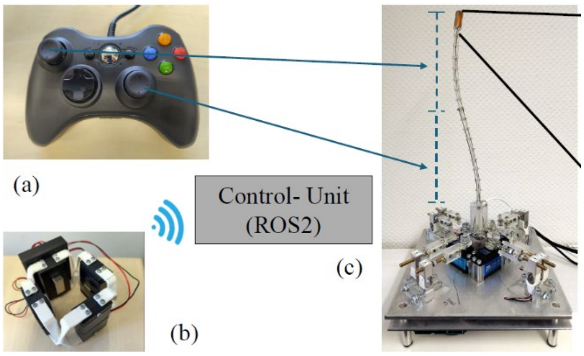
Friedrich-Alexander-Universität
Institute of Autonomous Systems and Mechatronics | ASM

30.09.2024

Master Thesis

Haptic Guidance for Advanced Control of Surgical Robots



Source: (Fischer, Andreas, Beckerle, Mathis-Ullrich, & Marzi, 2024)

Limited or absent haptic feedback is reported as a factor constraining the continued adoption of surgical robots. The integration of haptic feedback systems in surgical robots can enhance the users' perception to increase accuracy and safety in surgical tasks (Enayati, De Momi, & Ferrigno, 2016). Vibrotactile feedback, a specific type of haptic feedback, has demonstrated its ability to enhance task performance in various applications (Schoonmaker & Cao, 2006). Navigation through cavities, where unintended contact with the tissue is to be avoided, motivates the need for feedback systems with non-contact localization. This comes into play in surgical procedures where visual feedback alone is not sufficient. Thus, we aim to equip a robotic arm with a capacitive sensor that communicates with a haptic feedback bracelet to guide the user through an arbitrarily shaped phantom.

Task Description

1. Conceptualization
   a. Create a setup to test different haptic guidance concepts
2. Hardware Setup
   a. Implement robot control and feedback in ROS
   b. Prepare a test bench for the user study
3. Evaluation
   a. Collect data from participants for functional tests
   b. Evaluate haptic guidance methods
4. Documentation and presentation of results.

Prerequisites

- Studying mechatronics, medical engineering, computational engineering, electrical engineering, autonomy technologies, or similar
- Good python skills and experience with ROS

References

Enayati, N., De Momi, E., & Ferrigno, G. (2016). Haptics in Robot-Assisted Surgery: Challenges and Benefits. *RBME, 9:49-65*.

Fischer, J., Andreas, D., Beckerle, P., Mathis-Ullrich, F., & Marzi, C. (2024). Vibrational Feedback for a Teleoperated Continuum Robot with Non-contact Endoscope Localization. *Current Directions in Biomedical Engineering, (Vol. 10, No. 1, pp. 17-20). De Gruyter*.

Schoonmaker, R., & Cao, C. (2006). Vibrotactile feedback enhances force perception in minimally invasive surgery. *HFES, 50:1029-1033*.

Start: Oktober 2024

Supervisor: M.Sc. Daniel Andreas Email: Daniel.andreas@fau.de
Examiner: Prof. Dr.-Ing. habil. Philipp Beckerle