Multi-Robot Path Planning: Structural Studies and High-Performance Algorithms

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Background

- The primary project I am working on is showing the hardness of the Rubik table problem.

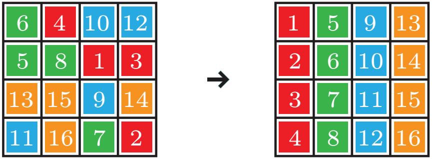

Figure: Rubik Table Problem [1, Fig. 2]

- Given an arbitrary arrangement of cells, shuffle the columns/rows such that all colors are in the same column.

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Rubik Table Problem

Theorem

[1, Thm. 3.1] A Rubik Table problem is solvable using n column shuffles followed by n row shuffles. Additional n column shuffles then solve the labeled Rubik Table problem.

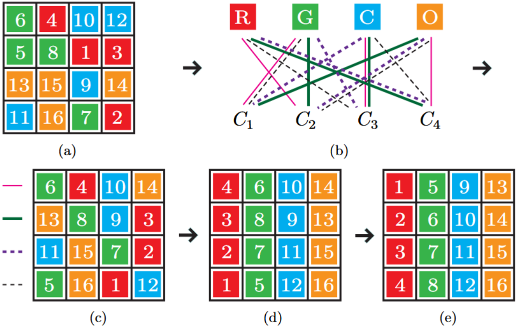

Figure: Rubik Table Diagram [1, Fig. 4]

Current Progress

Lemma

A Rubik Table problem is solvable using n-1 column shuffles followed by n row shuffles. Additional n column shuffles then solve the labeled Rubik Table problem.

- It is conjectured that minimizing the amount of shuffles is NP-hard.
- Currently working on a reduction from max independent set.

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Research Goals

- Is determining the minimum number of parallel shuffles NP-hard?
- Work on minimizing the total displacement for the items during the shuffling operations.

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References

[1] Mario Szegedy and Jingjin Yu. *Rubik Tables and Object Rearrangement*. 2023. arXiv: 2002.04979 [cs.RO]. URL: https://arxiv.org/abs/2002.04979.