IZTECH ME401 Project Proposal

Advisor(s): Halil Tetik

Project title: Development of an experimental setup and determination of optimum printing parameters for direct-ink-writing of soft elastomers

Number of groups: 1

Number of students in each group: 5

Is the project within the scope of Co-Op Extended?: No

Project Background:

High performance elastomeric materials are highly demanded by new emerging fields such as soft robots, medical implants, and simulated human tissues. Traditional manufacturing of elastomer-based products is costly and time-consuming and additive manufacturing, also known as 3D printing, have been proposed as a promising alternative to address the issues on the manufacturing[1]. Direct-ink-writing (DIW), where the liquid resin with desired thixotropic rheology is extruded from an attached syringe and deposited to form a 3D structure, offers high flexibility of material selection and enables the possibility of 3D printing highly desired thermosetting and elastomeric materials, for many different applications[2]. Monitoring the print bead in situ can provide information that can be used to improve the quality and reliability of DIW. One way to do so is by utilizing digital image analysis. Because the only additional hardware required is a camera, digital image analysis can be a rapid, small footprint, low-cost way to monitor print quality. Common digital image analysis techniques are readily available in free packages such as OpenCV and ImageJ as well as high-level languages like Matlab and Mathematica. As such, digital image analysis is an accessible and powerful tool for monitoring print quality in situ [3].

Project Objectives:

- Development of an experimental setup
- Optimization of printing parameters
- In-situ quality control

Project Design Criteria:

- Active printing area of 200×200 mm
- A build plate capable of achieving a temperature range between -20 and 80℃
- A printhead setup capable of achieving a temperature up to 80℃
- A robust 3-axis motion stage with adjustable kinematic architecture
- Capability of real time process monitoring at least from two views

Expected Outcomes:

[1] Superstretchable and Processable Silicone Elastomers by Digital Light Processing 3D Printing
[2] A Dual Approach in Direct Ink Writing of Thermally Cured Shape Memory Rubber Toughened Epoxy
[3] In Situ Digital Image Analysis in Direct Ink Writing

- A robust 3D printing setup with an ability of real-time process monitoring
- A methodology for 3D printing parameter optimization
- A methodology of automated image processing for quality control.

Literature Survey Subjects:

- 3D printing of soft elastomers
- Direct ink writing of elastomeric materials
- Real time process monitoring in 3D printing
- Optimization of 3D printing parameters

Please write your notes below, which you find useful for students to know about the project.

Students are expected to have a high motivation, personal interest and some background in robotics/mechatronics, materials, (additive) manufacturing, or programming.