

# Fully Dynamic Shortest Paths and Reachability in Sparse Digraphs

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**Abstract:** We study the exact fully dynamic shortest paths problem. For real-weighted directed graphs, we show a deterministic fully dynamic data structure with  $O(mn^{4/5})$  worst-case update time processing arbitrary  $s, t$ -distance queries in  $O(n^{4/5})$  time. This constitutes the first non-trivial update/query tradeoff for this problem in the regime of sparse weighted directed graphs.

Moreover, we give a Monte Carlo randomized fully dynamic reachability data structure processing single-edge updates in  $O(n\sqrt{m})$  worst-case time and queries in  $O(\sqrt{m})$  time. For sparse digraphs, such a tradeoff has only been previously described with amortized update time [Roditty and Zwick, SIAM J. Comp. 2008].

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**Session Classification:** Track A-1