Multi-physics modeling and simulation to advance 3D bioprinting

Biofabrication enables the creation of complex tissue models for a wide range of human organs through the precise deposition of different cell types and scaffold materials with locally varying material properties. While this method offers great potential for regenerative medicine, efforts are still in their early stages. The three-dimensional reproduction of complex and functional tissue structures remains a major challenge as transient processes occur within the biofabricated construct. Properties change over time, e.g. due to swelling or diffusion.

On the basis of continuum mechanical modeling, it is possible to numerically simulate the influence of and coupling between various stimulation factors crucial for functional tissue analogues, e.g. the print pattern, temperature, mechanical properties, chemical and/or electrical potential. Computational simulations can be used to determine otherwise inaccessible parameters and systematically optimize biomaterials and process parameters.

This post-doc position is targeted at developing a computational framework to capture the coupling between physical, chemical, and biological processes in the 3D printed construct using the C++ based FE library deal.ii. The candidate will integrate multimodal mechanical measurements across scales, generated in our group with 3D bioprinting, and continuum mechanical modeling and simulation to analyze and predict the complex time-dependent behavior of biofabricated tissue replicates (see Figure 1).

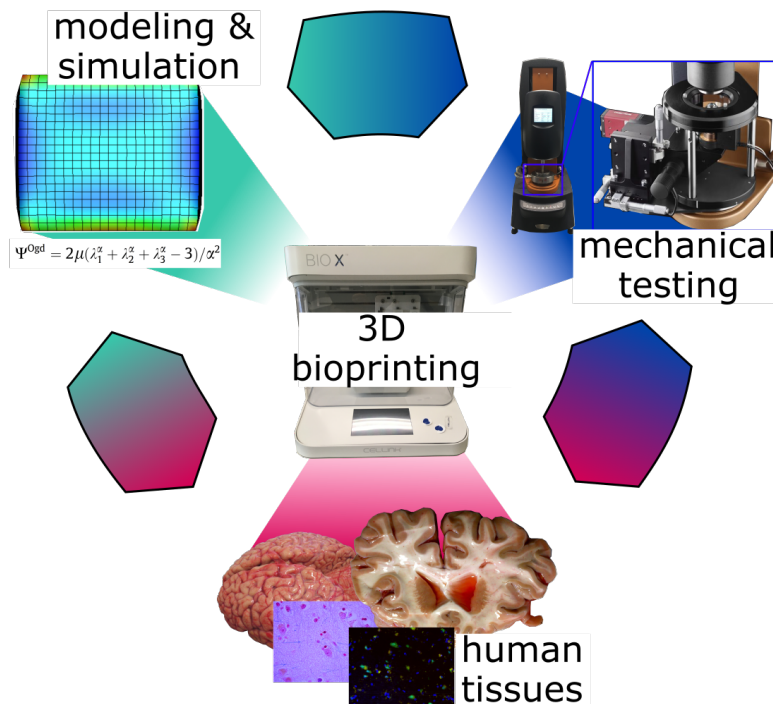Applications by female scientists are highly encouraged.

Figure 1: Integrated approach to advance the field of 3D bioprinting..

Fields: biomechanics, multi-physics modeling, constitutive modeling, biofabrication

Required qualifications: PhD in Mechanical/Computational/Biomedical Engineering or equivalent

Desirable qualifications: experience in programming in C++/deal.ii, fluent in English and German

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