ACS 2023 Surgeons and Engineers: A Dialogue on Surgical Simulation Meeting

Research In-Progress

Multi-Sensor Analysis of Surgeon's Moves and Conduct to Improve Surgical Efficiency

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Introduction: Analysis of the surgeons' kinetics and actions is often used for the assessment of surgical skills. Video analysis and electromagnetic tracking are the most used techniques for this purpose. These techniques only track the movements, are non-specific and their interpretation is time consuming. We designed a multisensorial detection system to automatically quantify the specific actions taken during a simulated procedure as a teaching tool to improve surgical efficiency.

Methods: A simulated surgical field was equipped with multiple sensors to automatically detect specific moves and surgical actions. We used video recording to validate readings from the following sensors. Hall effect sensors recorded the number of approaches and duration of presence in the field of the magnet-mounted forces. Multiple photoresistors recorded the presence and the count of the hand in three peripheral zones. Vibration sensor read the magnitude and duration of the field vibration. Time-of-flight distance sensor read the variations in the distance to the field. Data from these sensors are collected by an Arduino microcontroller to Excel spreadsheet. The model was tested on two surgeons: Surgeon A= is highly experienced, Surgeon B= is a trainee.

Preliminary Results: During an identical suturing procedure, surgeon B approached the field with the forceps 58%, held the forceps in the filed 78% and manipulated the field 96% more than surgeon A. Surgeon B also made 7 unnecessary moves that wasted time and affected efficiency. Distance and photoresistors showed surgeon A's working zone was significantly smaller than for surgeon B. The readings from the sensors had a 100% correlation with the video recordings.

Next Steps: We plan to optimize and validate this system to create a surgical skill assessment tool. As a training platform, this system potentially improves surgical efficiency and fluidity by detection, quantification and elimination of unnecessary moves and touches.