Data collection system for surgical instrument localization

Unmet Need

There is no data that describes how surgical instruments are used in open surgery – the vast majority of operations. Achieving accurate intraoperative instrument position data could help improve surgical approaches and accreditation, evaluate physician prowess, alert the surgical team if instruments are left inside the patient, recommend patient recovery modes from instrument dynamics, inform the design and development of new instruments, provide unbiased documentation around operative proceedings, and map a surgical site. Researchers have attempted to use video cameras, stereo vision, fluorescent labels, radio-frequency identification, and other technologies to measure the intraoperative location of surgical instruments. Each of these technologies struggle to capture accurate location data from surgical instruments due to the complexity of the operating room environment. With recent advances in machine learning, RFID-based localization has become more feasible, however large datasets are required to train localization algorithms. There is a need for a collection system to gather data describing both the position of surgical instruments with RFID tags and the RFID data from the tags in a way that emulates the operating environment. Once an algorithm is trained on this data, RFID data from surgical instruments collected intraoperatively can be preprocessed and supplied to the algorithm to achieve tagged-instrument locations.

Technology

Duke inventors have developed a system for generating large artificial datasets that can be used to train localization algorithms to accurately predict the position of RFID-tagged surgical instruments. Specifically, the present invention describes a robotic system holding an RFID-tagged instrument that will move the instrument to many positions, generating a diverse RFID-response dataset from known locations.

Other Applications

This technology collets data used to pre-train machine learning (ML) models, which locate instruments used in surgeries based on their RFID tags. Further, the type of datasets generated by this model can be used to understand how surgeons operate and correlate the usage of specific tools with specific surgery outcomes for surgical residents. With adjustments, the robotic system can be used to generate cost efficient and large datasets for other localization purposes.

Advantages

- This robotic system can generate training datasets quickly and cost efficiently for RFID tracking system localization compared to other data generation methods.
- The dataset generated by the robotic system is controlled and easily adjustable based on needs.
- With adjustments, the robotic system can be used to generate cost efficient and large datasets for other localization purposes.

Duke File (IDF) Number

IDF #:T-007138

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