Multi-robot Path Planning with Collision Avoidance

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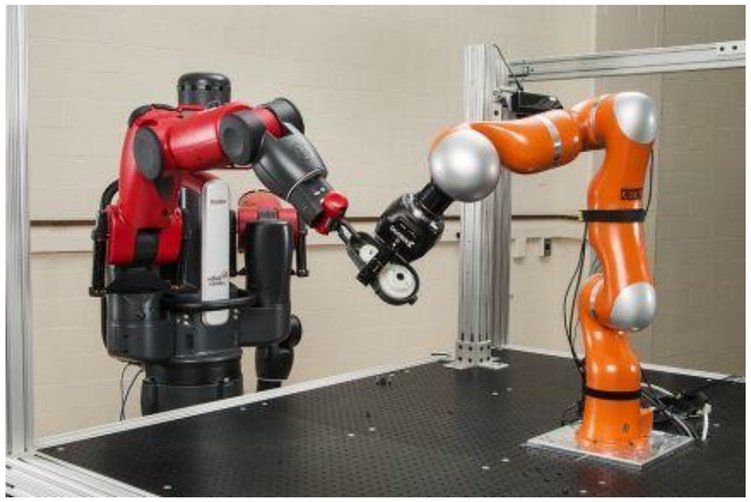
Objective: To develop a task allocation and path planning optimization model for multiple collaborative robots to reduce the overall task completion time while avoiding collisions and moving at constant velocities.

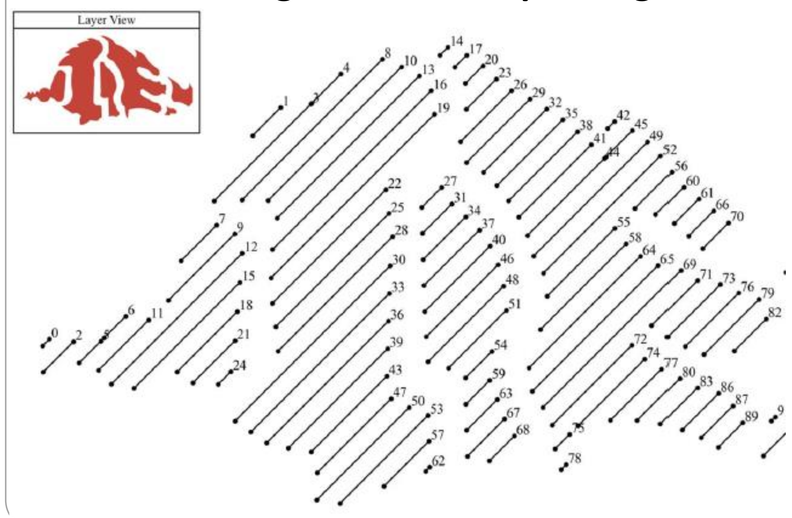
Applications

- Spray Painting
- 3D Printing (Additive Manufacturing)
- Pressure Washing
- Loading Docks (Object manipulation)

Two collaborative robots performing a task

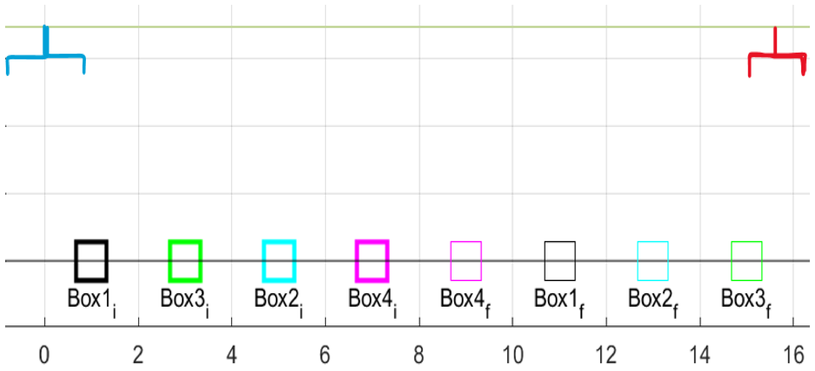


Raster Segments for 3D printing

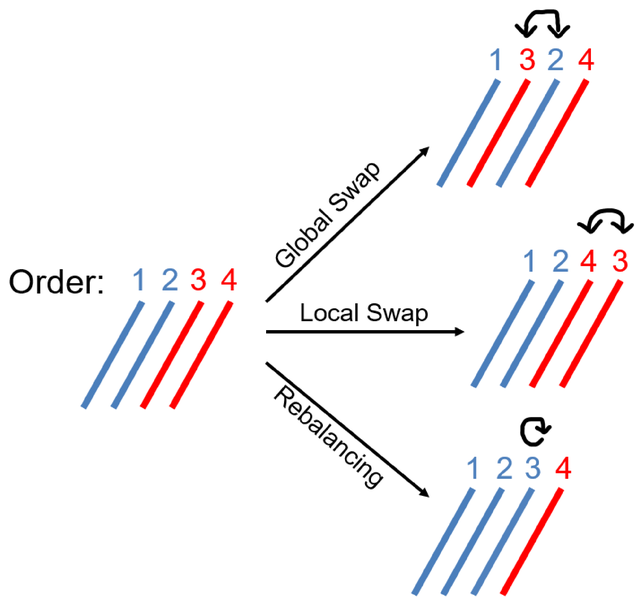


Simplified Problem

Pick and arrange four boxes using two cranes in the optimum manner without collisions.

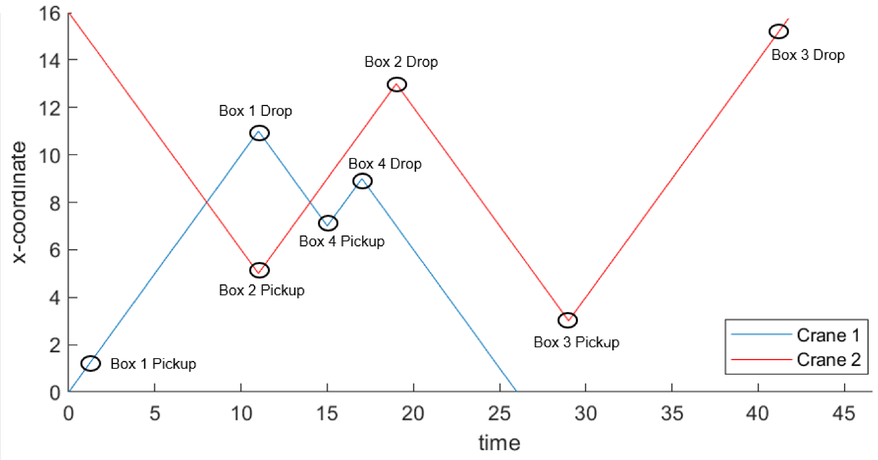


Task Allocation & Path Planning



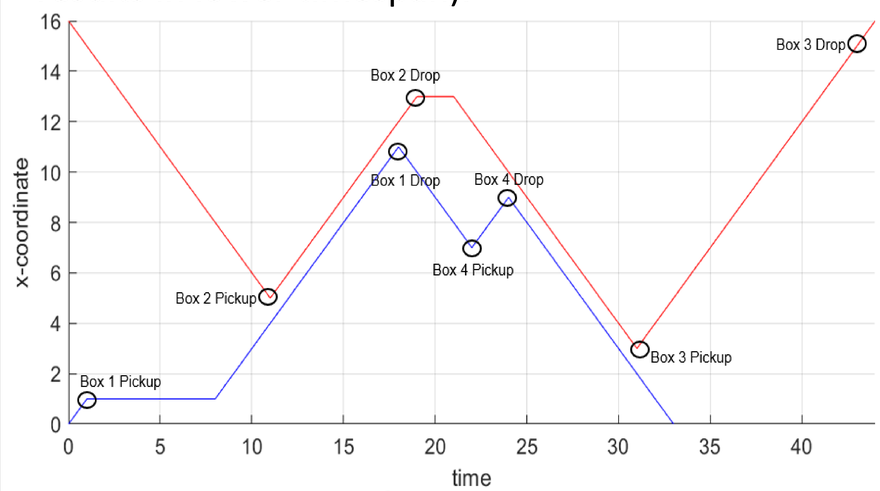
Tabu Search Heuristic is employed for task allocation and to find the optimal path with minimum timespan.

Optimal Path with collisions



Collision Avoidance

In order to avoid collisions, delays are introduced in either crane 1 or crane 2's path (which ever results in lower timespan).



References

"Performance of Collaborative Robot Systems."NIST,8 May 2018, https://www.nist.gov/programs-projects /performance-collaborative-robot-systems.

Hieu Bui, Harry A. Pierson, Sarah Nurre Pinkley & Kelly M. Sullivan (2021) Toolpath planning for multi-gantry additive manufacturing, IISE Transactions, 53:5, 552-567, DOI: 10.1080/24725854.2020.1775915