University
of Basel

Department of
Biomedical Engineering

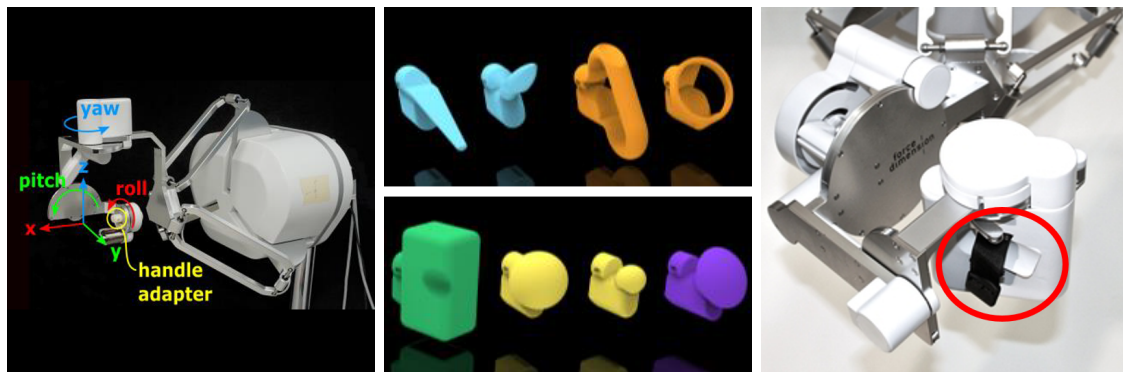BIROMED-Lab
Medical Robotics and Mechatronics

Master Thesis:
Augmenting a Custom Haptic Input Device Handle with Force Feedback for Intuitive Grasping

Context: Haptic input devices offer an elegant way to intuitively control robotic systems. They not only allow the transmission of user motions to the robot, but also to haptically render the interaction forces occurring between the robot and its surroundings. It has been shown in several areas that this additional type of feedback can help the user to perform tasks more quickly and safely. The lambda.6 by Force Dimension **(a)** is a haptic input device with six degrees of freedom (DoFs); several custom handles **(b)** for this device have been developed [1] and assessed [2].

Task description: In its current state, the haptic input device fitted with one of the custom handles allows the user to control as well as to sense force feedback in six DoFs; three translations, and three rotations. In a next step, we wish to include control and force feedback of a seventh DoF for grasping; an example of such an additional DoF can be seen in **(c)**. Your task will be to augment one of the custom handles developed in [1] with grasping force feedback, to manufacture your new design, and to validate its functionality.

(a) Force Dimension lambda.6   **(b)** Custom handles [1]   **(c)** Grasping force feedback

Work packages:
- Review the relevant body of literature and extract the key concepts and features
- Assess the haptic input device handles developed in [1] w.r.t. the given requirements and carefully select the most appropriate model to augment with grasping force feedback
- Develop and manufacture a modified design of the chosen model including grasping force feedback
- Validate the manufactured device w.r.t. the given requirements

Requirements:
- Solid background in mechanical engineering or a closely related field
- Knowledge of mechanics, basic electronics, and programming
- Ideally, basic knowledge of anatomy, ergonomics, and human-robot interaction
- Ideally, practical experience with CAD (Solidworks)

References:

[1] E. I. Zoller et al. "Development of Different Grasp Type Handles for a Haptic Telemanipulator," presented at the 9th Joint Workshop on New Technologies for Computer/Robot Assisted Surgery (CRAS 2019), Genoa, Italy, 2019.

[2] E. I. Zoller et al. "Assessment of the Functional Rotational Workspace of Different Grasp Type Handles for the lambda.6 Haptic Device," in *Proc. 2019 IEEE World Haptics Conf. (WHC)*, 2019, pp. 127-132.

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