Intraoperative Fiducial Tracking in TORS

CIS II Project #15
Mini Check Point Presentation

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Project Overview

• Project Goal:

The goal of this project is to design and implement an intraoperative fiducial tracking algorithm in TORS that can accurately track the fiducial under the endoscope.

Images courtesy of Wen P. Liu
Project Overview (Continue)

• **Project Background**:

  • TORS: TransOral Robotic Surgery

  • The base of tongue tumors has become a significant health care concern. Because most base of tongue tumors are buried deep in the musculature of the tongue, when doing the transoral surgery, expert surgeons always rely on experience to remain correctly oriented with respect to critical anatomy.

  • Such practice leaves considerable room for improvement and has brought TORS. It is a minimally invasive surgical intervention for resection of base of tongue tumors.

http://www.ohsu.edu/xd/health/services/comprehensive-robotics-program/surgical-services/transoral-robotic-surgery-tors.cfm
Project Deliverables

• Minimum (Planned 4/10): Might be delayed to 4/15  Done 4/22
  Implementation of fiducial segmentation of the recorded endoscopic images  Done 4/14
  Implementation of fiducial tracking of the recorded stereo video  Done 4/22

• Expected (Planned 4/22): In Progress
  Real-time fiducial tracking under the robot endoscopic camera  Done 4/25
  Optimization of the implementation to confirm better result than the already existed tracking method
  Still working on this

• Maximum (Planned 4/29): Might be delayed to around 5/3  Would delay or drop
  A more accurate tracking under intraoperative scenario  might not do this
  Video recording for the intraoperative fiducial tracking process  won’t do this
  A new fiducial for better and more accurate tracking  won’t do this
Project Deliverables (Continue)

• A big change about the deliverables:

• will not do within C++ and CISST, but instead use Matlab only

due to time management and underestimating the difficulties of the project

which means most work before around March 20 is useless
Project Deliverables (Continue)

- Fiducial detection of the recorded endoscopic images

left image:
Project Deliverables (Continue)

- Fiducial detection of the recorded endoscopic images

right image:
Project Deliverables (Continue)

• Fiducial detection of the recorded endoscopic images

Then use binocular vision can reconstruct the tumor in the endoscopic scene
Project Deliverables (Continue)

• Fiducial detection of the recorded endoscopic images

• Some Problems:

  The threshold of color chosen is not robust enough, so it doesn’t work for the video

  The fiducial group selection algorithm is not robust enough and would result in false fiducial detection in the video
Project Deliverables (Continue)

• Fiducial detection of the recorded endoscopic images

• Some false examples when applied to the video:
Project Deliverables (Continue)

- Fiducial detection of the recorded video
- modified the threshold function: absolute value → relative value
- modified the fiducial group selecting algorithm → more strict requirements
- using Kalman Filter
Project Deliverables (Continue)

- Fiducial detection of the recorded video

Frame 52-57
Project Deliverables (Continue)

- Fiducial detection of the recorded video

Images were blurred, Frame 61-63
Project Deliverables (Continue)

• Fiducial detection of the recorded video
• some wrong examples, which still being worked on mainly because of illumination and occlusion, and the discontinuity adds difficulties for the Kalman filter
Project Deliverables (Continue)

- Fiducial detection of the recorded video
- Some more wrong examples:
  mainly because of illumination and occlusion

Frame 46-47
• Fiducial detection of the recorded video
• some more wrong examples, which still being worked on mainly because of illumination and occlusion
Project Key Dates

Feb. 20: Complete Software Installation: Visual Studio 9.0, CMake, SVN, cisst saw library, OpenCV done
Feb. 21: Begin algorithm design done
Feb. 22: Begin software and cisst study begun and required part done
Feb. 23: Begin new fiducial design (optional, might do it after testing the implementation on the robot) begun and dropped
March 1: Print the new fiducial (optional) dropped
March 7: Algorithm study and design complete done (modifying some parameters)
March 10: Begin algorithm implementation (coding) with C++ begun and paused
April 10: (Minimum deliverable) Complete algorithm implementation done
April 12: Begin testing on the robot dropped
April 22: (Expected deliverable) Optimization and begin testing on the robot first half in progress, second half dropped
April 29: (Maximum deliverable) Optimization under intraoperative scene haven’t begun yet
May 9: Post session and project report
Project Management

• Weekly meeting with Wen through the completion of the project. Every Monday afternoon. With occasional exceptions. Meet more frequently recently. Keep contacting by emails.

• **Bi-weekly Scheduled** meeting with Anton after the beginning of implementation.
Thank You