Virtual ACS 2021 Surgeons and Engineers: A Dialogue on Surgical Simulation Meeting

Research In-Progress

Kinematic and Kinetic Task Performance Data for Holistic Assessment of Skill at Robot-Assisted Minimally Invasive Surgery

Sergio Machaca; Rachel M. Haupt; Anand Malpani; and Jeremy D. Brown.

Johns Hopkins University, Baltimore, MD; University of South Carolina, Columbia, SC; Johns Hopkins University, Baltimore, MD

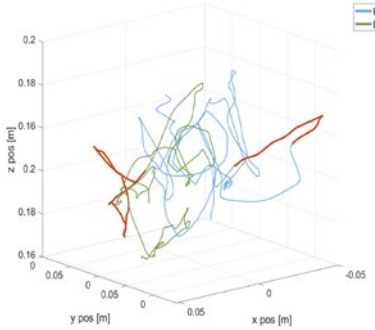
Introduction: As Robot-Assisted Minimally Invasive Surgery (RAMIS) becomes the standard of care for many surgical specialties, there is a growing need to ensure that all robotic surgeons have the same fundamental level of skill proficiency. Current clinical training and assessment, in particular with the real clinical robot, focus on reducing the observable egregious errors like breaking a suture or tearing tissue, and less on the underlying psychomotor behaviors that lead to these egregious errors. Recent skill assessment efforts have separately focused on the motion of the surgical tools (kinematics) or their physical interactions with the surgical environment (kinetics). The ideal skill assessment platform, however, should consider the interplay between the two, given their interdependence in psychomotor skill proficiency.

Methods: We have developed a data acquisition platform that is capable of measuring time-stamped kinematic and kinetic task performance data from a da Vinci surgical system, as well as the video feed from the robotic endoscope. Joint-level kinematics of the robot are provided by the da Vinci Research API. Kinetic data is provided by accelerometers attached to the robotic instruments and robotic endoscope, and a force sensor placed underneath the training task.

Preliminary Results: As demonstrated in the included figure, our platform is capable of measuring the kinematic and kinetic task performance data that is time-synced with the video frames from the robotic endoscope. For this example suturing task, we highlight the 3D trajectory of the robotic needle drivers as well as the forces produced on the suture pad while the participant attempts to tie a surgeon's knot.

Next Steps: We will collect task performance data on basic psychomotor skills tasks from clinical participants of varying skill proficiency. Ground truth labels of skill performance will be generated using crowdsourced methods, and machine learning algorithms will be trained to predict skill according to the GEARS structured assessment.


Large Needle Driver
Large Needle Driver


Right Instrument
Left Instrument
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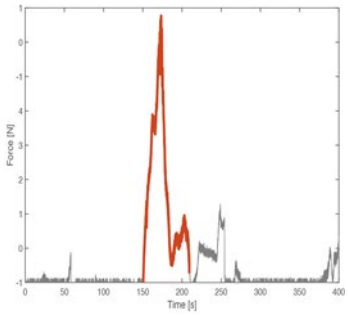
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