R&D field: Engineering

Unsteady Flow Analysis based on Large Eddy Simulation (LES)

- Program name: FrontFlow/Blue
- Developer
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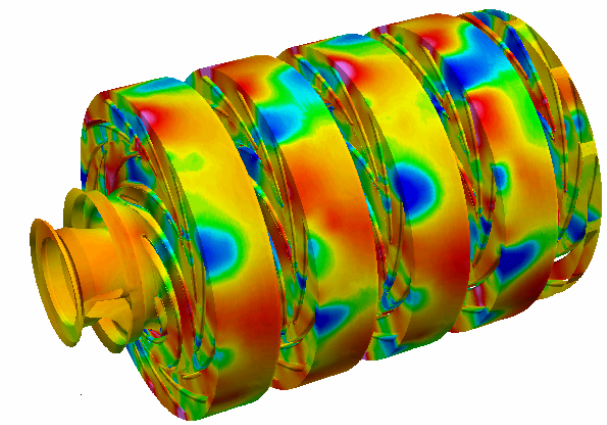
- Abstract
  - Flow analysis based on Large Eddy Simulation suited for highly accurate prediction of turbulent flow phenomena.
  - Prediciton of turbulent flows inside turbomachinery and resulting aerodynamic/hydrodynamic noise.
- Algorithm
  - Finite element method with the second-order accuracy in time and space.
  - Multi-frame function with the over-set method.
  - Parallel processing with domain decomposition.
- Current computation size
  - Elements: 5×10^8 (hexahedron).
  - Sustained performance 4.6 TFlops (480 nodes of Earth Simulator).
  - Memory 2.0 TB and disk 1.0 TB.
- Future computation size in 2010
  - Elements: 10^{12} (hexahedron).
  - 2,000 times of the current computation size.
  - Memory 4.0 PB and disk 2.0 PB.



Estimated result of pressure variation on a pump surface (C.Kato, at el, ASME FEDSM2005-77312)

- Expected results
  - Direct computation of turbulent flows will become possible for almost any kinds of turbomachinery. Highly accurate predictions of turbulent flow phenomena will be realized in most of industrial applications.
  - Prediction accuracy will be increased greatly for turbulence-related unsteady phenomena inside turbomachinery such as cavitation and unsteady fluid forces. As a result, advanced designing techniques will be developed based on complete understanding of turbulent flow phenomena.
- Reference
  - Kato, C., et al., “Numerical Prediction of Sound Generated from Flows with a Low Mach Number”, Computers & Fluids, 36 (2007), pp. 53-68.
  - http://www.rss21.iis.u-tokyo.ac.jp/theme/multi/fluid/index.html