

Objective Surgical Skill Assessment of Computer-Aided Hysterectomy Procedures

TEAM 12

Goal

Automatically assess skill in robot assisted hysterectomy procedures, particularly the **colpotomy** step, using video footage from procedures at Johns Hopkins Hospital, as well as motion data from the da Vinci Surgical System.

Team Member(s)

Elif Bilgin (ebilgin1@jhu.edu)

Mentor(s)

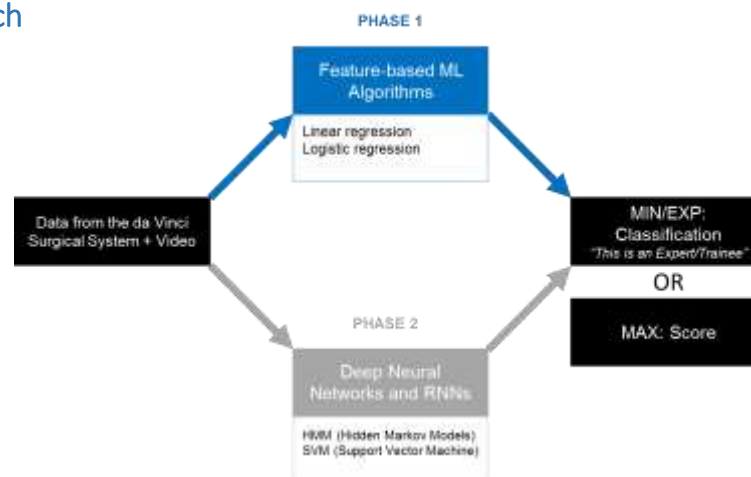
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Relevance/Importance

“Technological developments are enabling capture and analysis of larger amounts of complex surgical data...[This] allows for the objective computer-aided technical skill evaluation for scalable, accurate assessment; individualized feedback, and automated coaching.¹” Therefore, the ability to objectively assess the skill level of surgeons is critical for training future surgeons.

Technical Approach



¹ Swaroop Vedula, S & O Malpani, Anand & Tao, Lingling & Chen, George & Gao, Yixin & Poddar, Piyush & Ahmidi, Narges & Paxton, Christopher & Vidal, René & Khudanpur, Sanjeev & Hager, Gregory & Chiung Grace Chen, Chi. (2016). Analysis of the Structure of Surgical Activity for a Suturing and Knot-Tying Task.



Dependencies

Dependency	Status	Explanation
IRB data access	Resolved	Have completed the proper training modules, have been added to the IRB study
Access to the motion data which is under Intuitive NDA	Resolved	Signed the NDA
Access to the Johns Hopkins University compute server	Resolved	Given proper credentials by mentors
Obtain existing code for neural network methods from graduate student researchers	Will be resolved by Mar 28 th .	Molly has agreed to sharing her implementation
Getting surgeon time to get a scoring of each procedure*	Expected to be resolved by Apr 20 th .	Anand Malpani will be contacting physicians

***Max Deliverable Dependency**

Management Plan

- Weekly meetings with mentors on Thursday mornings
- Set up a Git repository for version control

Reading List

Robotic Surgery Papers Regarding Hysterectomy

Malpani, A & Martinez, N & Vedula, S & Hager, G & Chen, C. (2018). 17: **Automated skill classification using time and motion efficiency metrics in vaginal cuff closure.** American Journal of Obstetrics and Gynecology. 218. S891-S892.

Papers Regarding Scope of Project

Azari, David P. et al. “**Modeling Surgical Technical Skill Using Expert Assessment for Automated Computer Rating.**” Annals of surgery (2017)

Ershad, Marzieh & Rege, R & Majewicz Fey, A. (2018). **Meaningful Assessment of Robotic Surgical Style using the Wisdom of Crowds.** International Journal of Computer Assisted Radiology and Surgery. 13. 10.1007/s11548-018-1738-2.

Swaroop Vedula, S & O Malpani, Anand & Tao, Lingling & Chen, George & Gao, Yixin & Poddar, Piyush & Ahmidi, Narges & Paxton, Christopher & Vidal, René & Khudanpur, Sanjeev & Hager, Gregory & Chiung Grace Chen, Chi. (2016). **Analysis of the Structure of Surgical Activity for a Suturing and Knot-Tying Task.**

Soto, Enrique & Lo, Yungtai & Friedman, Kathryn & Soto, Carlos & Nezhat, Farr & Chuang, Linus & Gretz, Herbert. (2011). **Total laparoscopic hysterectomy versus da Vinci robotic hysterectomy: Is using the robot beneficial?.** Journal of gynecologic oncology. 22. 253-9. 10.3802/jgo.2011.22.4.253.

Poddar, Piyush & Ahmidi, Narges & Swaroop Vedula, S & Ishii, Lisa & Hager, Gregory & Ishii, Masaru. (2014). **Automated Objective Surgical Skill Assessment in the Operating Room Using Unstructured Tool Motion.** International journal of computer assisted radiology and surgery.

Zhang, Yetong & Law, Hei & Kim, Tae-Kyung & Miller, David & Montie, James & Deng, Jia & Ghani, Khurshid & the Michigan Urological Surgery Improvement Collaborative, for. (2018). **Surgeon Technical Skill Assessment Using Computer Vision-Based Analysis.** The Journal of Urology.

Machine Learning Papers

Malpani, Anand & Swaroop Vedula, S & Chiung Grace Chen, Chi & Hager, Gregory. (2015). **A study of crowdsourced segment-level surgical skill assessment using pairwise rankings.** International journal of computer assisted radiology and surgery.

Zia, Aneeq & Essa, Irfan. (2017). **Automated Surgical Skill Assessment in RMIS Training.** International Journal of Computer Assisted Radiology and Surgery. 13.

Vedula, Satyanarayana S et al. “**Objective Assessment of Surgical Technical Skill and Competency in the Operating Room.**” Annual review of biomedical engineering 19 (2017): 301-325.

Krishnan, Sanjay & Garg, Animesh & Patil, Sachin & Lea, Colin & Hager, Gregory & Abbeel, Pieter & Goldberg, Kenneth. (2017). **Transition state clustering: Unsupervised surgical trajectory segmentation for robot learning.** The International Journal of Robotics Research.