pMatlab Takes the HPCchallenge

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Motivation and Goals

• Motivation
  – The DARPA HPCS program has created the HPCchallenge benchmark suite in an effort to redefine how we measure productivity in the HPC domain
  – Implementing the HPCchallenge benchmarks using pMatlab allows a unique opportunity to explore the merits of pMatlab with respect to HPEC

• Goals
  – Compare traditional C/MPI with pMatlab. Measurements of productivity include:
    • **Maximum problem size**: Largest problem that can be solved or fit into memory
    • **Execution performance**: Run-time performance of the benchmark
    • **Code size**: Software lines of code (SLOC) required to implement the benchmark
HPCchallenge Relevance to HPEC

- HPCchallenge benchmarks encompass key embedded signal processing operations
  - FFT: Distributed corner turn and FFTs important in multi-sensor signal processing
  - RandomAccess: Random data accesses typical of “post detection” operations
  - Top500: Matrix-matrix multiplies typical of multi-element beamforming
  - STREAM: Distributed vector operations common to signal processing
FFT Results

![Graphs showing FFT results for different algorithms and software code sizes.](image)

<table>
<thead>
<tr>
<th>Algorithm</th>
<th>C/MPI</th>
<th>pMatlab</th>
<th>Ratio</th>
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<tr>
<td>SLOC</td>
<td>2509</td>
<td>72</td>
<td>35</td>
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- pMatlab memory scalability comparable to C/MPI (128x on 128 CPUs)
- pMatlab execution performance comparable to C/MPI (55x on 128 CPUs)
- pMatlab code size is 35x smaller than C/MPI