NAS FT Variants Performance Summary

Joint work with Chris Bell, Rajesh Nishtala, Dan Bonachea

Best NAS Fortran/MPI
Best MPI (always Slabs)
Best UPC (always Pencils)

0.5 Tflops
FFT Performance on BlueGene/P

- PGAS implementations consistently outperform MPI
- Leveraging communication/computation overlap yields best performance
  - More collectives in flight and more communication leads to better performance
  - At 32k cores, overlap algorithms yield 17% improvement in overall application time
- Numbers are getting close to HPC record
  - Future work to try to beat the record

HPC Challenge Peak as of July 09 is ~4.5 Tflops on 128k Cores
Case Study: LU Factorization

• Direct methods have complicated dependencies
  – Especially with pivoting (unpredictable communication)
  – Especially for sparse matrices (dependence graph with holes)

• LU Factorization in UPC
  – Use overlap ideas and multithreading to mask latency
  – Multithreaded: UPC threads + user threads + threaded BLAS
    • Panel factorization: Including pivoting
    • Update to a block of U
    • Trailing submatrix updates

• Status:
  – Dense LU done: HPL-compliant
  – Sparse version underway

Joint work with Parry Husbands
 UPC HPL Performance

- Comparison to ScaLAPACK on an Altix, a 2 x 4 process grid
  - ScaLAPACK (block size 64) 25.25 GFlop/s (tried several block sizes)
  - UPC LU (block size 256) - 33.60 GFlop/s, (block size 64) - 26.47 GFlop/s
- $n = 32000$ on a 4x4 process grid
  - ScaLAPACK - 43.34 GFlop/s (block size = 64)
  - UPC - 70.26 Gflop/s (block size = 200)

• MPI HPL numbers from HPCC database
• Large scaling:
  • 2.2 TFlops on 512p,
  • 4.4 TFlops on 1024p (Thunder)

Joint work with Parry Husbands