NASA Briefing on Information Technology R&D

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CIO for NASA
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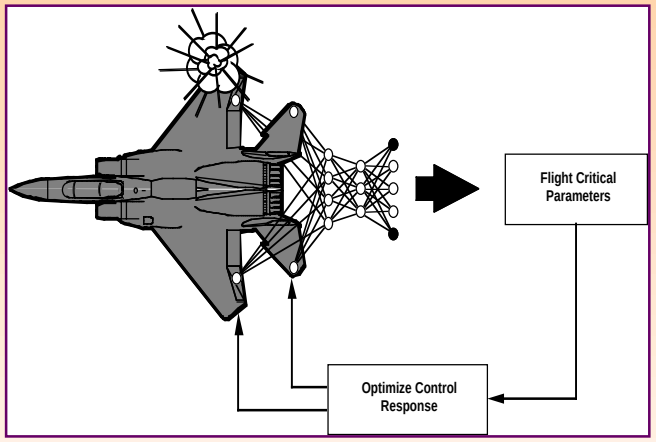
Agenda

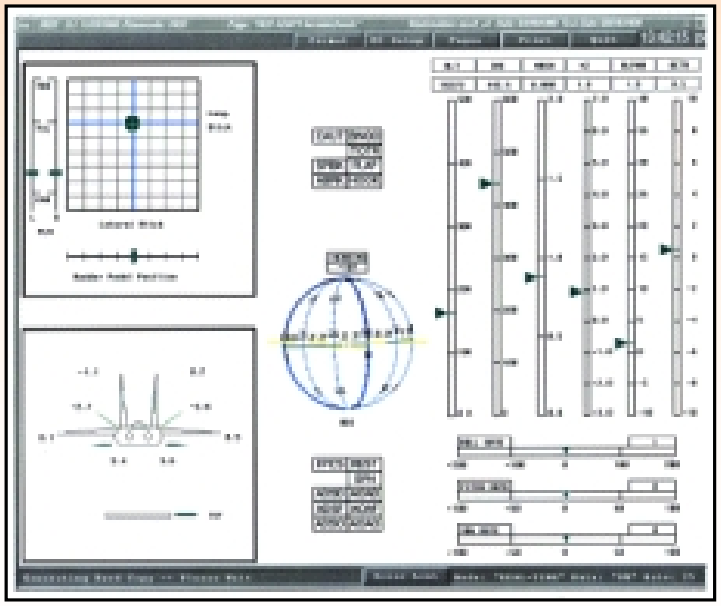
- Highlights of FY 99 Accomplishments
- Plans for FY 00 and 01
- Budgets for FY 00 and 01

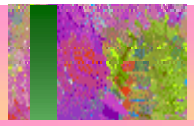
Intelligent Flight Controls

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**







Earth and Space Science (ESS) Project

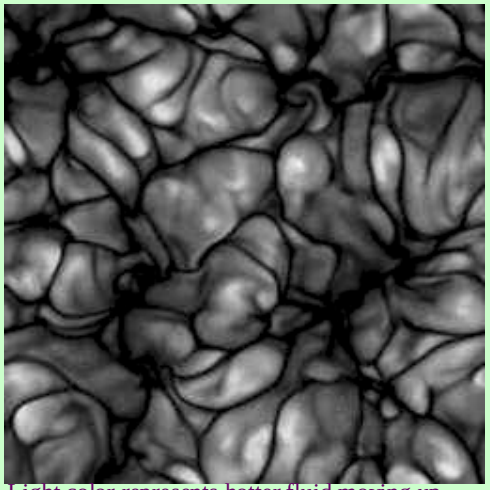
Turbulent Convection and Dynamos in Stars

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

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

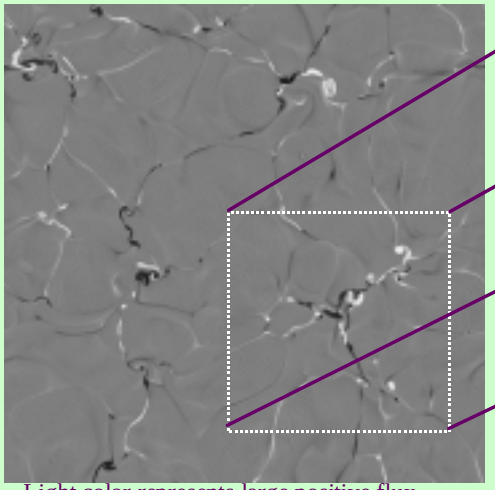
- Provides an important framework for the analysis of observations by eliminating incorrect interpretations.
- Provides robust theoretical guidelines for the planning of future missions like Solar-B.

Temperature of top layer

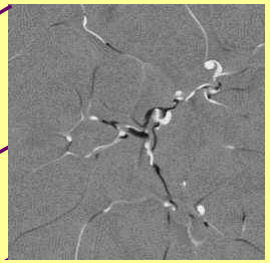


Light color represents hotter fluid moving up out of the page; dark color represents colder, sinking fluid.

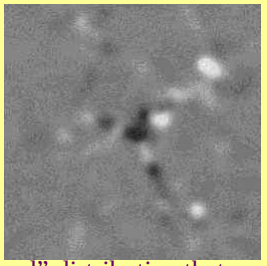
Magnetic Flux of top layer



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



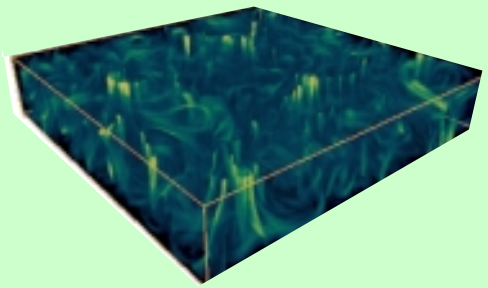
"actual" distribution produced by simulation

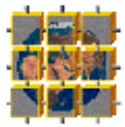


"blurred" distribution that would be observed by an instrument. It may be interpreted incorrectly as an emerging coherent flux tube.

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*

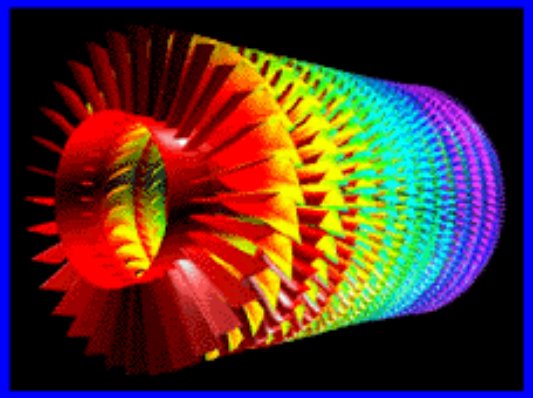


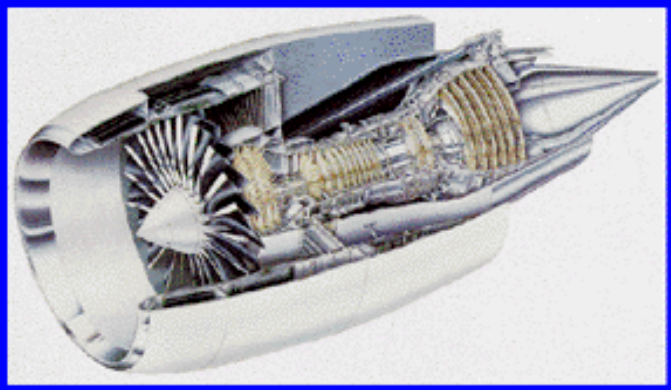


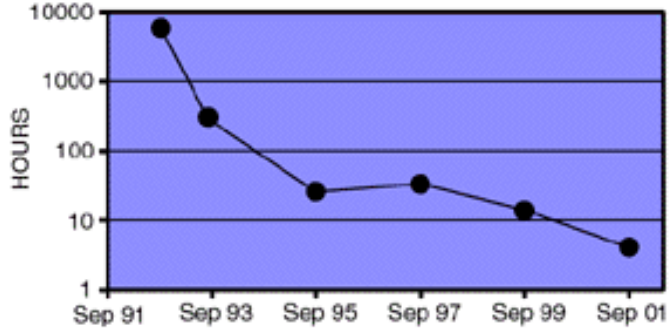
Andrea Malagoli, University of Chicago
http://astro.uchicago.edu/Computing/HPCC/

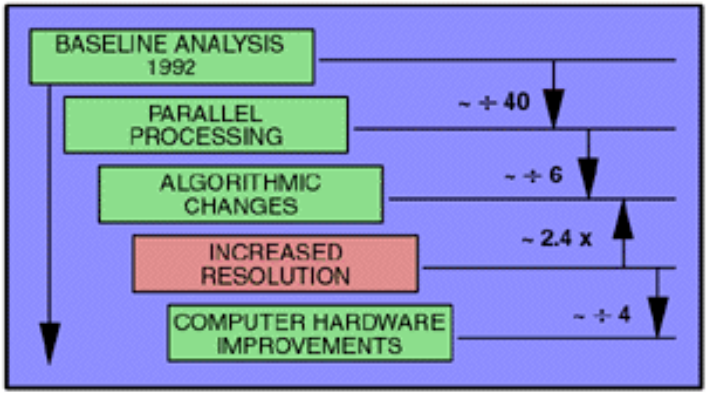
Computational Aerosciences (CAS) Project

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









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

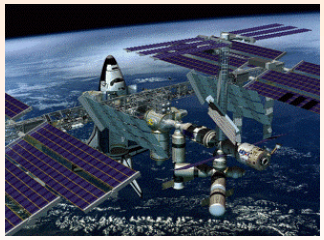
Developing advanced intelligence-based engineering and science simulation tools for analysis and design from concept through disposal and synthesis tools for seamless coupling of diverse discipline tools

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.



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.

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

NASA Crosscut Budget

	FY 00	FY 01
High End Computing	25.4	25.8
High End Computation and Infrastructure	99.4	129.1
Large Scale Networking	20.1	19.5
High Confidence Systems	6.5	9.1
Human Computer Interface and Information Management	5.5	17.9
Social, Economic, and Workforce Implications of IT and IT Workforce Development	6.7	8.3
Software Design & Productivity	10	20
TOTAL	173.6	229.7