Masterarbeit

ROS modeling of a Reaction Force Free robot with Haptic Communication for Capsule Endoscopic Examination

Robotic capsule endoscopy enables targeted examination of specific regions of the gastrointestinal tract that is not possible using conventional capsule endoscopy. This is achieved by external manoeuvring of the capsule using an extracorporeal magnet that is held by a robotic arm due to its heavy weight. To ensure safe procedure without uncontrolled forces and movements, a passive SCARA robot is used to hold the magnet, and a haptic joystick is used for the interaction between the operating person and the robotic arm. Figure 1 presents the system overview.
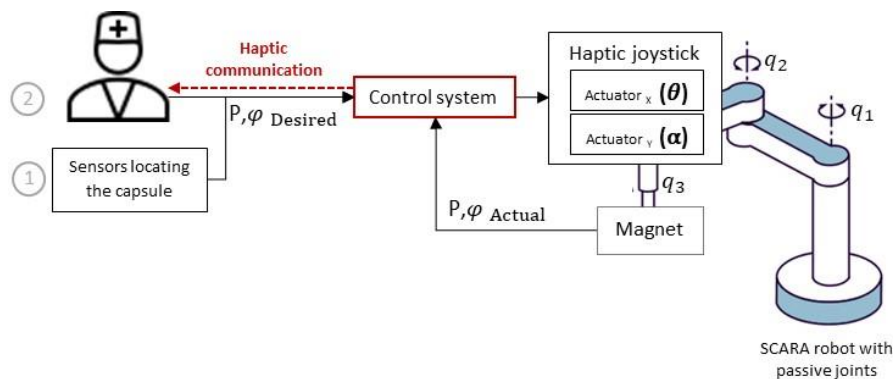

Figure 1 Reaction Force Free Robot System Overview

The reaction force free robot should allow the human operator to be the source of motion (moving the magnet to the desired position and orientation) while the joystick provides haptic force feedback with changing stiffness as the manipulator reaches the desired position. This helps the operator to manoeuvre the robot and the magnet without the need for visual feedback.

In order to do so, the entire system (including the 2-DOF passive SCARA kinematic structure, the haptic joystick with its 2 actuators and the required sensors) will be modelled and simulated in ROS Gazebo environment. The system should be able to:

- Tilt the joystick towards the direction of the desired position (after locating the capsule) using 2 actuators inside the joystick.
- Allow the operator to move the manipulator to the desired position while holding the joystick (introducing to the stick only a force vector, not a bending moment), meanwhile the joystick's stiffness changes as the manipulator approaches the desired position (providing haptic feedback instead of visual feedback)
- Make the joystick force-free once the desired position is reached.

Required Skills:

- First experiences in programming ROS
- Basic knowledge in automatic control
- Ability to communicate, a willingness to perform and an independent way of working
- Supervision will be done in English or Arabic

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