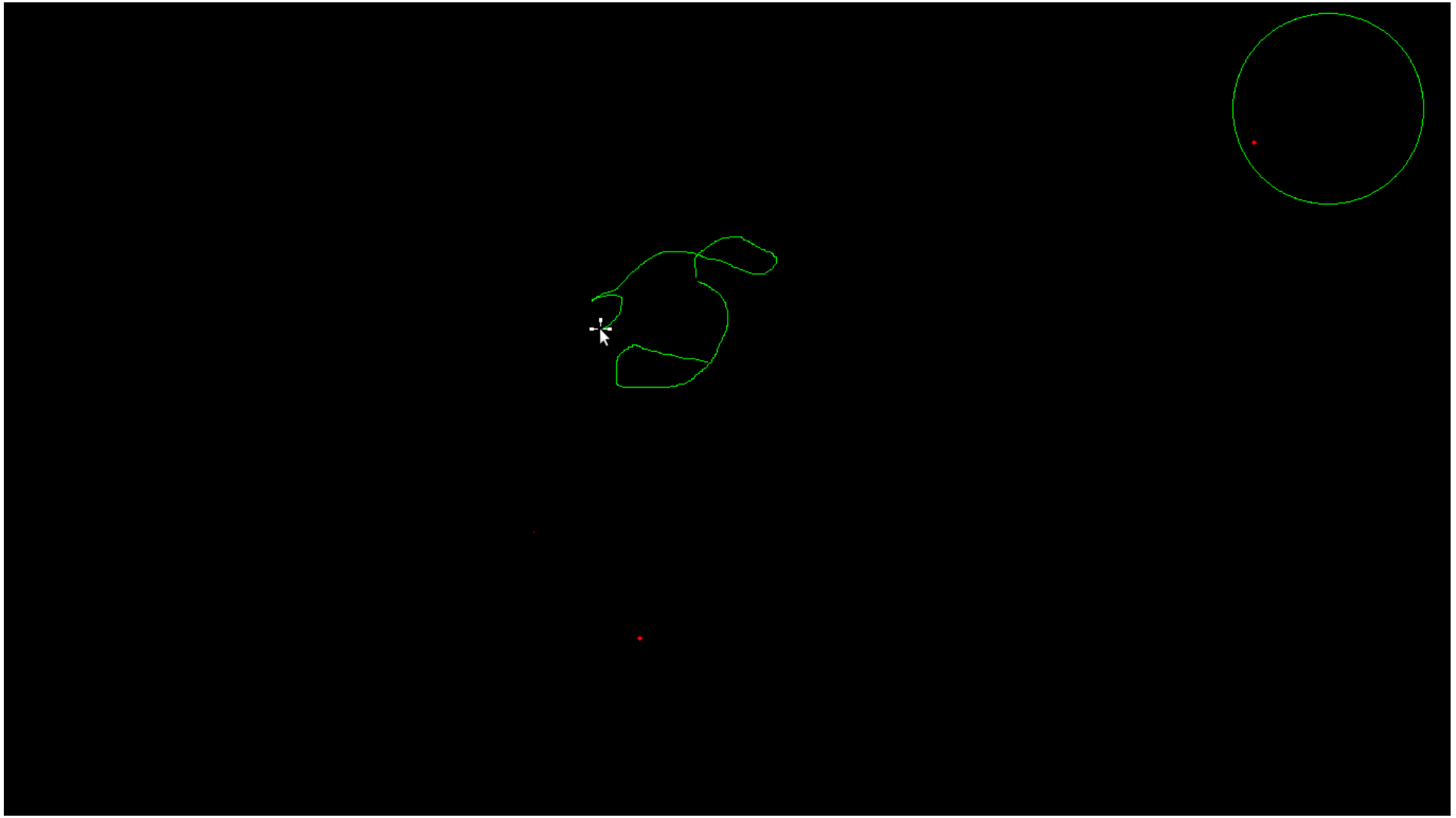


YAW $=$ $R_z(\alpha) = \begin{pmatrix} \cos\alpha & -\sin\alpha & 0 \\ \sin\alpha & \cos\alpha & 0 \\ 0 & 0 & 1 \end{pmatrix}$.

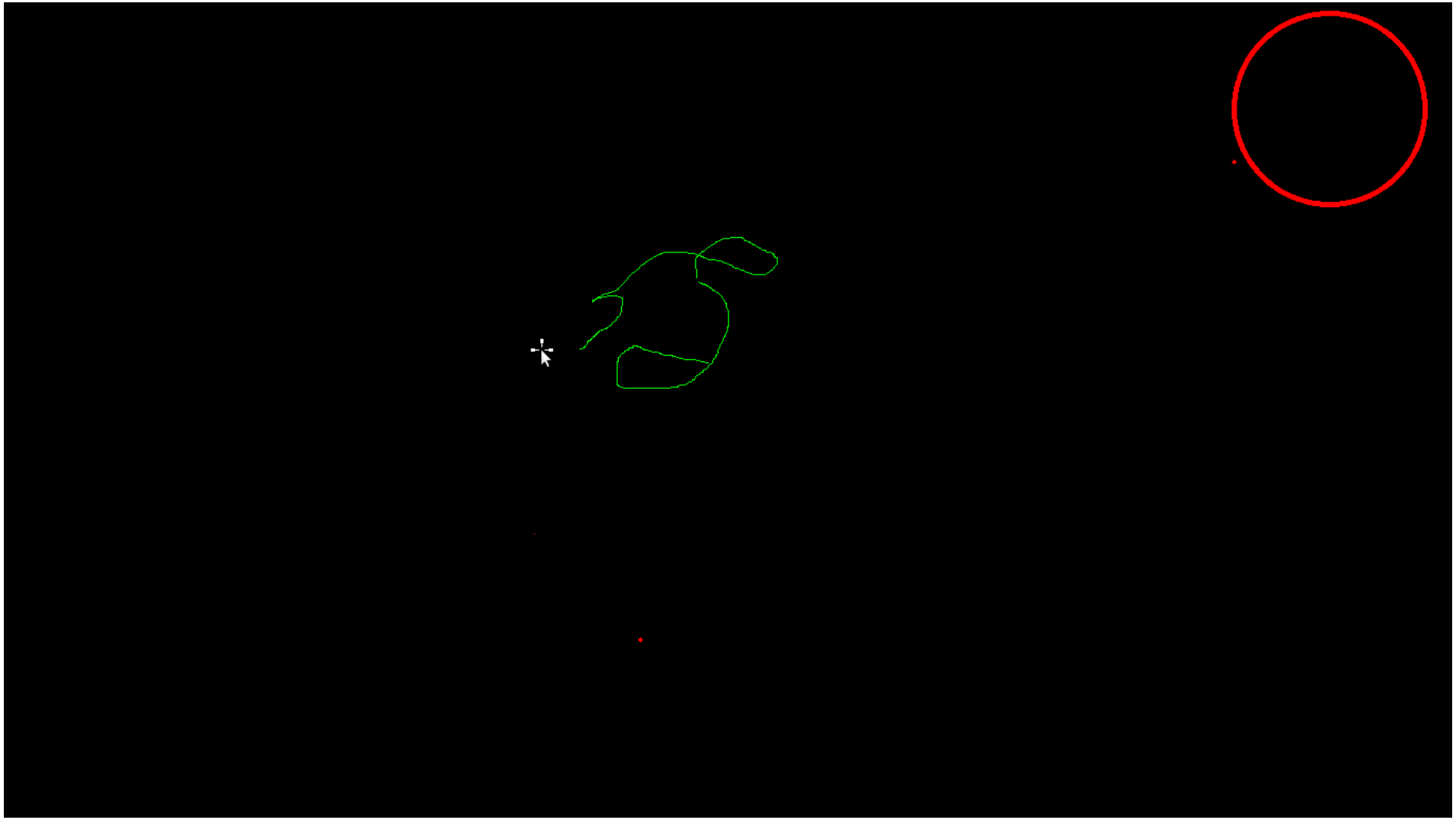
PITCH $=$ $R_y(\beta) = \begin{pmatrix} \cos\beta & 0 & \sin\beta \\ 0 & 1 & 0 \\ -\sin\beta & 0 & \cos\beta \end{pmatrix}$.

ROLL $=$ $R_x(\gamma) = \begin{pmatrix} 1 & 0 & 0 \\ 0 & \cos\gamma & -\sin\gamma \\ 0 & \sin\gamma & \cos\gamma \end{pmatrix}$.

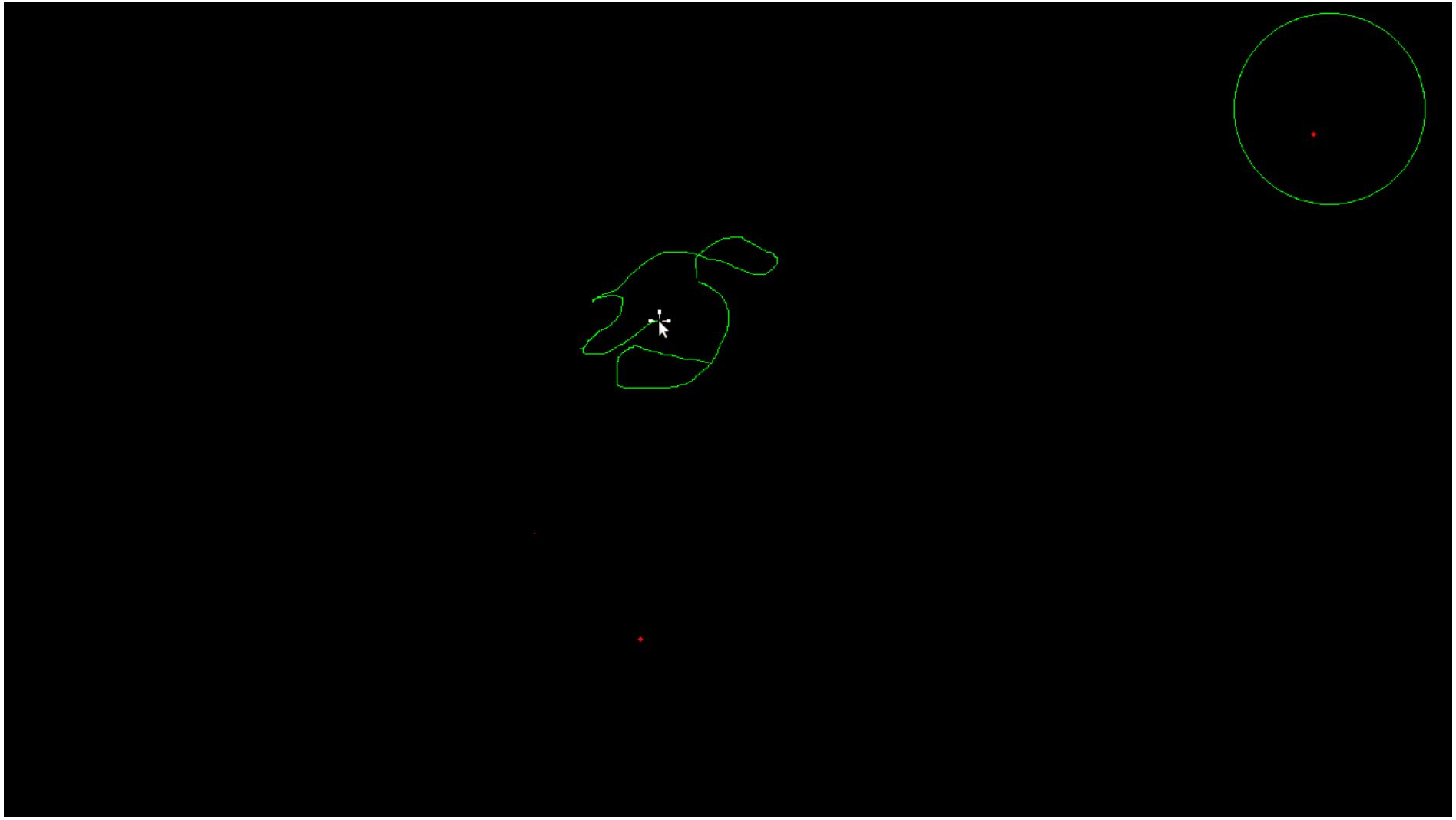
SCREENSHOT - I



SCREENSHOT - II



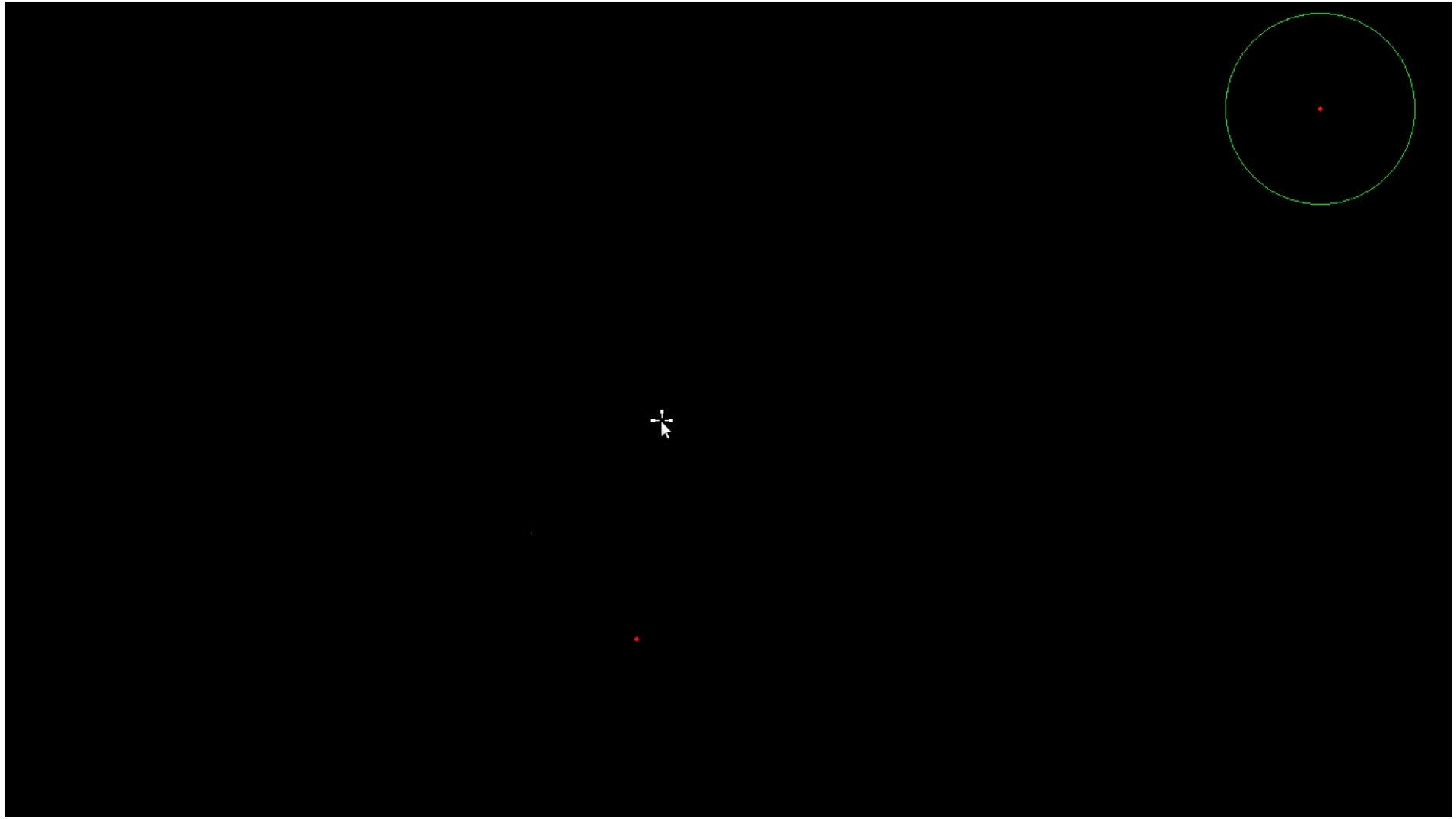
SCREENSHOT - III



PROBLEMS FACED

- Few complications with cisstVector
- Access to Micron
- 3D transformation not supported by CISST
- Build/Compile Delay

SAMPLE VIDEO



DELIVERABLES

Maximum

Improve the robustness.

Show the workspace of the micron tip.

Audio Feedback

Expected

Integrate the tool tracker

Visual alert assistance system

Get feedback from the surgeons.

Minimum

Test application running and have some overlays displayed .

Get Information form Micron

DEPENDENCIES

Dependency	Source	Status/Comments	What If ??
PC or Laptop	Self	Acquired	Project Delayed
CISST and Stereo Vision Libraries	Open Source-Online	Installed	Custom Libraries
QT Creator - IDE	Open Source-Online	Installed	Use other free IDEs available
Material to understand Micron better	Dr.Russel Taylor	Acquired	Learn Myself
Documentation of previous work	Marcin Balicki/Balazs Vagvolgyi	Acquired	Learn myself
Access to micron	Marcin Balicki/Balazs Vagvolgyi	In progress	Work on simulated data/Project Delayed
Access to Stereo video Microscope	Marcin Balicki/Balazs Vagvolgyi	In progress	Work on simulated data/Project Delayed

UPDATED TIMELINE

	Week Starting with	Feb. 4	Feb. 11	Feb. 18	Feb. 25	Mar. 4	Mar. 11	Mar. 18	Mar. 25	Apr. 1	Apr. 8	Apr. 15	Apr. 22	Apr. 29	May 6
PHASE -I	Understanding CISST and SteroVision libraries							Spring Break							
	Setting up development Environment														
	Understanding the Existing Framework														
	Create a test Application														
	Include some overlays														
	Develop Application using simulated data														
	Communicate with the micron and get the information														
	Develop Application using Micron data														
PHASE - II	Integrate Tool Tracker														
	Continuous Feedback														
	Rigorous Testing														
	Debugging														
	Include the micron tip workspace														
	Improve the tracker														

READING LISTS

[1] B. C. Becker, S. Voros, R. A. MacLachlan, G. D. Hager, and C. N. Riviere, "Active Guidance of a Handheld Micromanipulator using Visual Servoing", in IEEE International Conference on Robotics and Automation, Kobe, Japan, May 12-17, 2009. pp. 339-344.

[2] B. Becker, R. MacLachlan, and C. Riviere, "State estimation and feedforward tremor suppression for a handheld micromanipulator with a Kalman filter", in EEE RSJ Int Conf Intell Robot Syst, 2011. pp. 5160-5165. NIHMSID: 345014.

[3] B. Becker, R. MacLachlan, L. Lobes, and C. Riviere, "Vision-Based Retinal Membrane Peeling with a Handheld Robot", in IEEE Int Conf Robot Autom, 2012. pp. 1075-1080. NIHMSID: 368417.

[4] B. Becker, S. Yang, R. MacLachlan, and C. Riviere, "Towards vision-based control of a handheld micromanipulator for retinal cannulation in an eyeball phantom", in Proc IEEE RAS EMBS Int Conf Biomed Robot Biomechatron, 2012. p. accepted for publication. NIHMSID: 368431.

[5] B. Gonenc, M. A. Balicki, J. Handa, P. Gehlbach, C. N. Riviere, R. H. Taylor, and I. Iordachita, "Preliminary Evaluation of a Micro-Force Sensing Handheld Robot for Vitreoretinal Surgery", in IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Vilamoura, Algarve, Portugal, 7-12 October, 2012. pp. 4125-4130.

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[7] S. Yang, M. Balicki, R. A. MacLachlan, X. Liu, J. U. Kang, R. H. Taylor, and C. N. Riviere, "Optical Coherence Tomography Scanning with a Handheld Vitreoretinal Micromanipulator ", in IEEE Engineering in Medicine and Biology Conf, San Diego, Aug 28-Sep 1, 2012. pp. 948-951. NIHMSID: 383510.

[8] S. Yang, R. MacLachlan, and C. Riviere, "Design and analysis of 6 DOF handheld micromanipulator", in Proc IEEE Int Conf Robot Autom., St. Paul, MN, May 14-18, 2012. pp. 1946-51. NIHMSID: 368427.

[9] B. Becker, R. MacLachlan, L. Lobes, G. Hager, and C. Riviere, "Vision-Based Control of a Handheld Surgical Micromanipulator with Virtual Fixtures", IEEE Transactions on Robotics, pp. Acepted Nov 27, 2012, 2013. NIHMSID: 429749.

[10] M. Balicki, J.-H. Han, I. Iordachita, P. Gehlbach, J. Handa, R. H. Taylor, and J. Kang, "Single Fiber Optical Coherence Tomography Microsurgical Instruments for Computer and Robot-Assisted Retinal Surgery", in Medical Image Computing and Computer Assisted Surgery (MICCAI 2009), London, September 20-24, 2009. pp. 108-115. PMID: 20425977

QUESTIONS?