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COUPLING IMAGE PROCESSING AND COMPUTATIONAL MODELING AND SIMULATION FOR BIOMEDICAL APPLICATIONS

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ABSTRACT

The rapid advances in technology, data acquisition, storage and computing power have transformed medicine from a traditional discipline that empowered the clinician to a quantitative data science approach that relies on signal, images, and their processing, manipulation, interpretation, and use for various applications. Imaging has become a quintessential tool that enables non-invasive or minimally-invasive exploration of the anatomy and function either to detect and diagnose disease, plan treatments, or guide and deliver therapies. However, to enable all of the above, access to computational modeling and visualization tools is as critical as image acquisition. 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 (AI) 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. Computational modeling and simulation are central to the understanding and diagnosis of disease and determination of optimal treatment strategies. Digital twins, i.e., dynamic, virtual patient replicas, are being built using data from medical images, electronic health records, and genomic profiles and are used to perform *in silico* tests of medical devices or surgeries to predict patient-specific outcomes. Such virtual models are being updated with live data from wearables and sensors and can be used to perform real-time disease monitoring and adjustment of treatment. Mechanistic models are also being combined with data-driven AI models to develop hybrid models for improved prevention, monitoring, and control of diseases. These advancements play a key role in patient-specific disease diagnosis, treatment planning, and even therapy monitoring. This minisymposium is intended to foster an interdisciplinary venue at the intersection of imaging and computing and welcomes participation from computer science, engineering, mathematical modeling, imaging science and other related fields. Featured presentations will range from algorithms for image computing to computational biomedical models and simulations to mixed reality visualization for various biomedical applications.