Universitätsklinikum Würzburg
Anstalt des öffentlichen Rechts

Department and Chair for Functional Materials
In Medicine and Dentistry

fmz
Funktionswerkstoffe der
Medizin und Zahnheilkunde

Available master thesis project:
Development of a 5-axis additive manufacturing robotic system for tissue engineering

Description:
This master thesis project will focus on the development of a robotic arm-based printer for heart patch applications. It will work on the principle of a filament-based 3D printer. Besides testing the device, also the novel method of melt electrowriting (MEW) will be explored. The robotic arm system will be used and established to enable the fabrication of structures onto non-planar surfaces. The main task will be the implementation of the software for the robotic arm control in terms of path planning and control of the extrusion. Anisotropic structures will be printed and tested regarding their mechanical properties for the application in cardiac tissue engineering.
The student will carry out a training period in Italy at Research center “E. Piaggio” learning how to implement path planning with the robotic arm. After that, the project will be continued at the Department for Functional Materials in Medicine and Dentistry at the University Hospital in Würzburg and the Informatics XVII – Robotics Chair at the Julius-Maximilians-University Würzburg where the skills achieved at “E. Piaggio” will be applied to control the robotic arm.

Project field:
Robotics, additive manufacturing, melt electrowriting, scaffold, Tissue Engineering

Project requirements:
Knowledge in programming with matlab, experience with 3D printing and slicing, interest in scaffold fabrication and characterization

References:
[1] Luposchainsky, S., Jörissen, S., Nüchter, A., & Dalton, P. D. (2022). Melt Electrowriting of Poly (dioxanone) Filament Using a Multi-Axis Robot. Macromolecular Materials and Engineering, 2200450.
[2] Fortunato, G. M., Rossi, G., Bonatti, A. F., De Acutis, A., Mendoza-Buenrostro, C., Vozzi, G., & De Maria, C. (2021). Robotic platform and path planning algorithm for in situ bioprinting. Bioprinting, 22, e00139.
[3] Fortunato, G. M., Nicoletta, M., Batoni, E., Vozzi, G., & De Maria, C. (2023). A fully automatic non-planar slicing algorithm for the additive manufacturing of complex geometries. Additive Manufacturing, 69, 103541.
[4] Robinson, T. M., Hutmacher, D. W., & Dalton, P. D. (2019). The next frontier in melt electrospinning: taming the jet. Advanced Functional Materials, 29(44), 1904664.