R&D field: Life science

Simulation for blood-flow analysis

- Program name: MC-BFlow
- Developer
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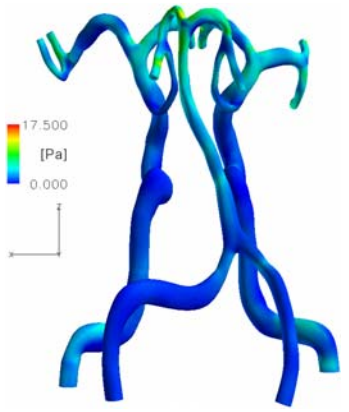
- Abstract
  - Analysis of hemodynamics, such as wall-shear stress significant to emergence and progression of vascular lesions, targeting at the whole cerebral-artery network with complex 3-dimentional structure.
  - Analysis of substance transport via blood flow.
  - Analysis execution for each patient using an artery-shape model extracted and structured with Medical pictures of MRI and other method.
- Algorithm
  - Finite volume method.
  - Fortran90 and MPI (domain decomposition).
- Actual computation size
  - About 0.18 - 0.23 million elements for the whole Willis arterial circle.
  - Approximation of arteries of diameters of 2-3 mm or smaller with zero- and one-dimensional models.
  - Memory 4 GB and disk 10 GB.
- Future computation size in 2010
  - 50 million-0.1 billion elements or more for the whole Willis arterial circle.
  - 3-dimensional analysis of arteries of diameters of 1-2 mm.
  - Memory 1 TB and disk 3 TB, or more.

The artery model



Distribution of wall-shear stress

- Expected results
  - It has been pointed out artery shape and blood flow may cause emergence and progression of vascular disease. We will develop precaution and therapy methods by clarifying how vascular disease emerges and progresses based on numerical analysis of increasing vascular disease (especially cerebrovascular disease).
  - Although subarachnoid bleeding due to cerebral-aneurysm rupture may be fatal, risk of operation for an aneurysm is also high. We will increase therapy effects by estimating the risk of cerebral-aneurysm rupture based on numerical simulation.
- Reference
  - http://www.rss21.iis.u-tokyo.ac.jp/theme/life/organ/index.html