Novel Algorithmic Techniques for Drone Flight Planning on a Large Scale

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Challenge:

1. Develop a concept for a robot coordination system that can find collision-free paths for a large number of drones of different sizes and capabilities
2. Develop a hierarchical approach, combining centralized and local coordination, to scale to thousands of robots

Key Innovations:

- To help better understand the hardness of MAPF instances, we developed a user friendly tool called MAPF-GUI to generate and analyze different MAPF instances
- Found that mean betweenness centrality is a very important environment-specific feature for prediction of MAPF instance hardness
- Utilizing mutex propagation as a more general tool to identify symmetries in MAPF problems and allowing for the automated design of symmetry-breaking constraints

Scientific Impact:

Development of a new system concept that allows one to scale up a promising emerging class of new heuristic search algorithms for collision-free navigation to a much larger number of robots than possible before.

Broader Impact:

- Four undergraduate students contributed to this project, two were women from historically underrepresented groups.
- Two undergraduates published within the reporting period, in the AAAI undergraduate symposium and SoCS

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