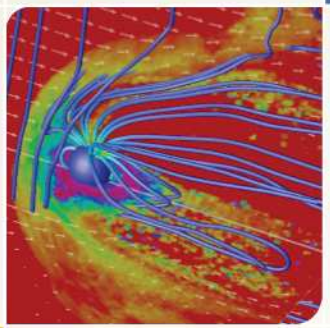
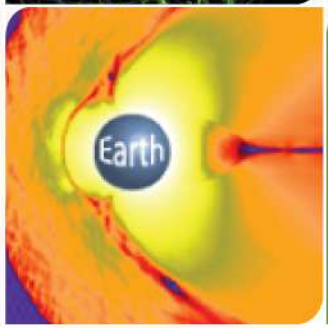
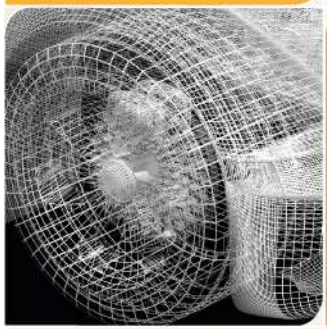





SimTools Panel
Challenges in Distributed Simulation

Richard Fujimoto

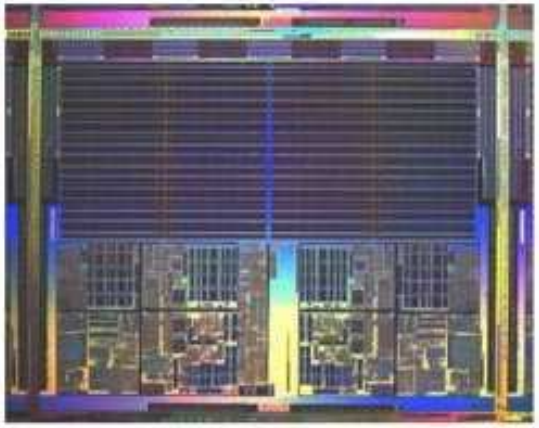
Georgia Tech College of Computing
Computational Science and Engineering

Technology Trends

- Exploding processor counts
  - Performance improvements coming from increased processor count rather than clock speed
  - Multiple processors on a single chip becoming widespread
- Multi-core everywhere!
  - Multiprocessors already in desktops and laptops; coming to mobile computing platforms
  - Cannot rely on Moore's law anymore for increased performance

Challenge 1: Parallel Simulation for the masses

Automate, automate, automate…



Dual Core Processor

IBM Blue Gene/L (512 nodes)

Supercomputing Trends

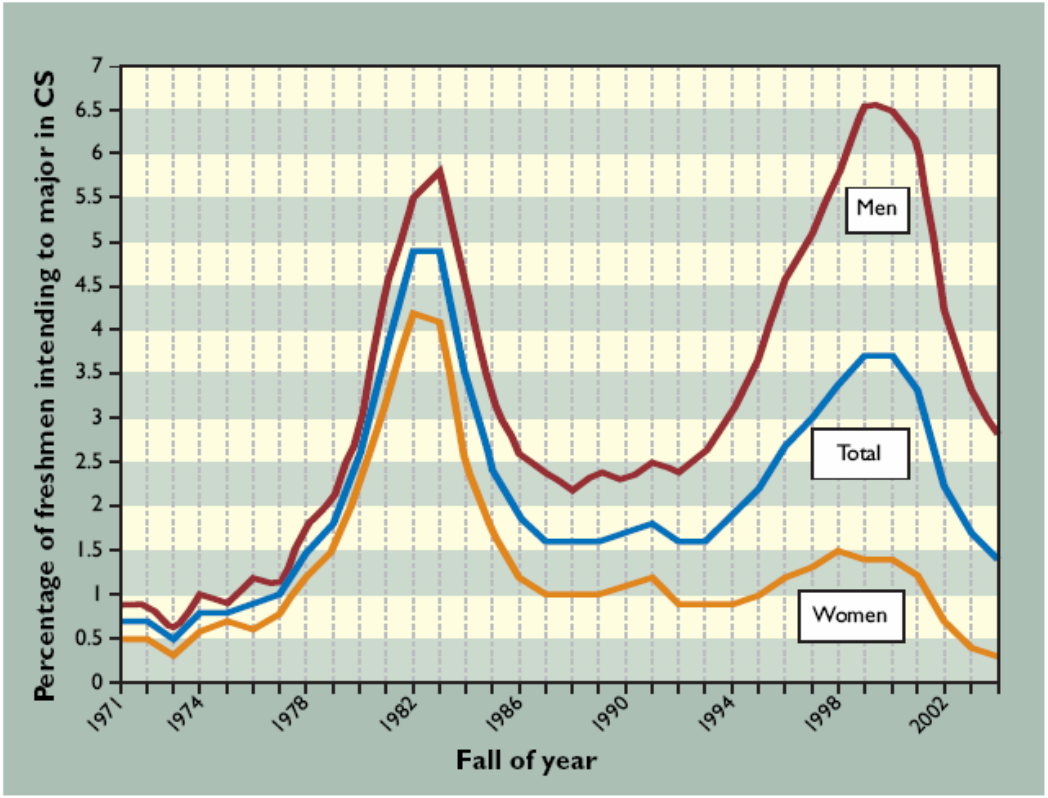
Cluster	Operational Date	Processors	Performance (Teraflops)
ASCI Red	1997	4,536	1.0
ASCI White	2000	8,192	7.3
ASCI Q	2002	8,192	13.8
Earth Simulator	2002	5,120	35.8
ASCI Red Storm	2004	10,880	36.1
NASA Columbia	2004	10,160	51.8
ASC Purple	2005	10,240	63.3
Blue Gene/L	2005	131,072	280.6 (367 peak)

100,000+ processor machines are already here
1,000,000+ processor machines are coming

Source: Top500 List

Challenge 2: Parallel Simulations on million processor systems
Model development; debugging; validation; resource allocation

Students Entering Computer Science



Source: HERI at UCLA

Challenge 3: creating workforce with enough computing savvy to exploit parallel simulation techniques

- Diversity and underrepresented groups
- Parallel computing education



Real-Time Decision Support

- A tsunami of data… financial, biomedical, transportation, environment, surveillance, …
- Computational models to aid or automate real-time decision making processes
  - Build upon maturation and growing deployment of sensors, networks, ubiquitous computing
- Combine live data with on-line simulations for state prediction and optimization
  - Emergency response and management (terrorist attacks, hurricane evacuation)
  - Transportation system management
  - Military operations
  - Dynamic supply chain optimization

Challenge 4: Real-time decision support that works!



Distributed Simulation Survey

Steffen Straßburger, Thomas Schulze, Richard Fujimoto, "Future Trends in Distributed Simulation and Distributed Virtual Environments," Fraunhofer Institute, 2008.

Survey of DS and DVE research community; 61 respondents

Findings:

- DS and DVE has high practical relevance
- Great need to exploit heterogeneous distributed resources
- Technology largely under-exploited outside Defense industry
- Challenges include
  - Achieving both high interactivity and high consistency in DVEs
  - Easy-to-use synchronization; solving the "zero lookahead" problem
  - True "plug 'n play" simulation capabilities
  - (Semi-) automated semantic interoperability between domains