Contribution ID: **100** Type: **not specified**

Leveraging Transfer Learning for Efficient Bioprinting

Tuesday, 17 September 2024 10:45 (20 minutes)

Bioprinting is an innovative set of technologies derived from additive manufacturing, with significant applications in tissue engineering and regenerative medicine. The quality of printed constructs is commonly measured in terms of shape fidelity trough a procedure known as printability assessment. However, the cost of experimental sampling and the complexity of various combinations of materials, processes, and conditions makes it difficult to train and generalize printability models across different scenarios. Typically, these models are application-specific and developed from scratch, exploring only a few parameters after arbitrarily predetermining several conditions.
The objective of this study is to demonstrate the first application of Transfer Learning (TL) in bioprinting. TL has already proven effective in additive manufacturing by leveraging existing knowledge and applying it to new conditions when materials, machines, or settings change.
In our study, we transfer the knowledge from a biomaterial (the source) to another (the target), aiming at modeling the target printability response by reusing the previous knowledge and thus minimizing experimental effort. The accuracy of the transferred model is assessed by comparing its prediction error with a conventional approach developed from scratch. Different established TL approaches are employed, compared, and improved to enhance prediction performance for this application. Additionally, we investigate the method's performance and limitations by varying the number of experimental target points.
This method demonstrates the feasibility of knowledge transfer in bioprinting, acting as a catalyst for more advanced scenarios across diverse printing conditions, materials, and technologies. Furthermore, the approach enhances reliability and efficiency of bioprinting process modeling.

Type of presentation

Talk

Classification

Mainly application

Keywords

Transfer Learning, 3D Bioprinting, Additive Manufacturing, Machine Learning, Printability Assessment

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Session Classification: AI in industry 1

Track Classification: AI in Industry