A Framework for Low-Communication 1-D FFT

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In state-of-the-art high-performance computing on distributed-memory systems, communication often represents a significant part of the overall execution time, and quite likely consumes a major share of the total energy used. For distributed 1-D FFT, every industry-standard implementation performs three all-to-all internode data exchanges which make up the bulk of communication. We present here a mathematical framework for deriving a family of easy-to-implement single-all-to-all 1-D FFT algorithms. Furthermore, our framework allows tradeoff between accuracy and performance. Depending on the problem size and the computer system used, implementations at comparable accuracy based on our new approach can outperform leading FFT libraries by as much as twofold, higher still if reduced accuracy is acceptable.

Based on joint work with Jongsoo Park, Daehyun Kim, and Vladimir Petrov