Biocellion: a large capacity modeling platform for multicellular biological systems

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We present the Biocellion modeling and simulation platform developed at the Pacific Northwest National Laboratory and available free for non-commercial use. Biocellion supports multiscale many-cell modeling for a wide range of multicellular biological systems. We have designed Biocellion to enable modelers to start simple, following examples and tutorials contributed by our growing community; then to incrementally refine their base models, integrating additional knowledge, to achieve ever increasing fidelity. As models become more complex, the computational cost of simulation grows. However, because Biocellion has been designed from the ground up to exploit high-performance computing, time-to-result even for systems having billions of cells, can be kept in check by using commonly available cluster computers. No additional programming is required to accelerate simulation to faster than the speed of life. Simply put, Biocellion offers unprecedented modeling and simulation “capacity” for the life sciences:a product of the *flexibility* needed to realize a wide spectrum of component models and the *performance* needed to simulate many-cell systems of macroscopic scale.

We demonstrate Biocellion’s large capacity through various biological system models developed on Biocellion: yeast and bacterial systems in lab and natural environments, skin, gut, blood clotting, and multiple cancer models. We collaborate with academia and industry to further our goal including the Institute for Systems Biology, University of Washington, Utah State University, Fred Hutchinson Cancer Research Center, Procter and Gamble, and Celgene as our key collaborators.

We continue to build an ecosystem around Biocellion. A biocellion wiki hosts community contributions of examples and tutorials. A forum provides quick answers to questions from other community members. We have invested in making the 3D visualization tool ParaView, also a free download, compatible with Biocellion output. We are also developing new visualization technologies needed to support truly interactive exploration  of the voluminous data produced when Biocellion simulates living systems having billions of cells or more. We welcome collaborators in all the needed disciplines -- including mathematics, computer science, biology, chemistry, medicine, engineering -- in academics, government and industry to join us in our pursuit of many-cell modeling using Biocellion.