NASA Briefing on Information Technology R&D

Lee B. Holcomb
CIO for NASA
February 25, 2000
Agenda

- Highlights of FY 99 Accomplishments
- Plans for FY 00 and 01
- Budgets for FY 00 and 01
Intelligent Flight Controls

Develop and flight demonstrate a flight control technique that can effectively identify aircraft stability and control characteristics using neural networks and utilize this information to optimize aircraft performance.

Impact
• Enhanced Safety
• Reduced Cost

Flight Critical Parameters
Optimize Control Response

[Diagram of a jet with neural network connections]
Results from MPS, a MHD PseudoSpectral code simulating magnetic fields in the Sun

- Carried out on a 512x512x97 grid.
- The size of the simulation enables it to contain several coherent structures that can be associated with the sun's granules.
- Run at 50 Gigaflop/s on 512 processors of the ESS Cray T3E at GSFC.
- 100,000 iterations

**Goal:** To understand the structure and evolution of both large- and small-scale magnetic fields near the surface of the Sun.

- Carried out on a 512x512x97 grid.
- The size of the simulation enables it to contain several coherent structures that can be associated with the sun's granules.
- Run at 50 Gigaflop/s on 512 processors of the ESS Cray T3E at GSFC.
- 100,000 iterations

For the first time the resolution of simulations of turbulent convection on the Sun’s surface can exceed the resolution of the observations.

- Provides an important framework for the analysis of observations by eliminating incorrect interpretations.
- Provides robust theoretical guidelines for the planning of future missions like Solar-B.

Temperature of top layer

- Light color represents hotter fluid moving up out of the page; dark color represents colder, sinking fluid.

Magnetic Flux of top layer

- Light color represents large positive flux pointing up out of the page; dark color represents large negative flux.

"actual" distribution produced by simulation

"blurred" distribution that would be observed by an instrument. It may be interpreted incorrectly as an emerging coherent flux tube.

Andrea Malagoli, University of Chicago

http://astro.uchicago.edu/Computing/HPCC/
Computational Aerosciences (CAS) Project

APNASA 21 BLADE ROW COMPRESSOR SIMULATION
TURNAROUND TIME REDUCED BY A FACTOR OF 400 : 1

ESTIMATED TURNAROUND TIME

FACTORs INFLUENCING TURNAROUND TIME

- BASELINE ANALYSIS
- PARALLEL PROCESSING
- ALGORITHMIC CHANGES
- INCREASED RESOLUTION
- COMPUTER HARDWARE IMPROVEMENTS
FY 00 Plans

- Demonstrate a prototype, heterogeneous, distributed computing system linking multiple, geographically distributed computing testbeds into a single computing environment.
- Demonstrate a 500-times end-to-end improvement (over 1992 baseline) in internetwork capability for grand challenge applications.
- Demonstrate scalable, spaceborne applications and software-based fault tolerance on a first generation embedded computing testbed.
FY 00 Plans (Continued)

- Benchmark and identify high-payoff discipline tools, integration methods and architecture, and life-cycle processes for a selected set of testbed applications:
  - Reusable space transportation
  - Space station/space shuttle operations
  - Earth observation
  - Deep space robotic/human exploration
FY 01 Plans

- Prototype network connectivity, databases, query and analysis tools, and intelligent agents for access to aviation safety data
- Develop software tools to simulate, benchmark, and optimize the performance of advanced computing systems
- Demonstrate real-time capability with software-based fault tolerance for spaceborne computing systems
FY 01 Plans (Continued)

- Demonstrate a portable, scalable debugging and test environment for computational aerosciences applications on a TeraFLOPS system
- Demonstrate 1000-times improvement (over 1992 baseline) in time-to-solution for grand challenge applications
- Establish prototype collaborative engineering environments focused on a selected set of testbed applications (as defined in FY 00)
FY 01 Plans (Continued)

- Establish architectural “plug and play” integration standards
- Develop preliminary knowledge recovery and data mining tools
Intelligent Systems

Automated Reasoning
- Executive Reasoning
- Case-Based Reasoning
- High Assurance Software
- Biologically-Motivated (Biomimetic) Adaptive Systems
- Planning & Scheduling

Human-Centered Computing
- Optimized Displays
- Immersive / Haptic Environments
- Biologically-Motivated (Biomimetic) Computer/Component Architectures and SW
- Internet-Based Knowledge Representation
- Cognitive Architectures

Intelligent Systems for Data Understanding
- Geographically Distributed Computing
- Knowledge Management and Institutional Knowledge Capture
- Reconfigurable Computer Architectures
- Knowledge Discovery and Data Mining

Revolutionary Computing
- Quantum Mechanical Computing
- Neurally-inspired Computing
- Holographic Memory Devices
- Biological Computing
Intelligent Synthesis Environment

**Rapid Synthesis and Simulation Tools**
Developing advanced intelligence-based engineering and science simulation tools for analysis and design from concept through disposal and synthesis tools for seamless coupling of diverse discipline tools.

**Cost and Risk Management Technology**
Develop advanced cost analysis and risk tools in a unified framework covering end-to-end mission design, and compatible with design and analysis tools for fully integrated life cycle simulations.

**Life-Cycle Integration and Validation**
Developing integration methods, smart interfaces and frameworks to achieve seamless “plug and play” integrated design and analysis, and assessment, validation and demonstration of ISE technologies.

**Revolutionize Cultural Change, Training and Education**
Changing the engineering culture to take full advantage of advanced tools and environments and developing distributed active learning and training collaborative environment.

**Collaborative Engineering Environment**
Advancing the state of practice and inserting the state of the art collaborative infrastructure and applied design and analysis capabilities into enterprise use.
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