Parallel Software Design for AVIRIS Project

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Highlights of AVIRIS Software

¥ Two major codes: MODTRAN and Nonlinear Least Squares Fitting (NLSF).
¥ MODTRAN was developed by the Air Force Phillips Laboratory in 1970s with about 40,000 lines in Fortran, and NLSF code was designed by the JPL group.
¥ Running the entire package is very time consuming if a large data set is encountered.
Object of Present Study

- Establish high speed computation for the AVIRIS data processing.
- Design a parallel version of software for different parallel platforms.
- Apply the software for various scientific applications.
Computing Systems

¥ Original system: Sun workstation.
¥ Target systems:

Cray T3D and T3E (massively parallel systems)

HP SPP2000 (shared memory parallel system)

Beowulf PC clusters (cheap parallel systems)

Any parallel systems with the MPI software

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Problems Encountered

¥ Different compiler gives different error messages.
¥ Binary data conversion on different systems.
¥ Subroutine’s names conflict with system’s call.
¥ File unit numbers are out of the legal system range.
¥ I/O errors.
¥ Data structure inconsistency.
¥ Some other problems.
Technical Approach

- Testing the entire package on various computing systems.
- Use compiler options to handle some problems.
- Modify codes if necessary.
- Documentation.

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Technical Approach

- Domain decomposition with MPI.
- Load balance.
- Parallel and sequential I/O.
- Performance analysis.
- Scripts (easy to use the package on parallel systems).
- Documentation.
Performance Results - Real Time Comparison

Fig 1. MODTRN (a) and Nonlinear Least Squares Fitting code (b) on parallel systems
Performance Results—Speedup

Fig 2. Speedup of parallel MODTRN (a) and the parallel Nonlinear Least Squares Fitting code (b) parallel systems

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The AVIRIS Software Package on PC Clusters

Fig 3. Real time comparison for the AVIRIS software (a) and speed-up of the package on two Beowulf systems (200 MHz and 450 MHz).

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Conclusions

- The parallel software is portable to various computing systems.
- The entire package works well on different parallel systems, such as the Beowulf clusters and the Cray T3x.
- The parallel version gives excellent speed-up.
- The Beowulf systems give the best performance among several parallel systems.
- The parallel MODTRAN can be to be integrated to other projects.
- The parallel AVIRIS software is ready for various applications.

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Useful Links

Information about the parallel MODTRAN:

Information about the parallel AVIRIS package:
contact Robert Green for details.

Information about Beowulf PC clusters:
contact Ping Wang for details.