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BioCAE: A multiscale framework for complex biological systems and biofabrication of tissues and organs

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Statement of Purpose: 3D bioprinting process can be adapted to produce tissues in a variety of formats, structural complexities, such as material types, cell types, growth factors and differentiation, extracellular matrix composition, mechanical properties, macro and microvasculature and technical challenges associated with the creation of biomodels that mimic real vascularized tissues. In recent years, *in silico* approaches have been practiced in several fields, and offers new opportunities for medical discovery and investigation, helping and improving the storage, organization, and classification of the large data sets of digital biological information that is available. The purpose of this work is to present different approaches to predict the development and behavior of several biological processes, such as molecular networks, gene interactions, diffusion, cell differentiation, tissue and organ development, beyond to provide new perspectives and strategies in the biofabrication of tissues and organs.

Methods: A range of multiscale strategies was employed to develop a BioCAE for biofabrication of tissues and organs. Here we describe some approaches in steps, which may be part of the BioCAE, thereby preventing a significant amount of trial and error experiments in laboratories. *In silico* study focuses on the biological process of the angiogenesis of an aggregate of endothelial cells. The software CompuCell3D (CC3D) was used to mimic angiogenesis *in silico*. CC3D is an open-source environment for multi-cell and single-cell-based modeling of tissues, organs, and organisms.

Results & Conclusions: The emergence of integrated platforms on different systems levels to understand complex biological processes will enable the prediction and creation of biofabricated biological structures. We emphasize here that BioCAE is work-in-progress and there are a vast number of possible additions to the multiscale models for the biofabrication.

Biography

Janaina de A Dernowsek is currently working on a Postdoc Scholarship at the Center for Information Technology Renato Archer (CTI), Campinas, Brazil. She has obtained the MSc and PhD degrees in Genetics from the University of São Paulo (USP). During her PhD studies (2010–2014), she acquired knowledge and skills in posttranscriptional interactions between the miRNAs and mRNAs during the osteoblastic differentiation of human immature dental pulp stem cells. Currently, she is involved in the Biofabrication group at CTI Renato Archer working with several steps of biofabrication, mainly on the multiscale representation of tissue and organs for a blueprint. This hybrid 3D blueprint will contain all the necessary information for all bioprinting steps.

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