Improving Spatial-Temporal Models for Surgical Workflow Analysis

Timothy Corwin[1], Colin Lea[2], Dr. Austin Reiter[2], Dr. Gregory D. Hager[2]

(1) Department of Computer Science, Providence College;

(2) Whiting School of Engineering, Johns Hopkins University

Abstract

Minimally invasive surgery is becoming more and more common in hospitals. Advanced robotic systems, such as Intuitive Surgical's da Vinci, not only provide patients with smaller incisions, less pain, and faster recovery times, but also provide doctors with greater control and vision during surgery. However, although current operative instruments are able to follow the controls of the surgeon precisely, offering vision and a full-range of motion in areas previously not known possible, many of these devices are not able to provide intelligent intraoperative assistance to the surgeon. In this project, our team works to develop a real-time autonomous artificially intelligent system that can learn and identify the fine-grained action tasks of surgery. Specifically, we apply a spatial-temporal Convolutional Neural Network (CNN) to recognize action tasks in cholecystectomy and continuous curvilinear capsulorhexis surgeries. Using a Dynamic Time Warping approach, we demonstrate the ability to recognize, with relatively high accuracy, the fine-grained action tasks that occur along the workflow timeline of a completed surgery.

1 CSMR REU Experience – Summer 2016

As part of the CSMR REU program this 2016 summer, the other REU students and I not only received research experience by world renowned faculty and staff in the state-of-the-art research laboratories at Johns Hopkins University, Homewood, but also were offered extracurricular field-trips and lectures by guest speakers. The other REU students and I had the privilege to receive hands-on experience in the operating room practicing laparoscopic surgery at Johns Hopkins Hospital MISTC. Just to name a few of the events, we also received an inside tour of NASA's Goddard Space Center overlooking research in the Hubble Space Telescope successor, the James Webb telescope.

– NSF GRANT NO. EEC- 1460674 –