Design Principles for Syringe-Based Extrusion of Human Tissue-Mimicking Materials Using a 6 DOF Robot

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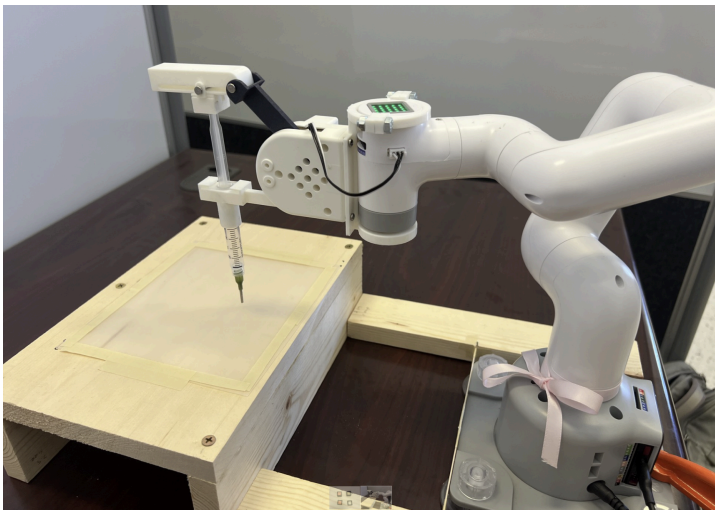

Due to the complexity of human anatomy, mechanically accurate, patient-specific, presurgical models are vital for conveying structural details and kinesthetic feedback to doctors during surgical planning and practice. Rapid production of these models has not been widely achieved, as current methods either fail to meet time or cost constraints, or to match natural human biological structures in terms of geometry and material properties. Robotic-actuated, syringe-based multi-material 3D printing offers a solution to these time, cost, and complexity limitations. This thesis explores design principles related to creating such a system, as well as extrudable materials for mimicking soft human tissue. The proposed approach involved design of a robot end effector to mechanically actuate a material-filled syringe, as well as development of code to extract coordinate and command data from a G-code file while controlling material extrusion. Experiments were run to identify a suitable low-viscosity material and define the printing parameters for its use.

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