SOUTENANCE DE THÈSE DE WEI-CHIH TSENG

Wei-Chih TSENG soutiendra sa thèse intitulée "Analysis of Flow Rate Impact in Extrusion-based Bioprinting to Improve Printing Quality", le mercredi 19 mars 2025 à l'université NCU à Taïwan. Un lien visioconférence sera disponible (envoyer un mail à barthelemy.cagneau@uvsq.fr ou luc.chassagne@uvsq.fr)

Wei-Chih TSENG soutiendra sa thèse intitulée "Analysis of Flow Rate Impact in Extrusion-based Bioprinting to Improve Printing Quality", le mercredi 19 mars 2025 à l'université NCU à Taïwan. Un lien visioconférence sera disponible (envoyer un mail à barthelemy.cagneau@uvsq.fr ou luc.chassagne@uvsq.fr)

Titre : Analysis of Flow Rate Impact in Extrusion-based Bioprinting to Improve Printing Quality

Abstract:
Extrusion-based bioprinting is an efficient, simple, and cost-effective technique in bio-printing, it capable of fabricating porous and complex three-dimensional scaffold structures widely used in tissue repair and regeneration. However, most biomaterial inks are non-Newtonian fluids, and the rheological and thermal properties of different inks vary significantly. The diversity and complexity of these fluids often result in the scaffold manufacturing process relying on several trial-and-error approaches to determine suitable printing parameter configurations, raising concerns about the quality and reproducibility of the printed scaffolds.
In this study, we integrated flow sensing into an extrusion-based bioprinting (EBB) system and replaced the conventional approach with fixed printing parameters by capturing time-series data of all printing parameters, enhancing the monitorability of the printing process. To improve the adaptability of EBB, we conducted experiments using three different biomaterial inks with various parameter configurations and developed multiple deep-learning models to evaluate their adaptability to different inks during the printing process. This approach enabled ink-insensitive predictions of the scaffold linewidth.
To improve the transparency of black box models and enhance the credibility of their prediction results, we employed two explainable artificial intelligence methods to analyze the decision-making process of the deep learning model. This analysis aimed to identify key features of the printing parameters and time series during the scaffold printing process.
The results enhanced the reliability of the model, and the identification of these key printing parameters also provides new insights into the bioprinting process, laying the foundation for improving the efficiency and quality of future bioprinting applications.

Flow rate was identified as a critical parameter that significantly influenced the quality of scaffolds during the bioprinting process. By assessing the specifications of flow meters used in bioprinting, we developed a novel flow application based on Particle Image Ve-

locimetry (PIV) technology to measure the flow rate of biomaterial ink during printing. The reliability of PIV in measuring biomaterial ink was validated by comparing mathematical theoretical models, precision scales, and PIV measurement results. This provided new approaches and applications for enhancing the quality of bioprinting.