TOWARD THE MULTI-SCALE SIMULATION FOR A HUMAN BODY USING THE NEXT-GENERATION SUPERCOMPUTER

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The next generation supercomputer of 10 Peta flops is now under construction as a national project in Japan. Not only the hardware development but also the software development is highly expected and the software development for the human body simulator is assigned as a grand challenge program for the effective use of this supercomputer. In this program, the multi-scale and multi-physics natures of the living matter are emphasized. Under this concept, we are developing the multi-scale simulator for a living human body. Basic strategy of the simulator is to utilize the medical image data taken by MRI, CT, or ultrasound for the prediction of disease and planning of therapy. For this purpose, we have developed full Eulerian fluid-structure-interaction solver without mesh generation procedure, which enables us to conduct the simulations directly from medical images. The method is based on the finite difference scheme with fractional step algorithm for incompressible flows and materials. The result has been validated through the deformable vesicle problem in the simple shear flow, and has been applied to a pressure-driven blood flow containing a large number of red blood cells and platelets. The mechanism of thrombus formation has been elucidated using this simulation and multi-scale modeling of platelets-vessel wall interaction.

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