

Title: Parallel Approximate Undirected Shortest Paths Via Low Hop Emulators

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Abstract: Although sequential algorithms with (nearly) optimal running time for finding shortest paths in undirected graphs with non-negative edge weights have been known for several decades, near-optimal parallel algorithms have turned out to be a much tougher challenge. In this talk, we present a $(1+\epsilon)$ -approximate parallel algorithm for computing shortest paths in undirected graphs, achieving polylog depth and near-linear work. All prior all prior $(1+\epsilon)$ -algorithms with polylog depth perform at least superlinear work. Improving this long-standing upper bound obtained by Cohen (STOC'94) has been open for 25 years.

Our algorithm uses several new tools. Prior work uses hopsets to introduce shortcuts in the graph. We introduce a new notion that we call low hop emulators. We also introduce compressible preconditioners, which we use in conjunction with Serman's framework (SODA '17) for the uncapacitated minimum cost flow problem.

Joint work with Alex Andoni and Peilin Zhong.

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Bio:

Clifford Stein is a Professor of IEOR and of Computer Science at Columbia University. He is also the Associate Director for Research in the Data Science Institute. From 2008-2013, he was chair of the IEOR department. Prior to joining Columbia, he spent 9 years as an Assistant and Associate Professor in the Dartmouth College Department of Computer Science.

His research interests include the design and analysis of algorithms, combinatorial optimization, operations research, network algorithms, scheduling, algorithm engineering, data science and parallel computing. Professor Stein has published many influential papers in the leading conferences and journals in his field, and has occupied a variety of editorial positions including the journals ACM Transactions on Algorithms, Mathematical Programming, Journal of Algorithms, SIAM Journal on Discrete Mathematics and Operations Research Letters. His work has been supported by the National Science Foundation and Sloan Foundation. He is a Fellow of the Association for Computing Machinery (ACM). He is the winner of several prestigious awards including an NSF Career Award, an Alfred Sloan Research Fellowship and the Karen Wetterhahn Award for Distinguished Creative or Scholarly Achievement. He is also the co-author of Introduction to Algorithms, with T. Cormen, C. Leiserson and R. Rivest. This book currently the best-selling textbook in algorithms and has sold over 750,000 copies and been translated into 15 languages.