

Colloquium

3D Map Exploration using Topological Fourier Sparse Set

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線上演講 (Google Meet)：

<https://meet.google.com/zub-dgqm-irj>

摘 要：

3D map exploration is one of key technologies in robotics. However, finding an optimal exploration path is a challenge due to unknown environments. This research proposed the Topological Fourier Sparse Set (TFSS) algorithm to enable an unmanned aerial vehicle (UAV) to explore 3D environments with theoretical guarantees. The algorithm combines the Rips complex with Fourier sparse set representation to take the advantages of topological and submodular approaches. More specifically, the Rips complex is used for expanding the exploration subgoals, while the Fourier sparse set encodes a learned representation of the subgoal selection problem in the form of a submodular optimization problem. Since the objective function of spatial exploration is reformulated as a maximizing submodular function with path constraints, greedy algorithms can achieve $0.5(1 - e^{-1})$ of the optimum. Experiments conducted with this algorithm demonstrates that the TFSS explores unknown environments 25% ~ 127% more than the NBV algorithm does. The TFSS exploration performance is close to the SFSS but it is 50 times faster than the SFSS.

