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SUPERCOMPUTING IN BIOLOGICAL AND MEDICAL PHYSICS

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ABSTRACT

Many countries are now facing health-care problems with the rapidly aging population. It is of great importance for such an aging society to offer more advanced medical treatments, which improve quality of life in patients. It is strategically meaningful to tackle challenges toward a new paradigm into predictive medicine. Along with continued growth of capacity in high performance computing, methodological progress in simulation technique, which enables to quantify dynamic behaviors of internal organs in a living body, is expected to realize more attractive medicine by predicting a development of disease and by helping surgical planning. Especially, the use of patient-specific data will make it possible to propose specific therapies suitable for characteristics of each individual, resulting in a powerful support tool for the next-generation tailor-made medical treatments.

Following the above idea, some big projects have been made or are ongoing internationally. For example, in Japan, during the development of the K computer (at about 10 Peta flops in the peak performance) as a national project, the software development for the human body simulator was assigned as a grand challenge program, in which the multi-scale and multi-physics natures of the living matter were emphasized. Currently, the developed simulators are attempted to be integrated, and utilized to reproduce complex processes in some diseases.

In the present mini-symposium, we would like to have papers that address the future development and direction of the biomechanical simulations for a wide variety of medical applications. For example, we here raise three classes of important issues: (i) fluid-structure interaction problems including organ-organ interactions simulated using the medical image data, and rheological properties and/or functions to sustain life in blood flows; (ii) multi-scale and multi-physics problems including couplings of the different scale phenomena among the organ, cell and molecular level such as ligand-receptor interactions; (iii) applications of diagnostic/therapeutic devices including the apparatus development and control.