MULTIMATERIAL 3D PRINTING OF SOFT ROBOTICS AND SENSORY BIOMEDICAL DEVICES

Luca Grignaffini (ET-BRT), Herman van der Kooij (ET-BRT), Ali Sadeghi (ET-BRT)

Abstract

In recent years, 3D printing has been increasingly utilized within the medical field as a fast and repeatable method for prototyping new devices in the field of prosthetics, wearable technologies, and assistive devices. With the latest advancements in this technology, we are able to integrate multiple materials with different properties as part of the same additive manufacturing process, using one single machine [1].

In this work, we aim to reach the full potential of multi-material 3D printing as a fabrication strategy for multiple medical applications by embodying features such as sensing systems and different material rigidities within the same component. We present two devices: a fully 3D printed modular hybrid hand with distributed tactile sensing [1], and a soft sensorized shoe insole for the measurement of 3D ground reaction forces.

In the case of the robotic hand, by tackling a common manufacturing limitation (i.e., poor bonding of soft and rigid materials), we developed a novel bonding technique called Repetitive Multi-layer Stacking" (ReMuSt) to effectively print hybrid parts. Conversely, regarding our sensorized insole, we developed a novel 3D printed piezoresistive sensor design that was tested on multiple subjects performing both jumping and walking trials with the aim of detecting all three ground reaction force components.

This research not only demonstrates the feasibility of multimaterial 3D printing as a manufacturing approach for robotic and medical devices, but also lays the groundwork for future studies into the optimization of fabrication strategies for a wide range of applications.

References

[1] L. Grignaffini, H. Van Der Kooij and A. Sadeghi, "A New Approach for Multi-Material Additive Manufacturing of a Sensorized Hybrid Soft Robotic Hand," 2024 10th IEEE RAS/EMBS International Conference for Biomedical Robotics and Biomechatronics (BioRob), Heidelberg, Germany, 2024, pp. 1107-1112, doi: 10.1109/BioRob60516.2024.10719764.