Computing Technology

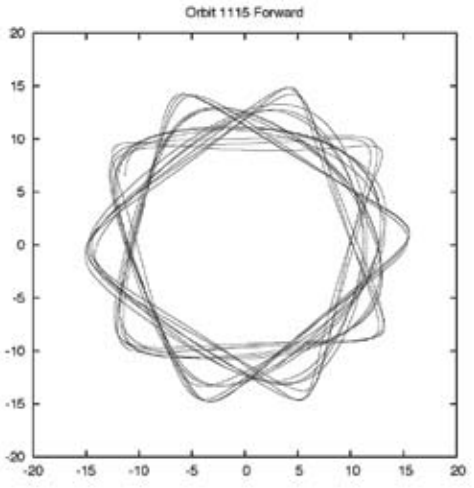
HECC Application Performance and Productivity

The Application Performance and Productivity (APP) Group supporting the High-End Computing Capability (HECC) project at NASA Ames Research Center has three key activities: enhancing performance of high-end computing application codes of interest to NASA, leveraging software technologies to improve user productivity, and characterizing performance of current and future architectures.

Our efforts to optimize performance of applications from all NASA mission directorates over the past year include:

- PGM3 (a solver for n-body integrator): Ported to the Pleiades supercomputer together with code modifications, which resulted in an 11.65x performance improvement over runs on the Columbia supercomputer
- TASS (Terminal Area Simulation System): Eliminated bottleneck in this code, providing a 5x performance improvement in runs on Columbia with 256 processors
- ADPDIS3D (a high order multiblock overlapping grid solver for hypersonic turbulence): Worked with end-users to develop a code that has good weak and strong scaling characteristics (tested up to 15,000 processors on Pleiades)

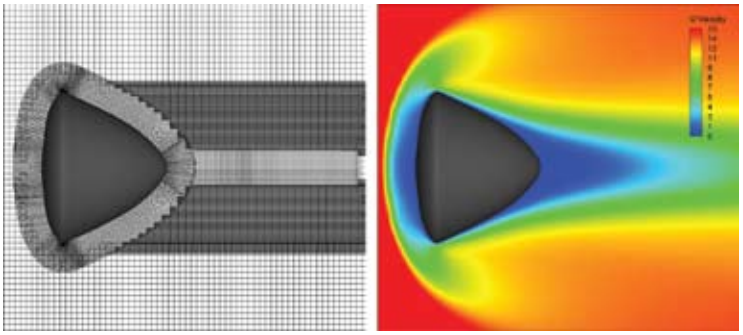
In addition to optimizing code for NASA researchers, the APP group regularly conducts performance characterization on new supercomputing architectures using a suite of NASA-relevant codes including benchmarks and full applications. We present our recent performance characterization efforts on several HECC systems including those based on AMD's Opteron and Intel's Xeon Clovertown, Harpertown, and Nehalem architectures.



An orbit of one 800,000-particle run on the Pleiades supercomputer, generated using the PGM3 flow solver. The potential in which the orbit lives is roughly spherical, but has superimposed on it the potential of a bar that rotates a full turn in 200 integration steps. (Dick Miller, University of Chicago)

CPUs	Before	After
32	5434	4735
64	3367	2582
128	2012	1032
256	2387	484

Magnitude improvement realized by changes made to TASS code by HECC APP experts—for a complete run (~1,780 cycles) on Columbia, the above chart illustrates processor scalability. (Shown is calculation time = total time – startup). Similar results were also obtained for Pleiades.



Two-dimensional slice through the grid and Mach number color levels in logarithmic scale for an Apollo-like Crew Exploration Vehicle traveling at Mach 16.

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