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## Exact Algorithms and Lowerbounds for Multiagent Pathfinding

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In the MULTIAGENT PATH FINDING problem, we focus on efficiently finding non-colliding paths for a set of $k$ agents on a given graph $G$, where each agent seeks a path from its source vertex to its target. An important measure of the quality of the solution is the length of the proposed schedule $\ell$, that is, the length of a longest path (including the waiting time). In this work, we propose a systematic study under the parameterized complexity framework.

We show that the MULTIAGENT PATH FINDING problem is W[1]-hard with respect to $k$ (even if $k$ is combined with the maximum degree of the input graph). The problem remains NP-hard in planar graphs even if the maximum degree and the makespan $\ell$ are fixed constants. We also show that the problem remains NP-hard even when the input graph is a tree of maximum degree five. Both of these proofs serve as improvements of the current state of the art conserning the intractability of this problem [1]. On the positive side, we show an FPT algorithm for $k + \ell$. As we delve further, the structure of $G$ comes into play. We give an FPT algorithm for parameter $k$ plus the diameter of the graph $G$. Finally, we show that the problem is W[1]-hard for cliquewidth of $G$ plus $\ell$ while it is FPT for treewidth of $G$ plus $\ell$.

# Références

[1] P. Surynek, *An Optimization Variant of Multi-Robot Path Planning Is Intractable*, *In M. Fox and D. Poole, eds., Proceedings of the Twenty-Fourth AAAI Conference on Artificial Intelligence, AAAI 2010, Atlanta, Georgia, USA, July 11-15, 2010.* AAAI Press.

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