**Motivation**
- The DARPA HPC Challenge program has created the HPC Challenge benchmark suite in an effort to redefine how we measure productivity in the HPC domain.
- MATLAB® is the primary high level language used within the signal processing community; increasingly used for:
  - large system simulations
  - processing data in the field
- pMatlab implements global array semantics in MATLAB
  - Global array semantics allow indexing and general element access for distributed data
- Implementing the HPC Challenge benchmarks using pMatlab allows a unique opportunity to explore the merits of pMatlab with respect to high performance embedded computing.

**Goals**
- Implement and analyze the performance of HPC Challenge benchmarks using pMatlab
- Optimize and add functionality to the pMatlab toolbox
- Compare traditional C/MPI with MATLAB using global array semantics.
- Measurements of productivity include:
  - Maximum problem size: Largest problem that can be solved on fit into memory.
  - Execution performance: Run-time performance of the benchmark
  - Code size: Software lines of code (SLOC) required to implement the benchmark

**Benchmark Platform**
- Top500 (High Performance Computing)
- STREAM
- GEMM (matrix multiply)
- TRID
- RandomAccess
- FFT

**HPCC Challenge**
- Four key benchmarks have significant relevance to HPEC:
  - FFT: Distributed corner turn and FFT is important in multi-sensor signal processing
  - RandomAccess: Random data accesses typical of "past detection" operations
  - Top500: Matrix-matrix multiplies typical of multi-element beamforming
  - STREAM: Distributed vector operations common to signal processing
- Multiple implementations:
  - C/Fortran, C/Fortran+MPI, MATLAB, pMatlab

**Conclusions**
- Memory scalability comparable to C/MPI on nearly all of HPC Challenge for 128 CPUs
- Allows MATLAB users to work on much larger problems.
- Execution performance comparable to C/MPI on nearly all of HPC Challenge (for 128 CPUs). Allows MATLAB users to effectively exploit parallel computing, and can achieve performance comparable to C/MPI.
- Code size much smaller. Allows MATLAB users to write programs much faster than C/MPI.
- pMatlab allows MATLAB users to effectively exploit parallel computing, and can achieve performance comparable to C/MPI.

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**Top500 Results**
- **Algorithm**: pMatlab
- **Software Code Size**: C/MPI
- **Ratio**: 3x
- **Maximum Problem Size**: 128x
- **Execution Performance**: comparable to C/MPI
- **RandomAccess (v0.5) Results**
- **Algorithm**: pMatlab
- **Software Code Size**: C/MPI
- **Ratio**: 3x
- **Maximum Problem Size**: 128x
- **Execution Performance**: comparable to C/MPI