The Status of PARKBENCH

Jack Dongarra

PARKBENCH

(PARallel Kernels and BENCHmarks)

- Founded at Supercomputing '92, convened by Dongarra and Hey
- Initial Goal - Convergence on an agreed set of benchmarks and procedures within 12 months
- Membership open to all - voting rights acquired by attendance at meetings
- Three monthly meetings with interim email discussion - pbwg-comm@cs.utk.edu
- Supported by most major benchmarking groups
- Supported by most major computer vendors

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- **OBJECTIVES**
  - To establish a comprehensive set of parallel benchmarks that is generally accepted by both users and vendors of parallel systems
  - To provide a focus for parallel benchmark activities and avoid unnecessary duplication of effort and proliferation of benchmarks
  - To set standards for benchmarking methodology and result reporting together with a control database/repository for both the benchmarks and results
  - To make the benchmarks and results freely available in the public domain

- **MOTIVATION**
  - Lack of distributed memory message passing benchmarks that were generally acceptable to both users and system vendors

PARKBENCH

Chairman:	Tony Hey (Southampton)
Vice-Chairman:	Jack Dongarra (Knoxville)
Secretary:	Mike Berry (Knoxville)

- Work divided between 5 subcommittees:
  - Methodology (David Bailey)
  - Low-level Benchmarks (Roger Hockney)
  - Kernel Benchmarks (Tony Hey)
  - Compact Applications (David Walker)
  - Compiler Benchmarks (Tom Haupt)

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METHODOLOGY

- Finalized, first report available:

  - R.W. Hockney and M.W. Berry, "Public International Benchmarks for Parallel Computers", PARKBENCH Committee report number 1, Scientific Programming 3(2), 101- 146, 1994.

- Source codes, Documentation, Results Database, Graphic Interface all available

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LOW-LEVEL Benchmarks

Single-Processor

- TICK1
- TICK2
- RINF1
- POLY1
- POLY2

Multi-Processor

- POLY3
- COMMS1
- COMMS2
- COMMS3
- SYNCH1

— From GENESIS - Release 3.0 (July '94) features PVM

— All available

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KERNEL BENCHMARKS

Matrix Kernels

- Dense matrix Multiply
- Transpose
- Dense LU Factorization
- QR Decomposition
- Matrix tridiagonalization

FFT Kernels

- 1-D FFT
- 3-D FFT (NAS)

PDE Kernels

- Successive Over-Relaxation (Genesis PDE1)
- Multigrid (NAS)

Other Kernels

- Embarrassingly Parallel (NAS)
- Large Integer Sor (NAS)
- Conjugate Gradient (NAS)
- Input/Output

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KERNEL BENCHMARKS

— All Available (Input/Output - pencil and paper style)

— NAS Benchmarks - NASA in-douse parallel implementations available for the Intel iPSC and the CM-2 and PVM3.3

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FURTHER WORK REQUIRED

— Parallel version of 1-D FFT kernel in progress

— Investigation of suitable codes for the Input/Output Kernel

— Uniformity of benchmark codes

Uniform timer routine

Language conformance - F77 (with defined extensions)
- PVM message passing
- no machine dependent code

Standard Makefile

HOST/NODE to be replaced (or supplemented) by SPMD

Minimize Interactive features

Single source code file if possible

Standard data sets for benchmarks or a configuration file with details of how to alter the data and the effect on memory requirement

— Reorganize Server Repository

Headings to clearly identify each benchmark
Identify available versions e.g. PVM, PARMACS, MPI
Check each code is the current version
Test each code on a number of machines
Check that documentation is included

— Methods for verifying benchmark results

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COMPACT APPLICATIONS

SEIS1.1

Seismic processing performance evaluation suite from ARCO

PVM and NX versions available

POLMP

Proudman Oceanographic Laboratory Multiprocessing
Program from the UK Natural Environment Research Council

sequential, HPF, PVM, Parmacs versions available

SOLVER

QCD Code from Edinburgh Parallel Computing Centre

PVM and Parmacs versions available

PSTSWM

Parallel Spectral Transform Shallow Water Model from ORNL

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FURTHER WORK REQUIRED

— Define Rules for Running the Benchmarks

Possibly: One result based on unmodified source code with compiler flags listed

A second result which allows any modification to optimize performance,so long as the final result is correct.

— Further results are required - For GBIS Graphical Interface
- These results will be forwarded for inclusion in PDS

— Define a method for reporting bugs

— Future - MPI versions of all codes
- Benchmarks to test gather/scatter/global sum
- Shared memory versions of codes (using defined primitives, e.g. put/get)
- GUI for setting up and running codes

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POLMP RESULTS

Cray Y-MP/8
Cray C90
Intel iPSC/860
Maspar MP-1104
Meiko CS-1 i860
TMC CM-200 16k

Results have been published in the following three papers:

Ashworth, M., Parallel Processing Environmental Modelling, in Proceedings of the Fifth Workshop on the Use of Parallel Processors in Meteorology, ECMWF 23-27 November 1992, (World Scientific), pp 1-25.

Ashworth, M. and Davies, A.M., Performance of a Three Dimensional Hydrodynamic Model on a Range of Parallel Computers, in Proceedings of the Euromicro Workshop on Parallel and Distributed Computing, Gran Canaria 27-29 January 1993, pp 383-390, (IEEE Computer Society Press)

Ashworth, M., A Review of the Exploitation of Parallel Processing in Environmental Modelling, in Proceedings of the Conference on Parallel Computational Fluid Dynamics '93, Paris, 10th-12th May 1993 (Elsevier), in press, 10pp.

The last of these is available in PostScript format (regrettably without figures) by anonymous ftp to bisag.nbi.ac.uk in /pub/ncssuper/reports/pcfd93.ps.

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HPF COMPILER BENCHMARKS

— Synthetic applications to test aspects of HPF compilation

— Addresses HPF subset

FORALL statement - kernel FL

Explicit template - kernel TL

Communication detection in array assignments
- kernels AA, SH, ST (structured communication)
- kernel IR (unstructured communication)

Non-elemental intrinsic functions - kernel RD

Passing distributed arrays as subprogram arguments
- kernels AS, IT, IM

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RELATION TO SPEC/HPSC

— PARKBENCH associate member of SPEC/HPSC

PARKBENCH presentation was given at SPEC/HPSC meeting held at AT&T (Napierville, IL) on 28 Sept 94

— SPEC - real world applications, only for all parallel platforms

— PARKBENCH - mainly DMMP, low-level, kernels, compact applications

— Possible SPEC/PARKBENCH link at Compact Application level

Possible SPEC/HPSC Codes are:

LANL

EULER 3D
MCNP
SWEEP 3D
NIKE
AMR
PUEBLO
POP
SPASM

IBM

GAMESS
AMBER

FUJITSU

LANS3D

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ON-GOING WORK

— Uniformity of benchmark codes

Uniform timer routine

Language conformance

HOST/NODE to be replaced by SPMD

Remove Interactive features

Single source code file, machine dependent code in separate file

— Further Results

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FUTURE WORK

— Further Compact Applications (e.g. Database applications)

— Analysis of Kernel Benchmarks in terms of low level parameters

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AVAILABILITY

— PARKBENCH Description, Source codes, Report, Documentation

WWW URL:-http://www.epm.ornl.gov/ walker/parkbench/

to go directly to the download page

http://www.netlib.org/parkbench/

or via xnetlib

— Genesis Benchmark Information Service (GBIS) Graphical Interface

Interactive graphical results for genesis and PARKBENCH

http://hpcc.soton.ac.uk/RandD/gbis/papiani-new-gbis-top.html

— PDS

http://netlib2.cs.utk.edu/performance/html/PDStop.html

— HPCC National Software Exchange (NSE)

http://www.netlib.org/nse/home.html

Genesis benchmark Information Service (GBIS) Graphical Interface

— Graphical benchmark results for Genesis and ParkBench Benchmark suites available on the World Wide Web

— Interactive selection of benchmark and computers from which a performance graph is generated and displayed

— Default graph options can be changed:

Available output formats :- gif, xbm, postscript, tabular results

Selectable ranges

Choice of log/linear axes

Key to traces can be positioned as required

— Links to Genesis and ParkBench information including Benchmark documentation, papers, source codes, etc.

World Wide Web URL's:-

http://hpcc.soton.ac.uk/RandD/gbis/papiani-new-gbis-top.html

http://hpcc.soton.ac.uk/RandD/gbis/papiani-new-gbis.html

http://hpcc.soton.ac.uk/RanD/RandD.html

Anonymous ftp Access to Tabular Results:-

par.soton.ac.uk

in directory /pub/benchmark_results