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Finding, hitting and packing cycles in subexponential time on unit disk graphs. (English)

Summary: We give algorithms with running time $2^{O(\sqrt{k \log k})} \cdot n^{O(1)}$ for the following problems. Given an $n$-vertex unit disk graph $G$ and an integer $k$, decide whether $G$ contains a path on exactly/at least $k$ vertices, a cycle on exactly $k$ vertices, a cycle on at least $k$ vertices, a feedback vertex set of size at most $k$, and a set of $k$ pairwise vertex-disjoint cycles. For the first three problems, no subexponential time parameterized algorithms were previously known. For the remaining two problems, our algorithms significantly outperform the previously best known parameterized algorithms that run in time $2^{O(k^{0.75} \log k)} \cdot n^{O(1)}$.

Our algorithms are based on a new kind of tree decompositions of unit disk graphs where the separators can have size up to $O(1)$ and there exists a solution that crosses every separator at most $O(\sqrt{k})$ times. The running times of our algorithms are optimal up to the log $k$ factor in the exponent, assuming the exponential time hypothesis.

MSC:
68R10 Graph theory (including graph drawing) in computer science
05C62 Graph representations (geometric and intersection representations, etc.)
68Q27 Parameterized complexity, tractability and kernelization
68U05 Computer graphics; computational geometry (digital and algorithmic aspects)
68W40 Analysis of algorithms

Keywords:
longest path; longest cycle; cycle packing; feedback vertex set; unit disk graph; unit square graph; parameterized complexity

Software:
Algorithm 447

Full Text: DOI Link

References:

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