

COUPLING IMAGE PROCESSING AND COMPUTATIONAL MODELING AND SIMULATION FOR BIOMEDICAL APPLICATIONS

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ABSTRACT

In recent years, there have been numerous advances in medical imaging, many catalyzed by new hardware and computing solutions. In addition to being able to acquire higher resolution, faster and better quality images of the human body using existing technologies such as computer tomography (CT), magnetic resonance imaging (MRI) or ultrasound (US) imaging, other examples include, but are not limited to, the development of whole-body positron emission tomography (PET) scanners, the use of amyloid PET imaging in the early detection and management of Alzheimer's disease, as well as many now already popular portable imaging equipment and wearable medical devices. In concert with these advances, the use of 4D diagnostic imaging has enabled researchers to obtain high-resolution, detailed visualizations of organs and tissues of interest. Artificial intelligence is being used extensively to extract features of interest from multi-modality, multi-dimensional medical images, classify these features or track them over time to generate dynamic biomedical models that help assess abnormalities or disease. Automated image-based model and mesh generation algorithms have contributed to the creation of virtual cohorts of many patients that help study biological variability across subjects. Big data has been used in concert with deep learning to enhance the risk prediction of a patient's health condition and to diagnose disease. Digital twins have been developed to non-invasively identify the best treatment for a patient's condition through precision medicine, to design effective clinical trials, and to optimize hospital operations and management. These advancements are playing an important role in patient-specific disease diagnosis, treatment planning, and even therapy monitoring. The goal of the minisymposium is to gain insight into recent developments in medical image computing and computational modeling and simulation for biomedical applications by bringing together experts from mathematics, computer science, imaging science, and engineering to discuss the latest trends.