Multiscale spatiotemporal modeling of cardiac mitochondria

The model - We are modeling how the nanostructure of mitochondria affects the internal distribution of metabolites and signaling molecules, thereby affecting production of useable energy for the cell in the form of ATP. This is important because mitochondrial structure is known to change during different physiological and disease states. Understanding how these changes alter energy metabolism is important to understanding disease processes.

What is new inside? - The creation of an accurate spatial model for mitochondrial metabolism at the nanoscale has not previously been done. We have compiled a database of mitochondrial structures by electron microscopic tomography of cardiac muscle. To construct mitochondrial compartments *in silico*, we have had to create a new algorithm to automatically identify and render the intricate 3D membrane surfaces within the mitochondria.

How will this change current practice? - We find that outcomes of computer simulations of energy metabolism are significantly affected by known variations in mitochondrial membrane topology. Thus, in many cases, current practice of running simulations in generalized compartments will have to change to include structure explicitly. Likewise. as the efficiency and reliability of automated membrane segmentation increases, it will replace the current labor and time intensive process of manual tracing of membranes inside tomograms..

End Users - Metabolic modeling will useable by a wide range of biomedical researchers on platforms like Virtual Cell. Automated segmentation will be generally useful for electron microscopy and might be applicable to other grainy images such at CT scans which can have medical and industrial applications.

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