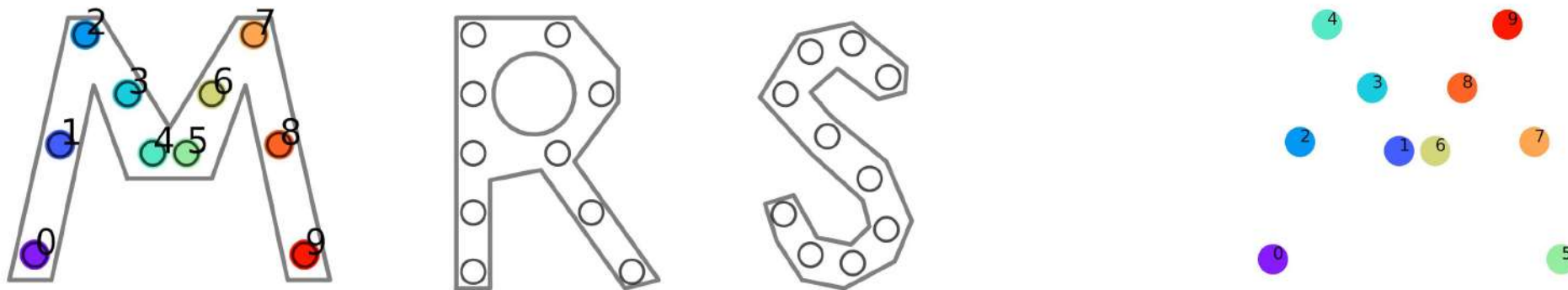


Space-Time Graphs of Convex Sets for Multi-Robot Motion Planning ^[1]

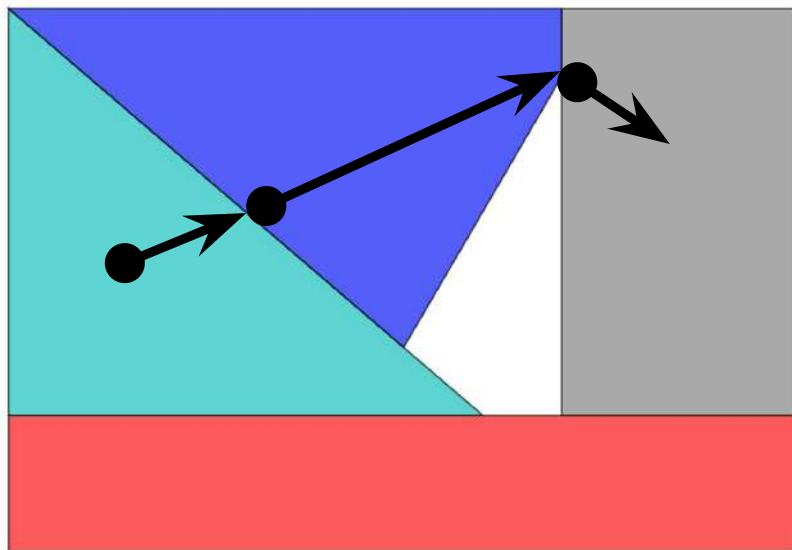
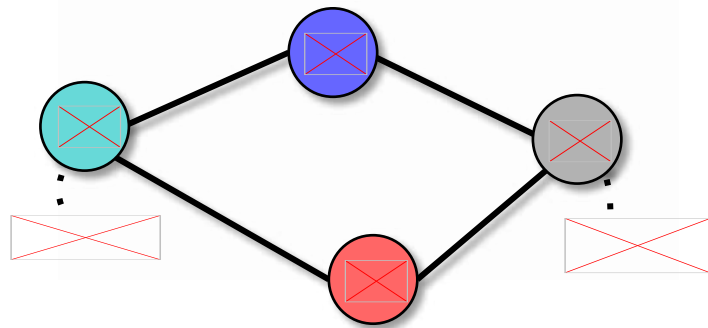
Jingtao Tang, Zining Mao, Lufan Yang, Hang Ma

School of Computing Science, Simon Fraser University

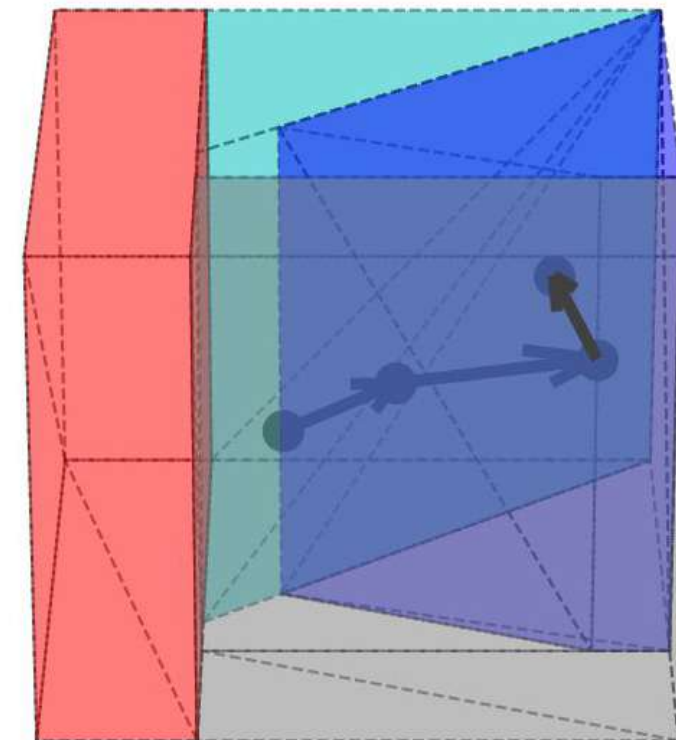
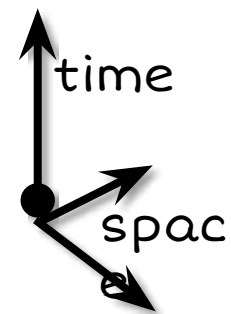


[1] Tang, Jingtao, et al. "Space-Time Graphs of Convex Sets for Multi-Robot Motion Planning." *IROS* 2025.

Space-Time Graphs of Convex Sets (ST-GCS)

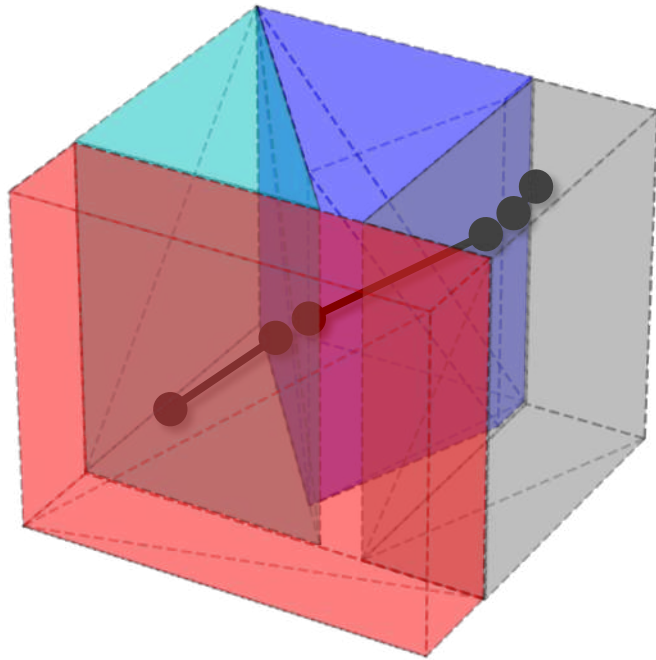


Motion Planning in GCS (2D) [2]



Motion Planning in ST-GCS (3D)

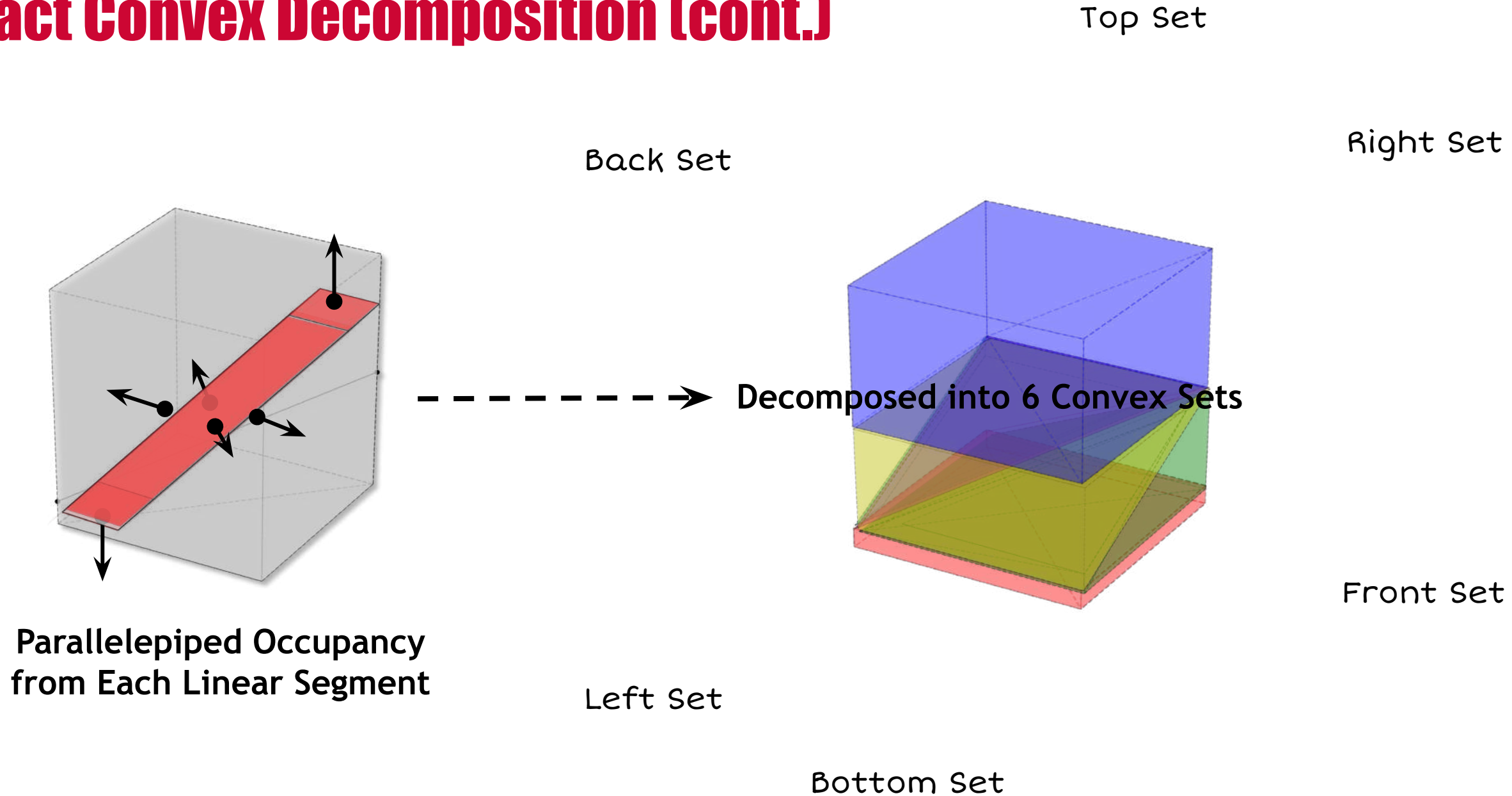
Exact Convex Decomposition (ECD)



An ST-GCS Trajectory

Multiple Linear Trajectory Segments

Exact Convex Decomposition (cont.)



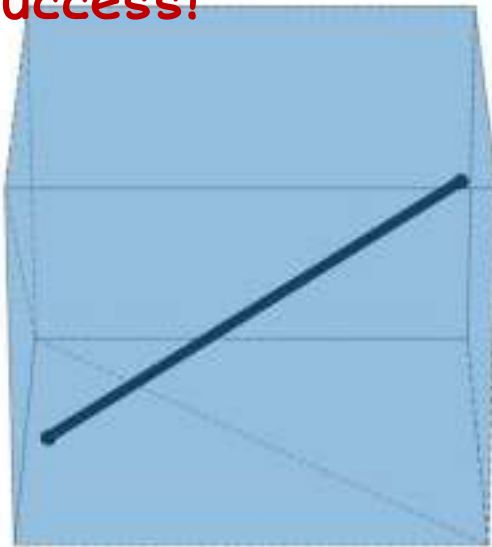
Prioritized Planning for Multi-Robot Motion Planning (MRMP)

Prioritized Planning (PP)

Foreach Robot from $[R_1, R_2, R_3, R_4]$ do:

- Spatiotemporal Planning on ST-GCS
- Trajectory Reservation via ECD

**Planning Report
Success!**



Random-Prioritized Planning (RP) [3]

Random exploration of total orders:

▶ $[R_3, R_1, R_2, R_4]$

Priority-Based Search (PBS) [4]

Tree search on partial pairwise orders w/ collisions:



▶ Initialize trajectories for $[R_1, R_2, R_3, R_4]$

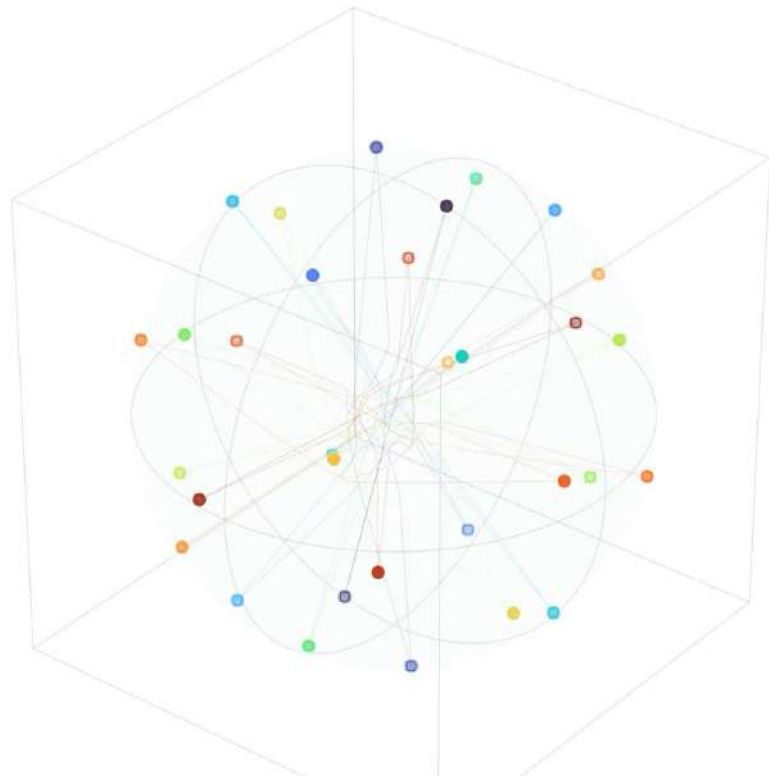
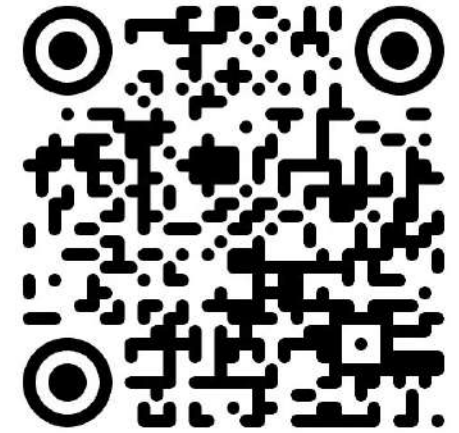
[3] Erdmann, Michael, and Tomas Lozano-Perez. "On multiple moving objects." *Algorithmica* (1987): 477-521.

[4] Hang, Ma, et al. "Searching with consistent prioritization for multi-agent path finding," in Proc. AAAI Conf. Artif. Intell., 2019, pp. 7643–7650.

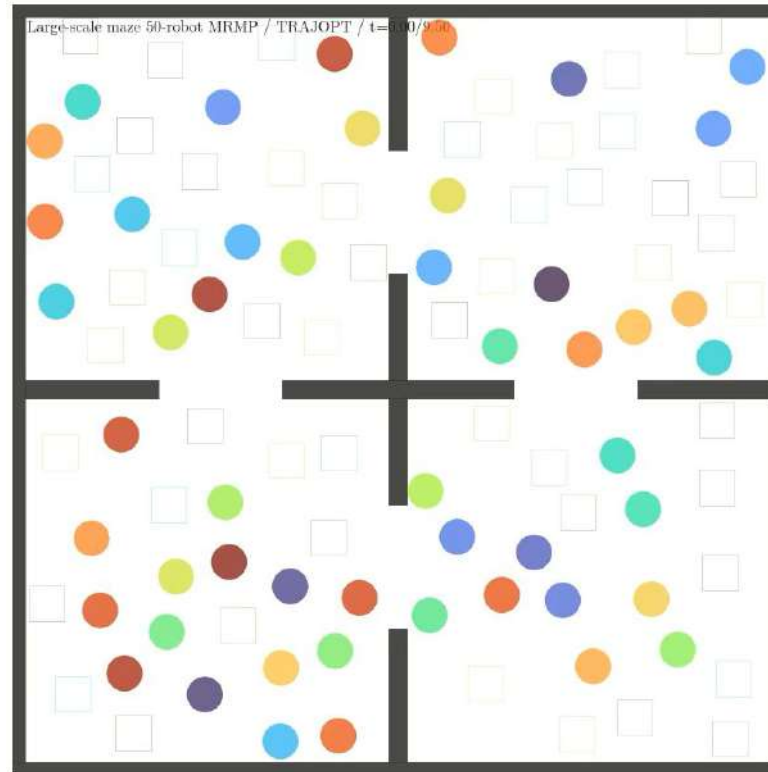
Summary

- ST-GCS inherits pros (and cons) of GCS for spatiotemporal planning
- ECD efficiently decomposes the task space
- PBS works well as a coordination framework

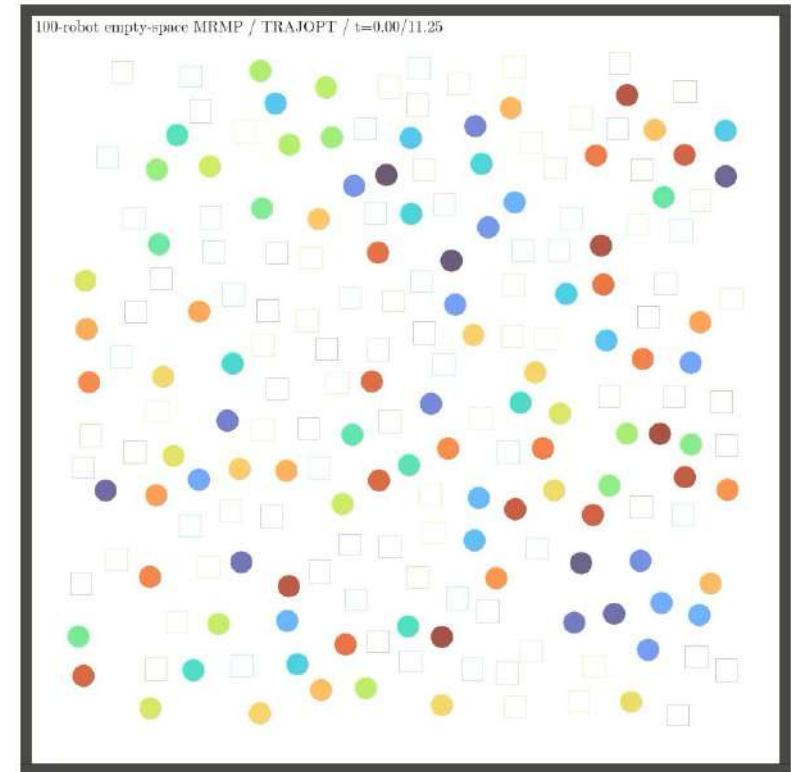
Webpage



1.15m solving + 2.61m traj-opt



1.61m solving + 1.96m traj-opt



1.63m solving + 4.54m traj-opt