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Approximate Nearest Neighbor for Polygonal Curves under Frechet Distance

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Abstract: We propose κ-approximate nearest neighbor (ANN) data structures for n polygonal curves with at most m vertices each under the Fr\'{e}chet distance in $\mathbb{R}^d$, where $\kappa \in \{1+\epsilon, 3+\epsilon\}$ and $d \geq 2$. We assume that every query curve has at most k vertices, $k \ll m$, and k is given for preprocessing. The query times are $\tilde{O}(k(mn)^{0.5+\epsilon}/\epsilon^{O(d)} + k(d/\epsilon)^{O(dk)})$ for $(1+\epsilon)$-ANN and $\tilde{O}(k(mn)^{0.5+\epsilon}/\epsilon^{O(d)})$ for $(3+\epsilon)$-ANN. The space and expected preprocessing time are $\tilde{O}(k(mnd^d/\epsilon^d)^{O(k+1/\epsilon^2)})$ in both cases. In two and three dimensions, we improve the query times to $\tilde{O}(k/\epsilon^{O(k)})$ for $(1+\epsilon)$-ANN and $\tilde{O}(k)$ for $(3+\epsilon)$-ANN. The space and expected preprocessing time improve to $\tilde{O}(k(mn/\epsilon)^{O(k)})$ in both cases. For ease of presentation, we suppress factors in our bounds that depend purely on d. The hidden polylog factors in the big-$\tilde{O}$ notation have powers dependent on d.

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