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Computational Sensing + Robotics

Project Checkpoint Presentation
(April 9th 2013)

Interfacing APL Snake End Effector to LARS

Group 3 Piyush Routray & Ashish Kumar

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Outline

- Project Summary
- Background and Significance
- Original Project Plan
- Major Change
- In Progress
- Project Plan Timeline
- Dependencies
- Reading List

Statement of Our Project

The main and static aim of our project is to interface the APL Snake end effector to the LARS and achieve end-point control.

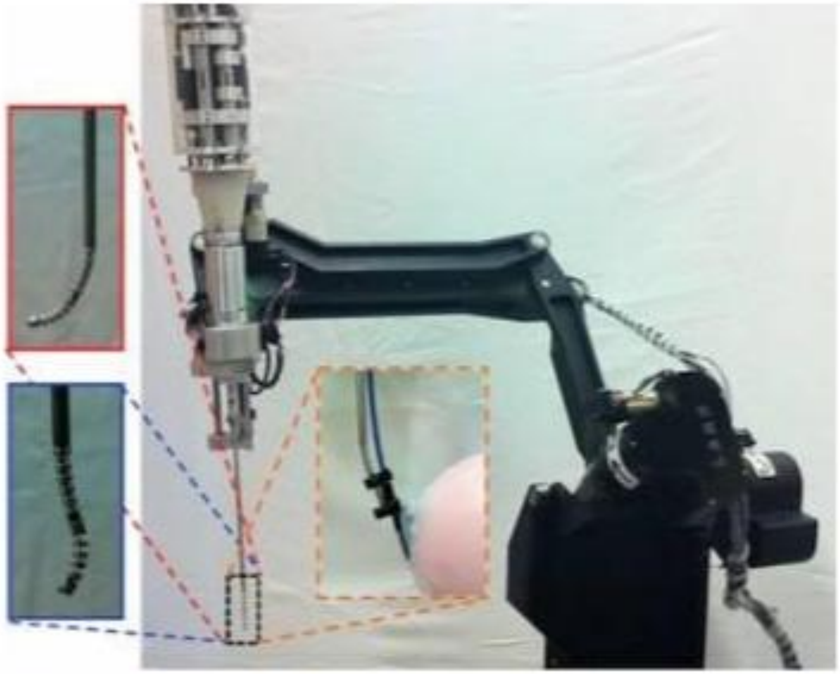

Image from: Tutkun Şen: *Elastography with LARSnake Robot*

Background & Significance

Image courtesy: Tutkun Sen

- The APL Snake was initially developed with an intention of use in hip osteolysis removal surgery.
- Various potential applications have been thought of since development, such as use in heart surgeries etc.
- Constantly being upgraded to be a self sustained surgical tool.
- Intuitive control interface for the manipulator, has since, been designed and integrated with the snake using PHANTOM® Premium haptic controller.
- LARS is an ideal system to aid autonomous operation of the APL Snake due to its mobility, dexterity, and versatility of use with various end-effectors.

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Original Plan: Project Stages

Minimum:

Fix the LARS———————————————————→(Mar 15th)

End-point control—————————————————→(Apr 15th)

Expected:

3D Registration and alignment with insertion axis– →(Apr 22nd)

Maximum:

Configure the Snake in any desirable alignment—- →(May 6th)

Demonstration of the same on cadaver—————— → (*)

*after the end of EN.600.446 timeline Prof. Armand expects us to demonstrate application on a cadaver and record video of the same.

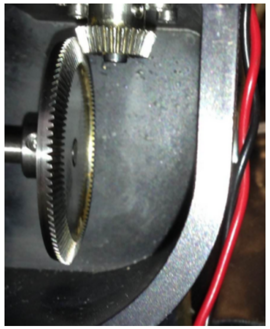
Major Change

• The repairing of original LARS given to us is taking more time than expected. Hence we had requested Dr Taylor for another LARS which is working. We have received the same on 9th April 2013.

Problems Faced

• **Open ends and loose wires. (resolved)**

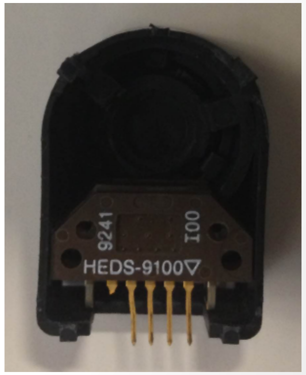
The connections where problems were detected were re-soldered.



• **Gear slip in motor.(unresolved)**

Notified to mentors. It was decided to be dealt with at the end when other motors were working.

•**Broken encoders.(partially resolved)**



New encoders have been received recently.

(images by Piyush, Ashish)

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In –Progress

Registration Algorithm.

The registration algorithm is a pre-operative as well as intra operative procedure. Our algorithm can be depicted as follows:

CT Image

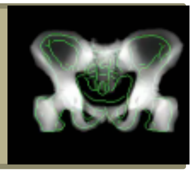


Image from CIS-I introductory lecture slides

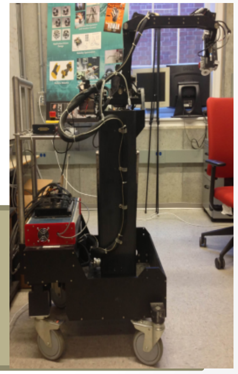
Optical Tracker

(images by Piyush, Ashish)

Saw Bone

(images by Piyush, Ashish)

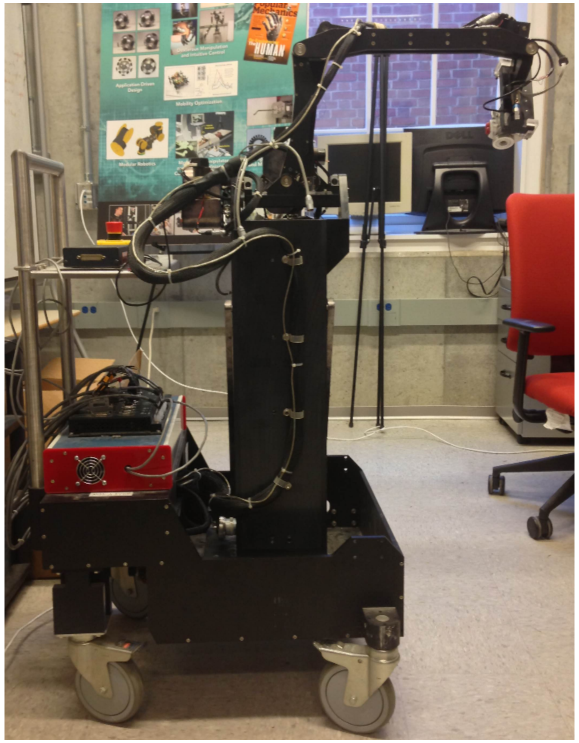
LARS



(images by Piyush, Ashish)

In –Progress

Forward Kinematics



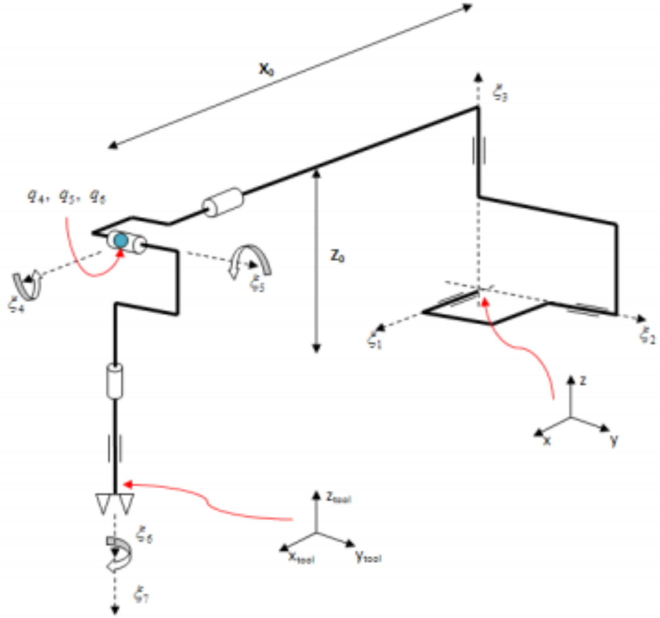
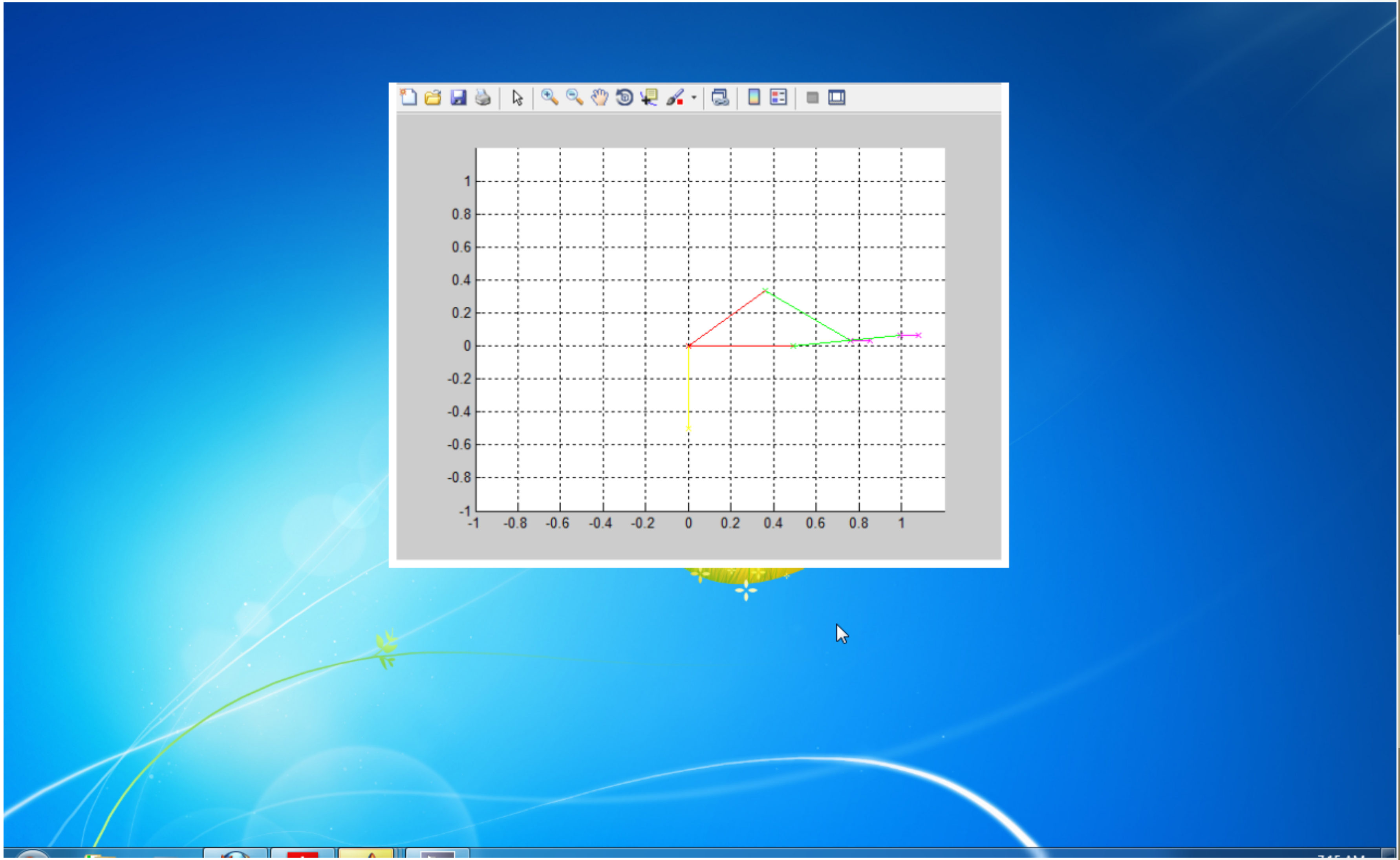


Image from Seth Billings and Ehsan Basafa

In –Progress

MATLAB Simulation OF Forward Kinematics



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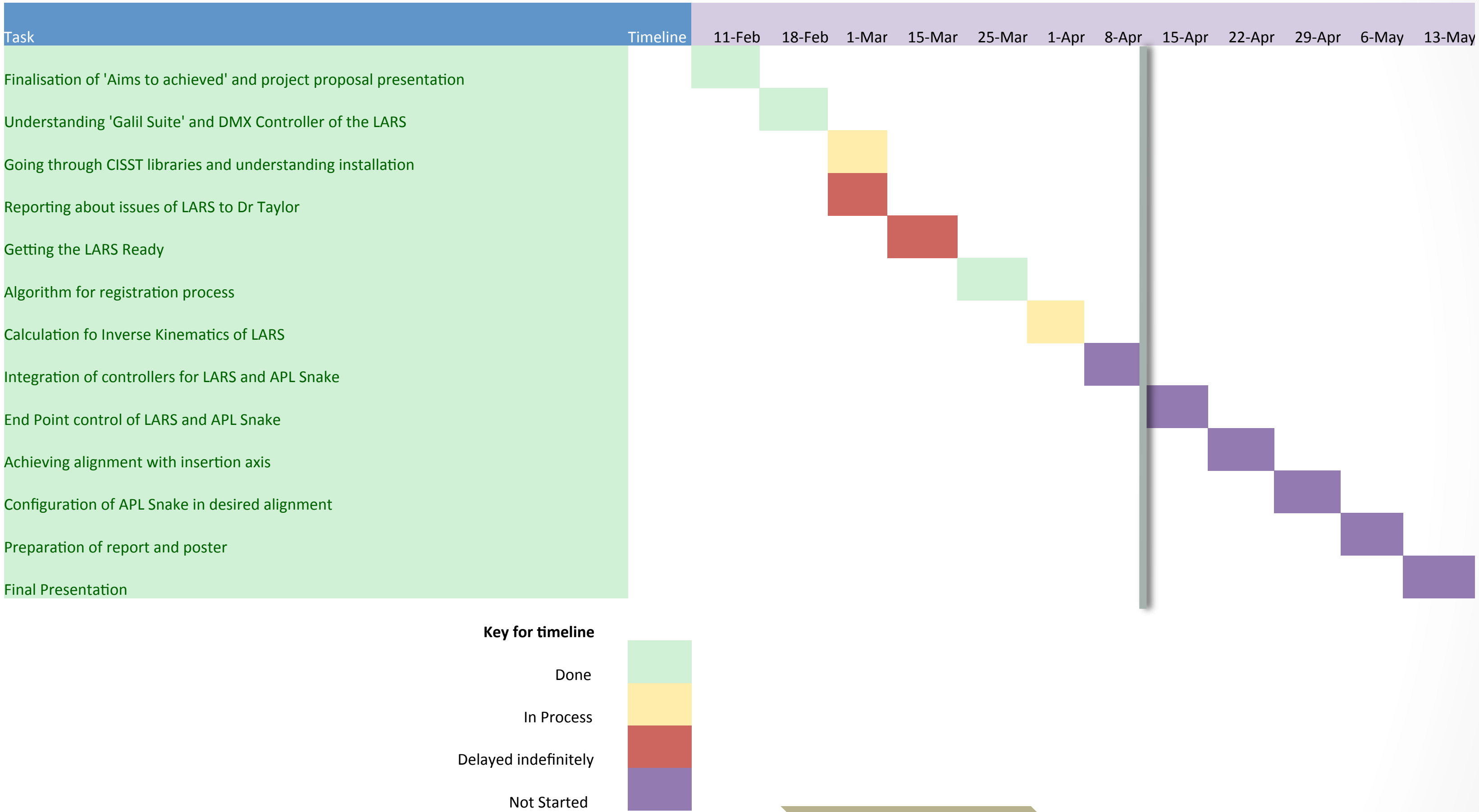
Project Plan Timeline



Project Summary | Original Project Plan | Major Change | In-Progress | **Project Plan Timeline** | Dependencies | Reading List

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Dependencies

- **Requirement of parts/tools for replacement in the LARS**.

After discussion with Prof Taylor and our mentors Prof Armand & Ryan Murphy it was found best to replace the LARS. ***We have received the new LARS today i.e. 9th April 2013***.

- **Working platform/software with the snake.**

We hope to have a working platform/software which can control the snake's precision by 22nd April 2013. This will allow us to implement accurate control of snake after mounting it on the LARS. Ryan Murphy is working on the same.

Reading List

[1] M. D. M. Kutzer, S. M. Segreti, C. Y. Brown, R. H. Taylor, S. C. Mears, and M. Armand, “Design of a new cable-driven manipulator with a large open lumen: Preliminary applications in the minimally invasive removal of osteolysis,” in Robotics and Automation, 2011. ICRA 2011. Proceedings of the 2011 IEEE International Conference on, 2011.

[2] J. Funda, R. Taylor, B. Eldridge, S. Gomory, and K. Gruben, “Constrained Cartesian motion control for tele-operated surgical robots,” IEEE Transactions on Robotics and Automation, vol. 12, pp. 453-466, 1996.

[3] Galil Motion Control, Inc. DCM-40×0 User Manual, Rev. 1.0c. Dec, 2008. www.galilmc.com

[4] Galil Motion Control, Inc. DCM-40×0 Command Reference, Rev. 1.0d. Dec, 2008. www.galilmc.com

[5] G. Hamlin and A. Sanderson, A Novel Concentric Multilink Spherical Joint with Parallel Robotics Applications. IEEE, pp. 1267-1272. 1994.

[6] A. Kapoor, M. Li, and R. Taylor, Constrained Control for Surgical Assistant Robots. IEEE Int’l Conf. on Robotics and Automation. pp. 231-236. May 2006.

[7] A. Kapoor. Motion Constrained Control of Robots for Dexterous Surgical Tasks. Johns Hopkins University Ph.D. Thesis. Sept, 2007.

[8] P. Marayong, et. al. Spatial Motion Constraints: Theory and Demonstrations for Robot Guidance Using Virtual Fixtures. IEEE Int’l Conf. on Robotics & Automation. pp. 1954-1959. Sept. 14-19, 2003.

[9] R. Taylor, et. al. A Telerobotic Assistant for Laparoscopic Surgery. IEEE Engineering in Medicine and Biology. pp. 279-288. May/June 1995

QUESTIONS?

THANK YOU!