Advanced Research in High Performance Scientific Computing

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Laboratory for High Performance Scientific Computing and Computer Simulation
Laboratory for Computational Medical Imaging and Data Analysis

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Laboratory for High Performance Scientific Computing and Computer Simulation

- Director: Dr. Jun Zhang
- National and international visibility
- Parallel scientific and parallel computing
- Computational sciences
- Modeling and simulations in bioinformatics
- Knowledge discovery and data mining in scientific computing
Laboratory for Computational Medical Imaging and Data Analysis

- Director: Dr. Jun Zhang
- Computational techniques for medical image analysis and visualization
- Data mining and information system for brain image analysis
- Non-invasive early detection of certain brain disorders
Mission Statement and Research in CMIDA and HiPSCCS Labs

- Study and design robust and efficient numerical algorithms and software packages for solving large scale scientific and engineering problems on high performance computers.
- Develop and evaluate software tools and problem solving environments for facilitating parallel and distributed simulation and visualization.
- Develop highly accurate and highly efficient computational methods and numerical schemes for simulating physical and engineering processes with a focus on applications in computational fluid dynamics.
- Develop efficient algorithms and software for large scale data mining and information retrieval.
- Develop efficient computational algorithms for bioinformatics and medical imaging applications.
- Promote and popularize high performance scientific computing techniques and practice in general science and engineering research, industrial and medical practices.
Application Areas

- Medical imaging analysis
  - Fiber tracking in the human brain for early detection of Alzheimer’s disease
- Biosimulations
  - Skin burn
  - Diffusion flame
- Computational electromagnetics
  - Electromagnetic scattering problems
- Data mining and information retrieval
  - Terrorism analysis system
Function and Connectivity of Human Brain

- Magnetic resonance imaging (MRI)
- Tracking brain white matter fiber
- White matter fibers – the connecting wires
- Use of DT-MRI data for fiber tractography
- Diffusion-based tracking technique
- Comparison of healthy & diseased brains
Computational Electromagnetics

- Electromagnetic scattering problems
- Hybrid integral equations
- Method of moment (MoM)
- Linear systems $A \times b$
- Fast iterative solvers
- Fast multipole method (FMM)
- Preconditioning techniques
Steady and Unsteady Laminar Diffusion Flame Simulation

- Computer simulation of laminar diffusion flame
- Applications to bioheat transfer in skin
- Human and firefighter protection
- Biomedical applications
Personnel and Grants

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