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Cluster of Excellence *liv***Mat**S
FIT – Freiburg Center for Interactive Materials and Bioinspired Technologies,
IMTEK, University of Freiburg

Characterization of soft digital materials for Polyjet 3D-printing* (HiWi, BSc, MSc)

Knowledge of the materials' properties is an essential element for creating complex systems that mimic natural materials. In the recent ten years, 3D printing gains enormous popularity thanks to the fabrication precision and a wide selection of 3D-printable materials with different properties. However, main printing processes, such as FDM or SLA, usually don't allow printing several materials simultaneously. While various solutions for this problem, such as changing printheads or alternating resin baths, exist, they remain quite cumbersome. In contrast, the Polyjet printing technique developed by Stratasys and Object changes the playfield quite drastically. Like in the classical inject printers, the printhead of Stratasys Connex 3D printer moves above the building tray, depositing liquid resin through multiple micrometer-sized nozzles. It enables simultaneous printing with up to four materials with resolution up to 20 microns. Moreover, Polyjet printing enables mixing the base materials through simultaneous deposition of multiple materials in the same location. As a result, such a mixed material obtains intermediate properties. Therefore, by mixing stiff and soft base materials in different ratios, it is possible to control the mechanical properties of the new material. Such intermediate materials are called "digital" in modern literature, and they are widely used when soft and highly deformable elements are required. Recently Stratasys announced a new generation of soft and durable materials under the name *Agulus*. By mixing soft Agulus material with rigid VeroWhite material, one may control the stiffness, extensibility, and shore index of corresponding digital materials.

Despite the importance of the above-mentioned materials, their mechanical properties are still underreported partially due to the relative complexity of the models that need to take into account hyperelasticity and viscoelasticity simultaneously. However, recently a couple of models that can capture the behavior of digital materials were proposed. The aim of this project is to perform thoughtful characterization of new generation digital materials for 3D printing and verify the applicability of theoretical models.

The skills that you can acquire during this project:

1. 3D printing (Polyjet)
2. Mechanical testing (uniaxial tension) with digital image correlation
3. Mechanical models with hyper and visco-elasticity

Please feel free to contact us if you have any questions.

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