Remote Control Of A Concrete Pouring Hose

Ivo Hoffmanns

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Concrete is a widely used material in the construction industry. The process of pouring the concrete typically involves multiple operators performing laborious tasks in a harsh working environment with plenty of health and safety risks associated. Safety risks include slippery surfaces, dangerously unpredictable behavior of the hose due to air bubbles, health issues due to concrete coming in contact with the skin, inhaling cement particles and the heavy manual labor involved. This provides a fantastic opportunity for robotics to take over the dangerous parts of this work and contribute to a safer working environment for the workers.

The thesis follows the process of testing and developing the remote controls for a prototype concrete pouring hose. The goal is to provide an answer to the question of whether the operator can be removed from the dangers surrounding the concrete hose and allow him to stand at a safe distance while remotely operating the concrete pouring hose. In addition, different steering modes are explored. The prototype consists of a piece of a standard pouring hose that can be mounted on a concrete boom truck, commonly used on construction sites or for pouring concrete slabs. Four so-called Pneumatic Muscle Actuators realize the movement of the hose by changing their length. These actuators can be pressurized and filled with air, causing them to contract in length while expanding in diameter, similar to how your muscles contract. Contracting one or two muscles at a time causes the hose to move toward that direction as shown in the image on the right. In the test setup, a Programmable Logical Controller is programmed to increase or decrease the pressure in each muscle separately based on what the operator inputs into a remote controller.

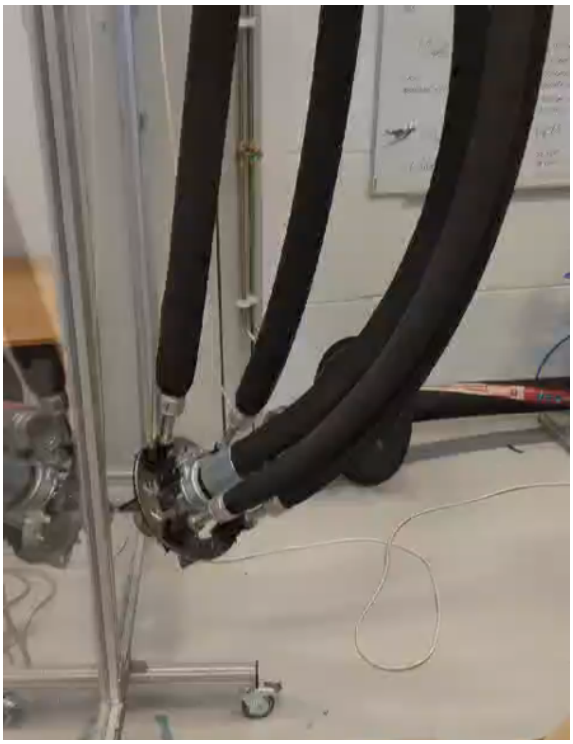

Figure 1: The prototype concrete pouring hose.

Throughout the thesis, controlling the hose is divided into specific sub-tasks. Starting with controlling a single muscle, expanding to two muscles and ultimately to all four muscles, the program for each sub-task is tested, after which the results are evaluated and the program is updated if necessary. Two different methods of steering are developed where the hose moves either by moving the joystick on the controller or the hose follows the position of the joystick. Specific challenges are discovered such as a limited flow rate of air causing the muscles to deflate slowly, a need to control the other muscles to avoid kinks or unwanted behavior, and the trade-off between range and responsiveness that needs to be considered. The results consist of a functioning program that allows for remote control of the hose and can form a solid base for further development of the prototype. Future recommendations include further testing with different setups, tests while pouring concrete, and improvements to the setup to allow for a more responsive system.