DDDAS Project Update

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Austin, Texas
February 8, 2007

Outline

- **Computations**

  Boundary Conditions

  Objective function

- **Data Transfer**

- **Hybrid OpenMP/MPI Paradigm**

Computations

- **Boundary Conditions allowing heat flow out of body but the thermal images show that the heat flux out of body not significant**

- **Time constraint resrictions imposed by real time calculation allow only a handful of objective function/gradient evaluations**

  - *Quasi Newton Methods taking too many iterations*
  - *Steepest descent guarantees objective function decrease*
  - *Objective function being minimized but parameters exceeding expected value*

Data Transfer

- **Data Transfer scripts written in Python**
- **Data Transfer is current bottleneck**

  MRI Machine write to disk

  Python Script scp file from Houston to TACC file system

  lonestar read in data from disk

  lonestar computes on data

  lonestar writes visualization file to disk

  Python Script moves file from Lonestar to Maverick for Visualization

- **XML-RPC allows transfer of data directly between memory**

OpenMP/MPI Paradigm

- **Computer Architecture at TACC is cluster of SMP nodes**

  Lonestar: 4 processors per compute nodes

- **Profiling shows linear solve time $\approx$ constant as increase processors for a given problem size**

- **Large number of processors communication between MPI tasks dominates solve time**

- **OpenMP Offers a way to avoid communication overhead**

  no communication between OpenMP threads, but Fork/Join overhead very expensive

OpenMP/MPI Paradigm

Sheet1

petsc to hp3d	1	2.59E-002	1.09E-001
assemble fnc	2	1.35E 001	1.14E 000
assemble jac	3	1.62E-001	9.10E-001
eval objective	4	6.17E-003	2.39E-002
elemfnc setup	5	3.17E-002	4.25E-002
elemfncsumfact	6	4.89E-002	4.74E-002
elemfnc bndry	7	2.37E 002	4.21E 002
elemjac setup	8	2.32E-002	5.19E-002
elemjacsumfact	9	9.98E-002	1.69E-001
elemjac bndry	10	2.52E-002	2.89E-002
elem imp	11	1.87E 002	8.23E 002
VecMDot	12	7.30E-002	3.98E-002
VecNorm	13	5.33E-002	2.03E-001
VecScale	14	3.61E-004	1.50E-004
VecCopy	15	9.66E-005	2.80E-004
VecSet	16	8.41E 004	1.89E 003
VecAXPY	17	5.36E-005	1.13E-004
VecWAXPY	18	7.22E-005	1.61E-004
VecMAXPY	19	2.49E-003	4.81E-003
VecAssemblyBegin	20	6.11E-002	7.83E-001
VecAssemblyEnd	21	3.17E-004	1.53E-001
VecScatterBegin	22	6.55E-003	3.43E-003
VecScatterEnd	23	3.63E-002	1.04E-003
VecNormalize	24	4.85E-002	4.83E-002
MatMult	25	4.34E 002	2.94E 002
MatSolve	26	1.08E-002	3.29E-002
MatLUFactorNum	27	4.66E-003	2.24E-002
MatAssemblyBegin	28	4.12E-002	5.49E-001
MatAssemblyEnd	29	1.94E-002	3.83E-002
MatZeroEntries	30	6.16E 004	2.02E 003
SNESSolve	31	4.78E-001	2.63E-000
SNESLineSearch	32	1.19E-001	1.09E-000
SNESFunctionEval	33	1.62E-001	1.73E-000
SNESJacobianEval	34	1.91E 001	1.29E 000
KSPGMRESOrthog	35	7.44E-002	4.31E-002
KSPSetup	36	2.74E-005	4.08E-005
KSPSolve	37	1.41E-001	1.41E-001
PCSetUp	38	4.83E-003	2.27E-002
PCSetUpOnBlocks	39	4.76E 003	2.26E 002
PCApply	40	1.37E-002	3.66E-002
TaoAppObjective	41	1.90E-001	2.68E-000

Time for fork/join .1sec

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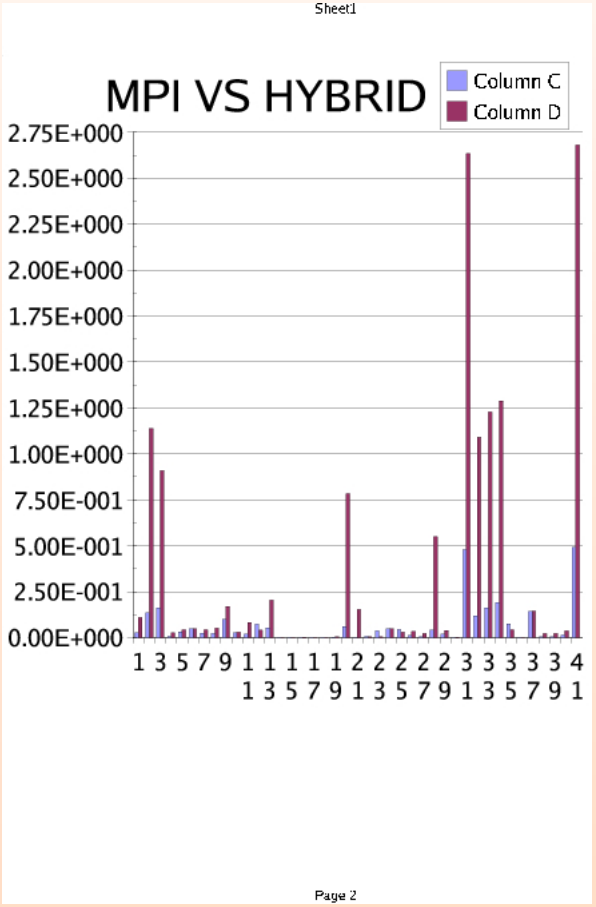
Sheet1



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