Partitioned FFTC: An Improved Fast Fourier Transform for the IBM Cell Broadband Engine

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Partitioned FFTC (PFFTC) Requirements

- 256-16K data points
- Low latency
- In-place memory usage
- Multiple SPE support
- Superior performance
- Efficient direction switching

PFFTC
1-D single-precision complex FFT for Cell BE
PFFTC Approach

Algorithm Design:

Partition → Solve → Combine

Initial FFT Problem

Final FFT Result

Supports 4, 8, or 16 partitions on 2-8 SPEs

Optimizations:

- Single-pass partitioning
- Register-level double buffering
- “Asynchronous” synchronization
- Communication-free combination stage
FFT GFLOPS vs. Problem Size

PFFTC Features:
- Lowest known latency on Cell BE
- Peak performance of 33.61 GFLOPS for 16K problem size
- Speedup of 31% - 56% over best prior Cell FFT
- Further improvement to 40 GFLOPS possible by using Fused Multiply-Add (FMA)-based FFT in solution stage

* FFT GFLOPS based on $5N\log_2 N$ operations / runtime

See poster C.8 for more details