Coupled, Seamless Organ-to-Molecular Scale Imaging and Modeling as a Tool for Discovery, BioTech Development and Diagnostics

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Like a storm gathering on the horizon or a dip in the equities market, the onset and progression of human disease is as difficult to predict as it is to abate or reverse. Multiscale modeling lends itself for elucidation of such complex systems behavior, since system parameters can be probed individually and in concert, to determine which combination of variables exerts dominant effects on outcome measures of interest. Yet, the promise of seamless multiscale modeling remained elusive, since bridging across length scales, from molecules to cells, tissues, organs and organ systems, required spatiotemporal imaging capabilities which were until recently unfathomable. In the past five years, a revolution in imaging and computing has opened the door for coupled, seamless organ-to-molecular scale imaging and modeling as a tool for discovery, biotechnology development and diagnostics.

Our webinar presents the current state of the art as well as the promise of multibeam electron microscopy coupled with multiscale computational modeling. As a first in the world study, we pieced together two million nanometer resolution images to create a seamlessly zoomable 'map of the human hip'. Our webinar outlines the technical aspects of the project. We also share our plans to provide Google Maps-like accessibility to study cell population health in the ecosystems of human tissues and organs, akin to epidemiological study of cell populations within individual patients. In particular, technical hurdles related to 4D+ multi length- (nm - m) and time-scale (ms - years) image acquisition, as well as data storage, processing and accessibility, will be addressed in terms of current and future feasibility.

The making of the maps as well as the maps themselves provide paths for discovery, leading collaborative R&D teams including the international public, to explore the human body's inner world. Ultimately, we aim to improve human health and the quality of life while inspiring a new generation of computational modelers *cum* human ecosystem engineers.

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