



Non-Euclidean Motion Planning with Graphs of Geodesically-Convex Sets

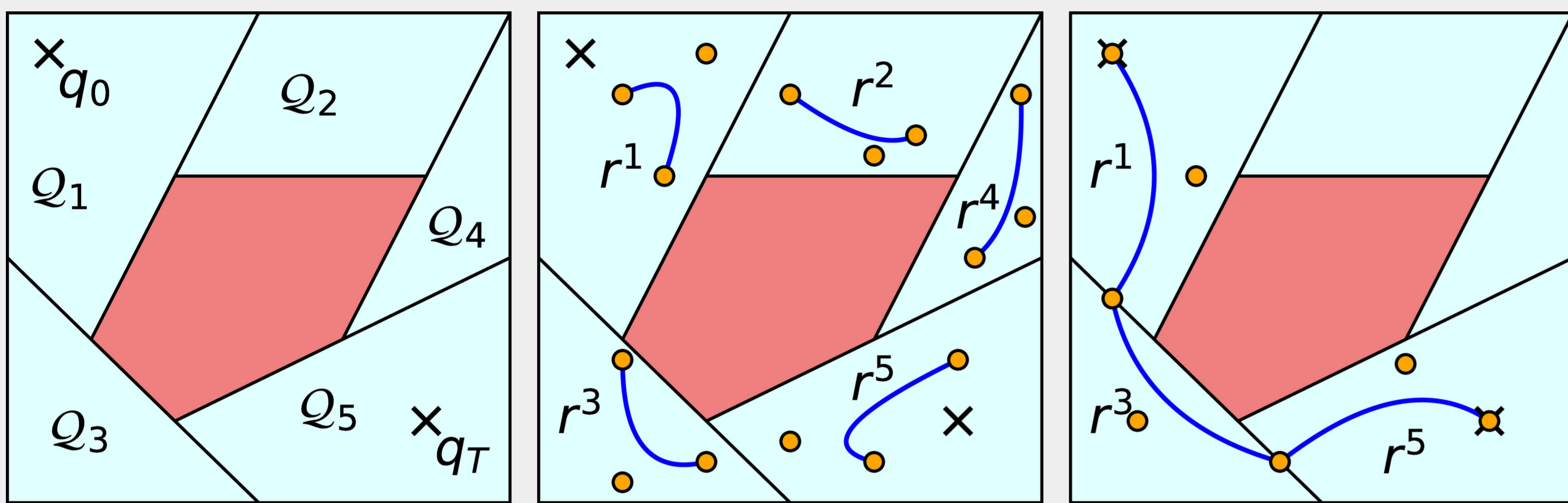


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Why Graph of Convex Sets (GCS)?

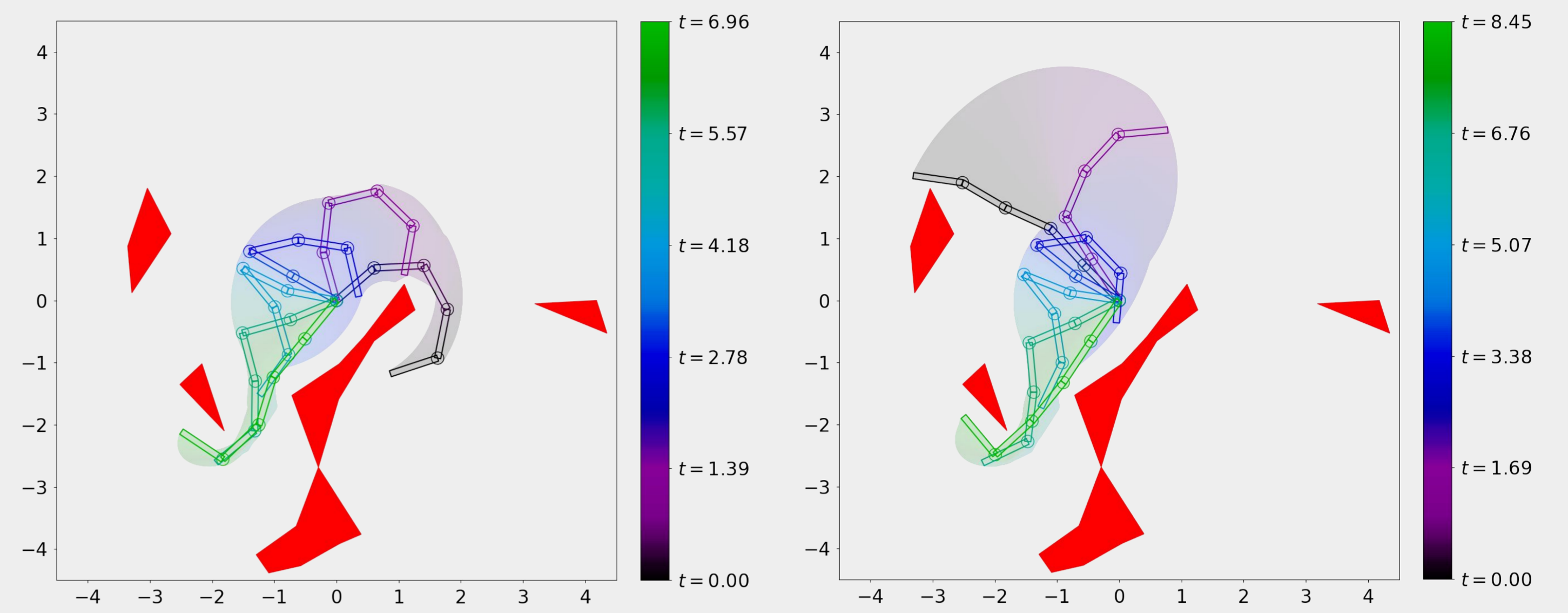
- Handle High-Dimensional Spaces
- Escape Local Minima
- Get Collision-Free Guarantees

Planning with GCS

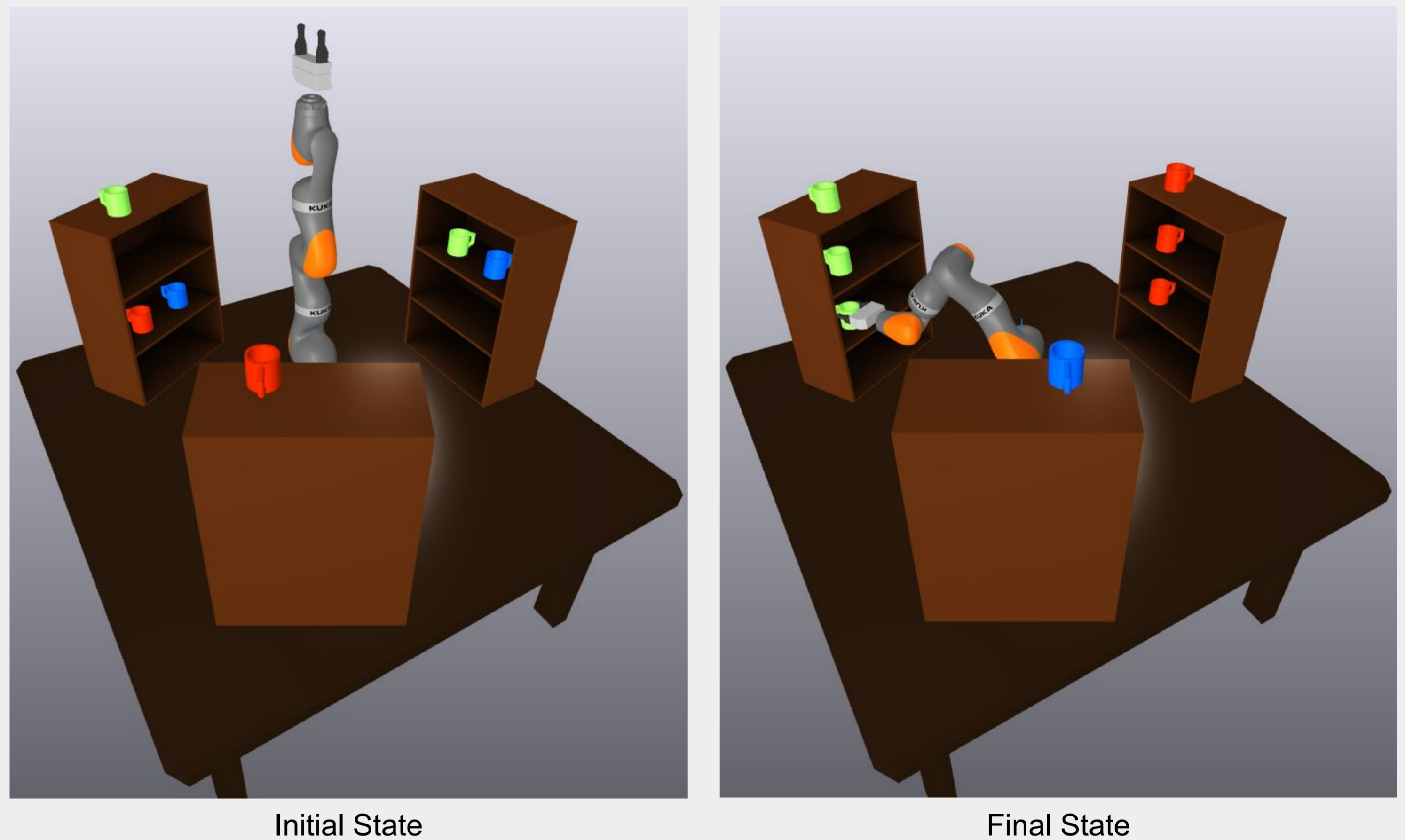


Reproduced from *Motion Planning around Obstacles with Convex Optimization*, Tobia Marcucci et. al.

Planar Arm (No Joint Limits)

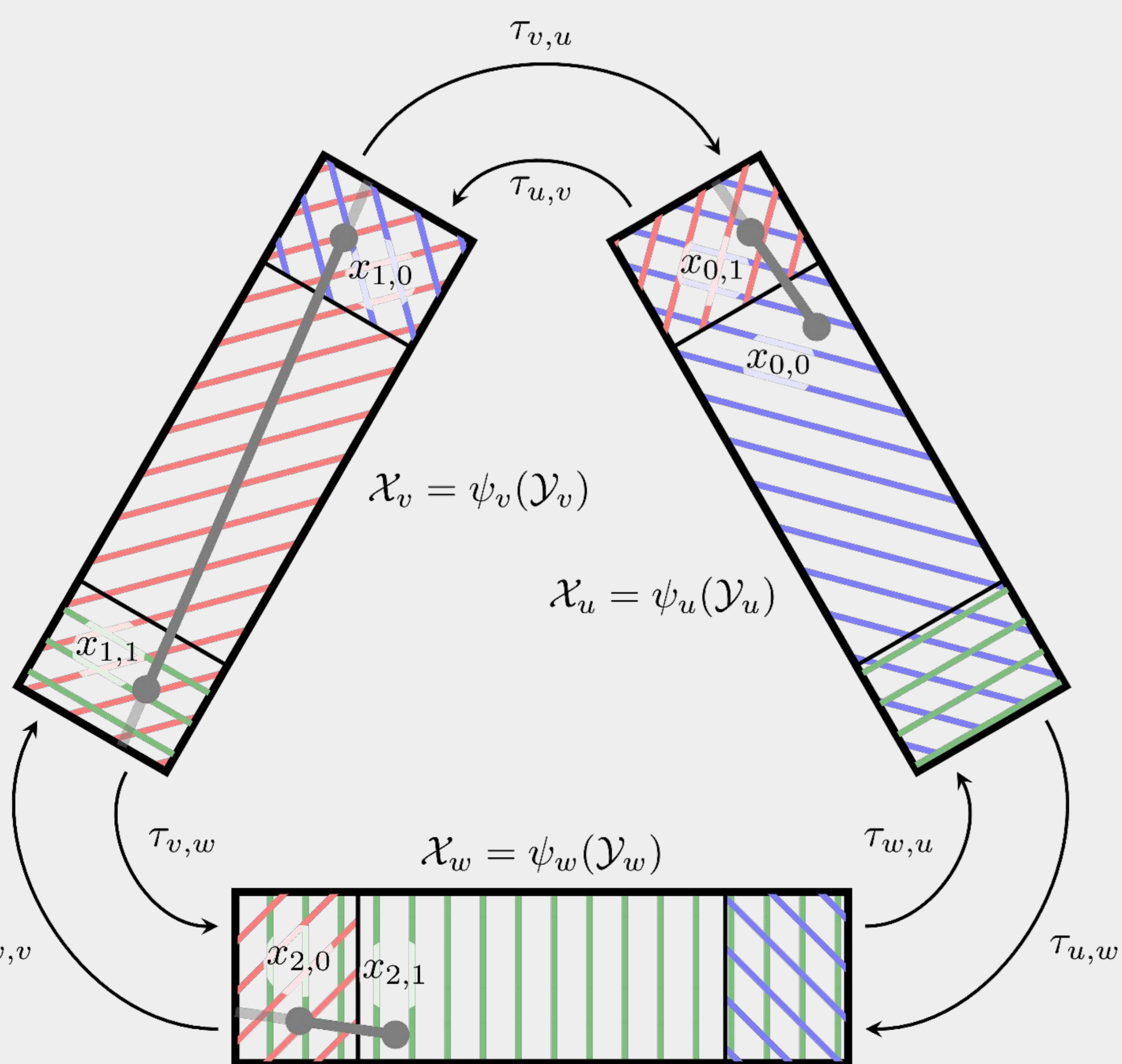
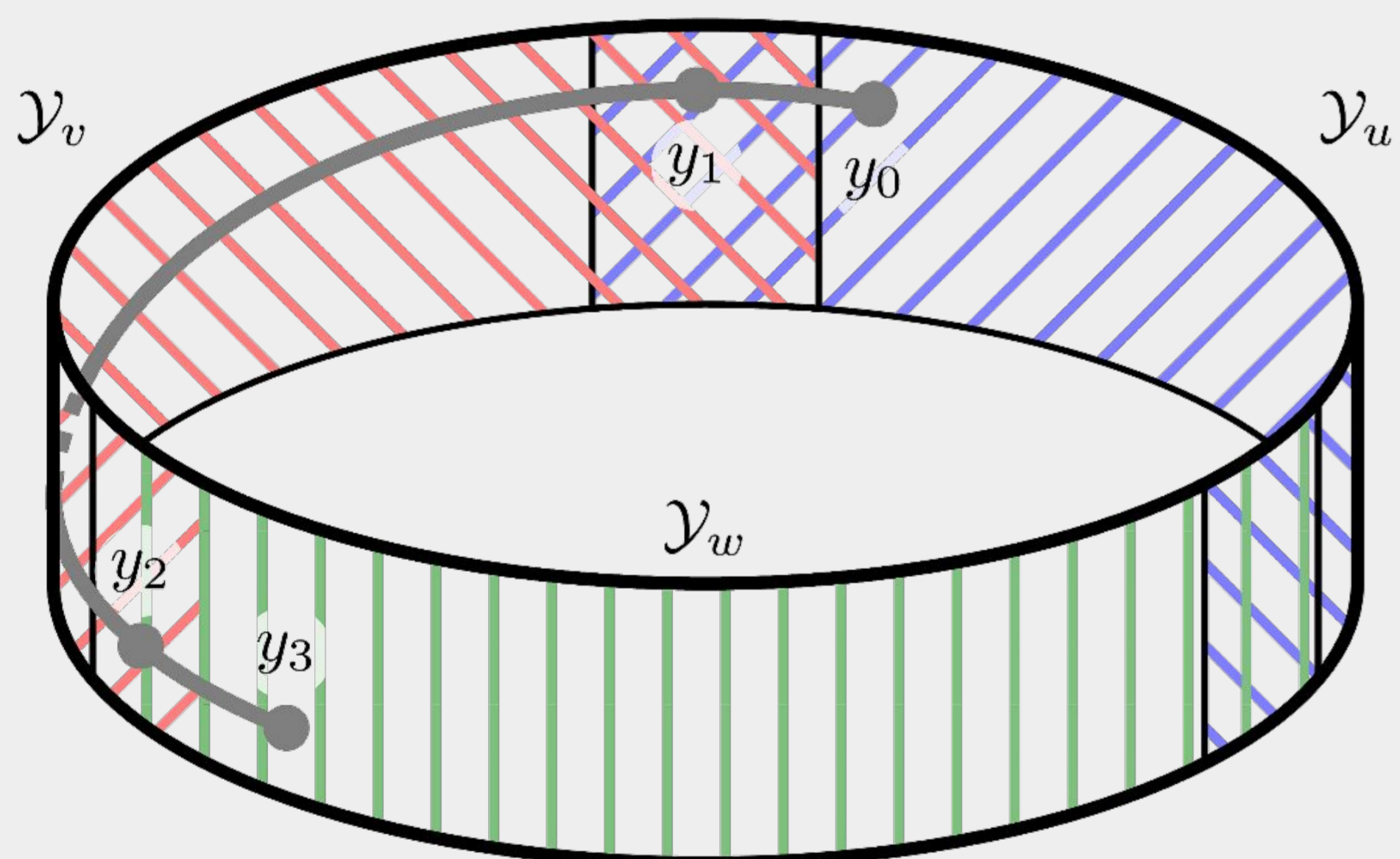


Multi Query Planning



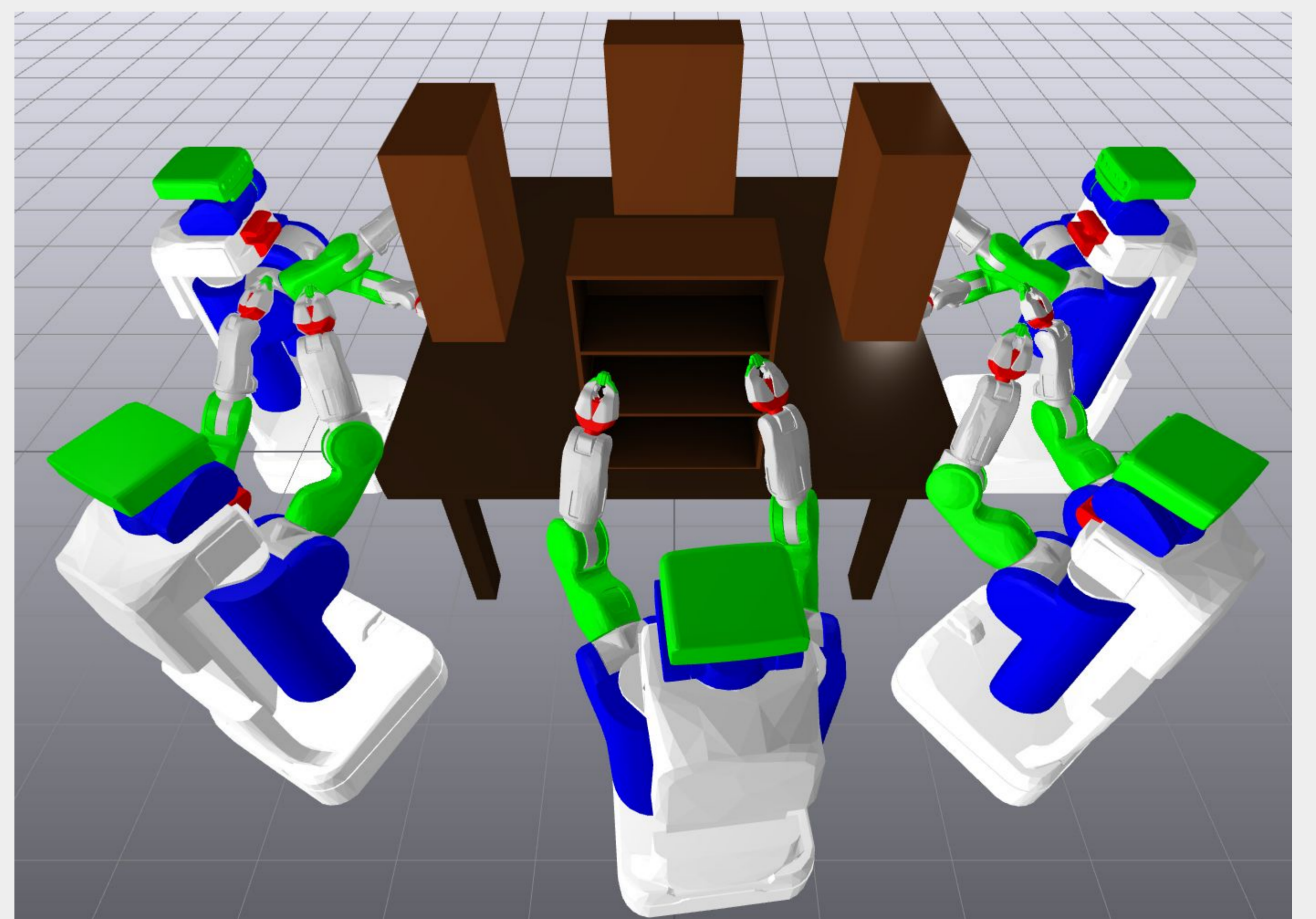
Planning on a Manifold

$\arg \min L(\gamma)$ — Minimize Arc Length
 subject to $\gamma \in \mathcal{C}_{pw}^1([0, 1], \overline{\mathcal{M}})$ — Path must be collision-free and piecewise-differentiable
 $\gamma(0) = p$ — Start point
 $\gamma(1) = q$ — End Point

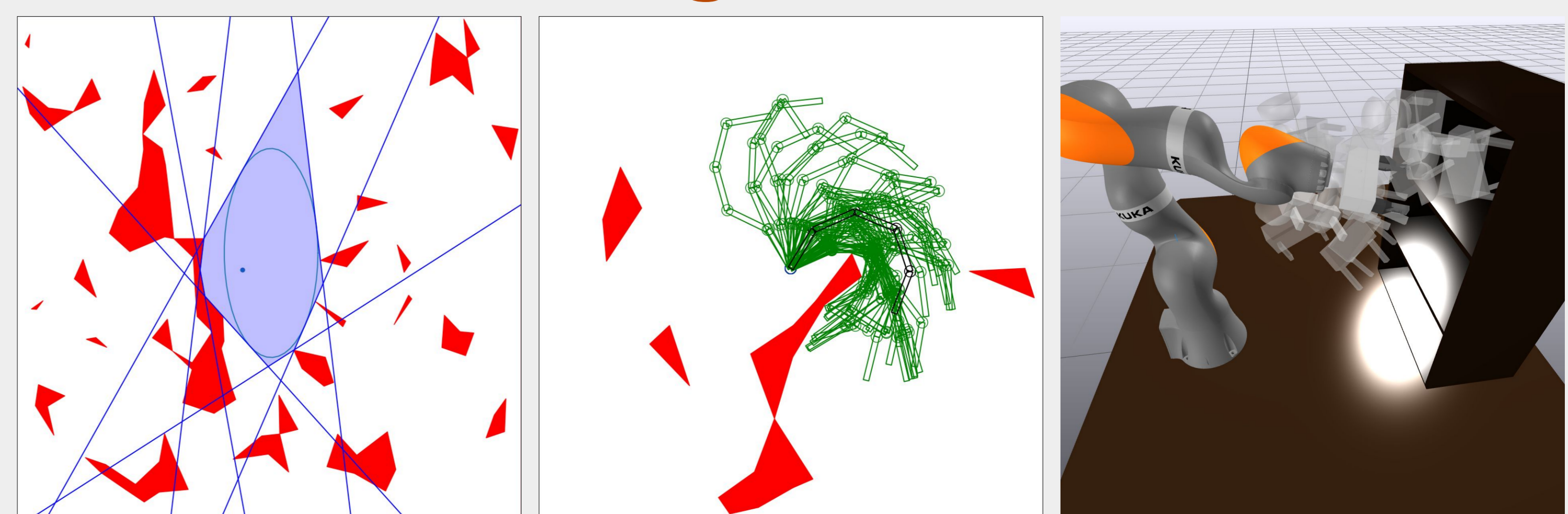


Additional requirements: Flat manifold, finite atlas of g-convex sets, isometric charts

Whole Body Planning (16 DoF)



Convex Region Generation



Convex Regions for a Planar Point Robot (Left), Planar Arm (Center), and KUKA iiwa Arm (Right)