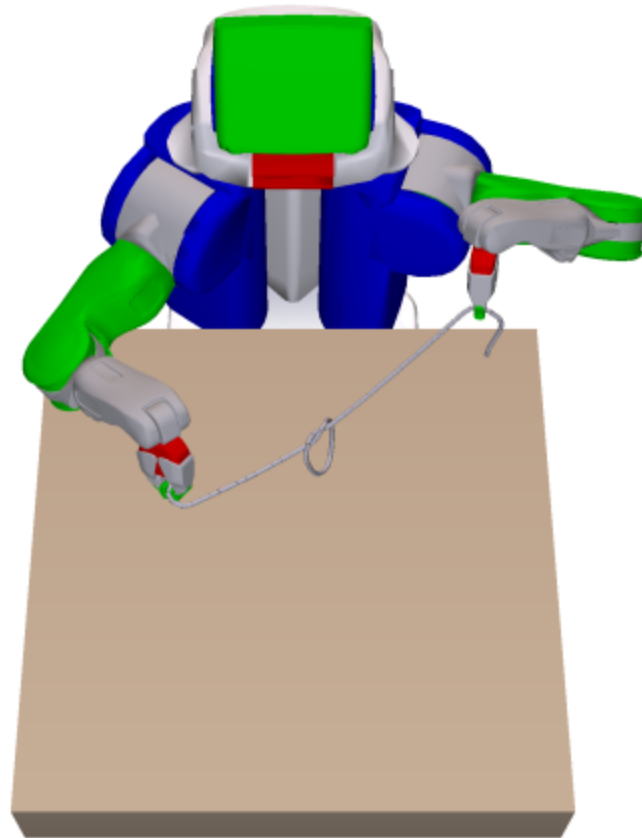


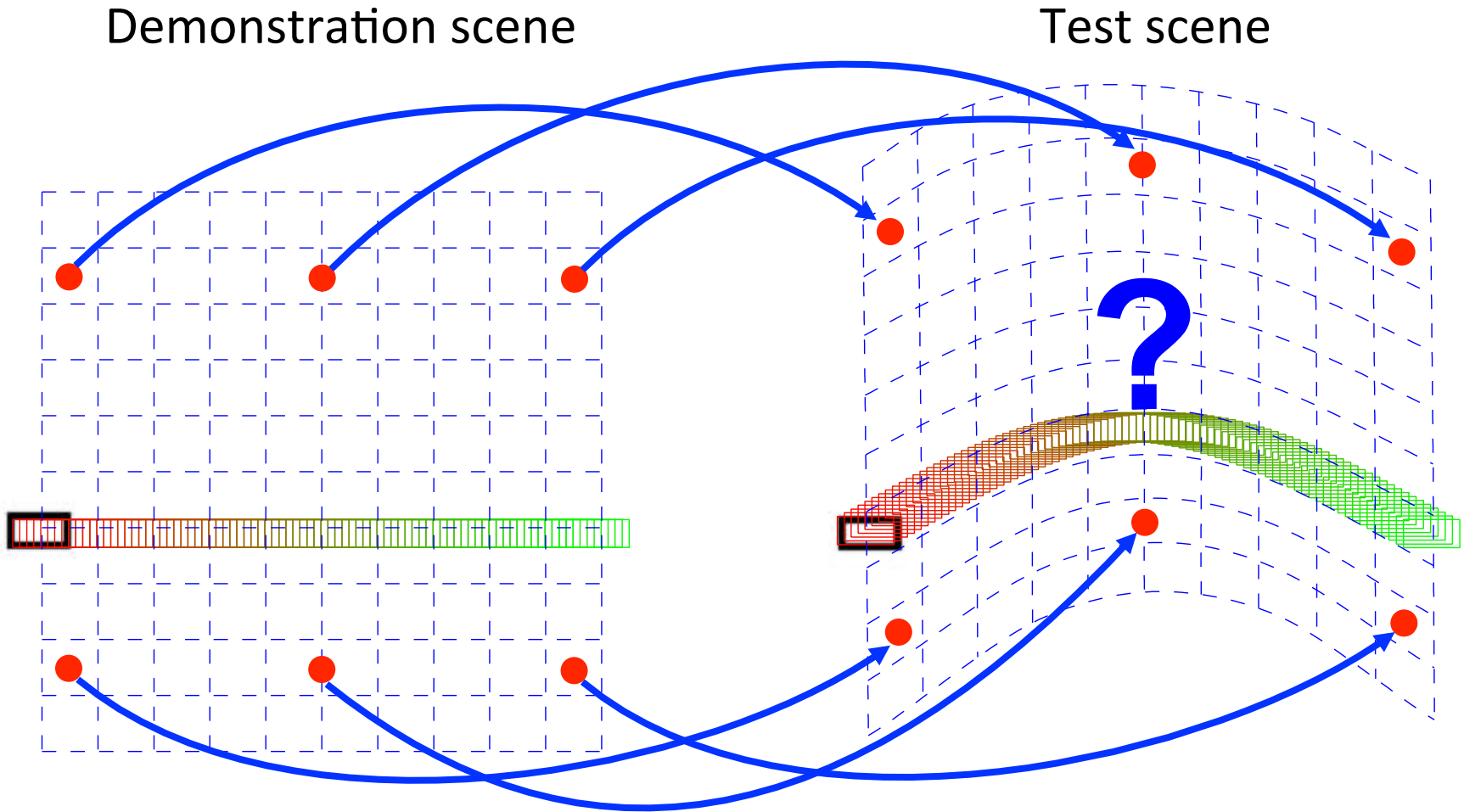
Unifying Scene Registration and Trajectory Optimization for Learning from Demonstrations with Application to Manipulation of Deformable Objects

Alex Lee, Sandy Huang, Dylan Hadfield-Menell, Eric Tzeng, and Pieter Abbeel

UC Berkeley EECS



Trajectory Transfer

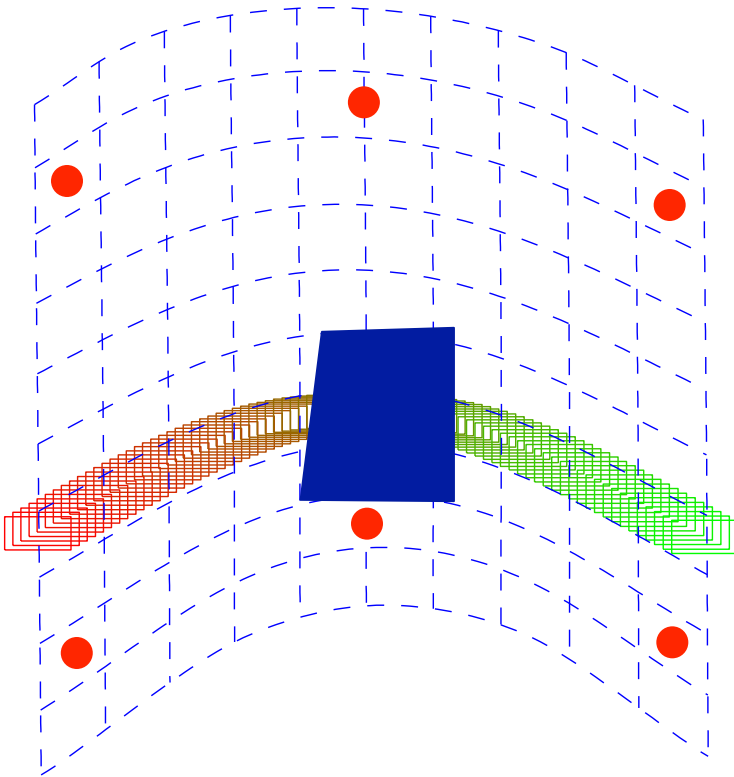


Step 1: $\min_{f \in \text{registration functions}} \text{registration_error}(S_{\text{demo}}, S_{\text{test}}) + \text{bending_energy}(f)$

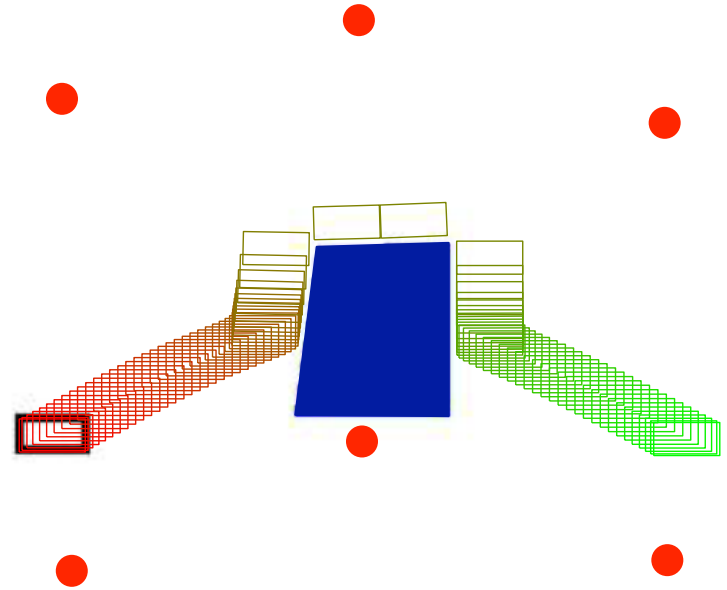
$$\tau_f \leftarrow f(\tau_{\text{demo}})$$

Trajectory Transfer

Transferred trajectory



Feasible trajectory

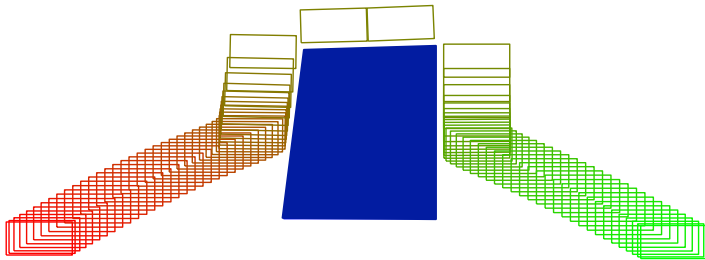


Step 2:
$$\min_{\tau \in \text{trajectories}} \text{trajectory_error}(\tau_f, \tau)$$

s.t. τ is feasible and collision-free

Unifying Trajectory Transfer

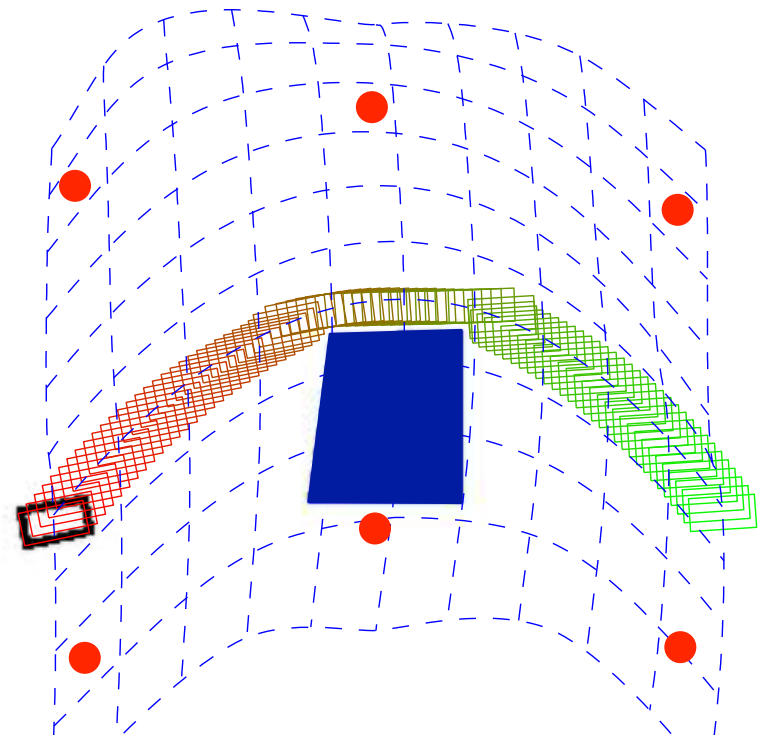
Two-step optimization



$$\text{Step 1: } \min_{f \in \text{registration functions}} \text{registration_error}(S_{\text{demo}}, S_{\text{test}}) + \text{bending_energy}(f)$$

$$\text{Step 2: } \min_{\tau \in \text{trajectories}} \text{trajectory_error}(f(\tau_{\text{demo}}), \tau) \\ \text{s.t. } \tau \text{ is feasible and collision-free}$$

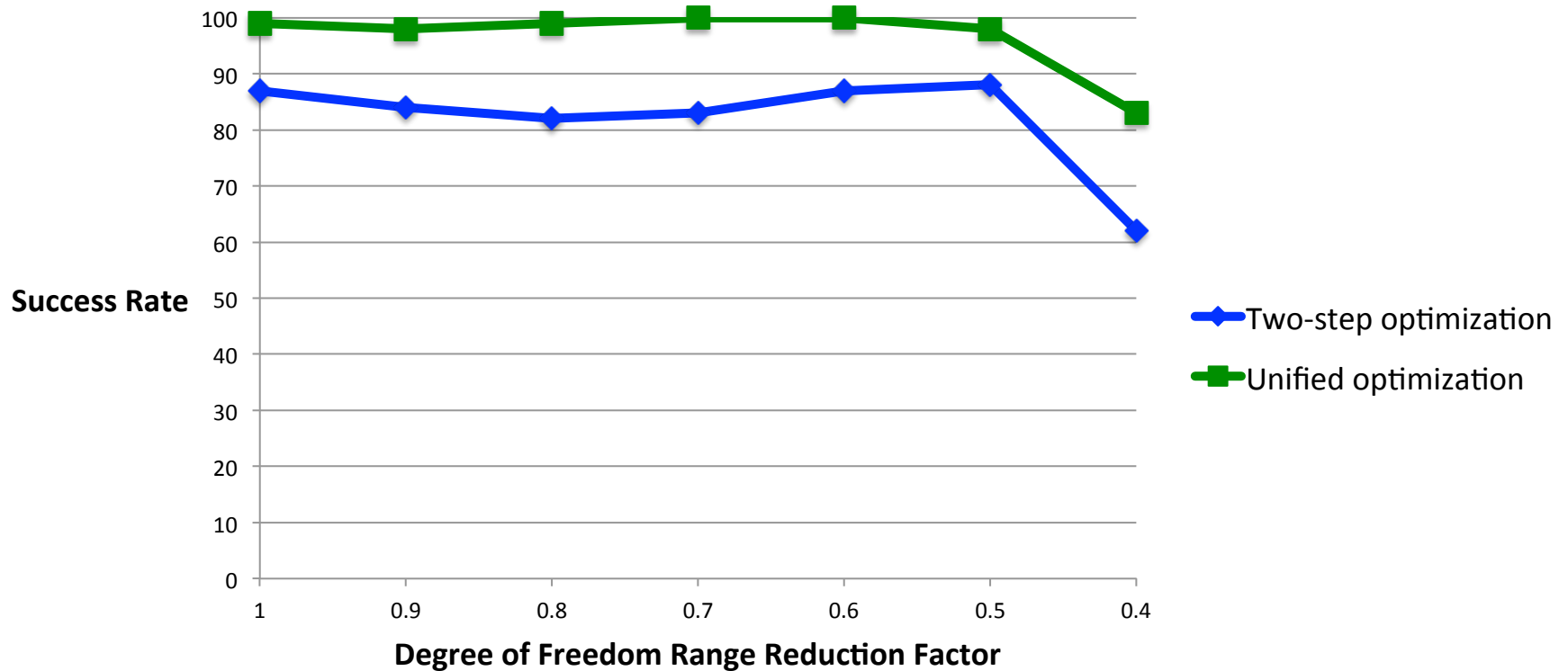
Unified optimization



$$\min_{\substack{f \in \text{registration functions} \\ \tau \in \text{trajectories}}} \text{registration_error}(S_{\text{demo}}, S_{\text{test}}) + \text{bending_energy}(f)$$

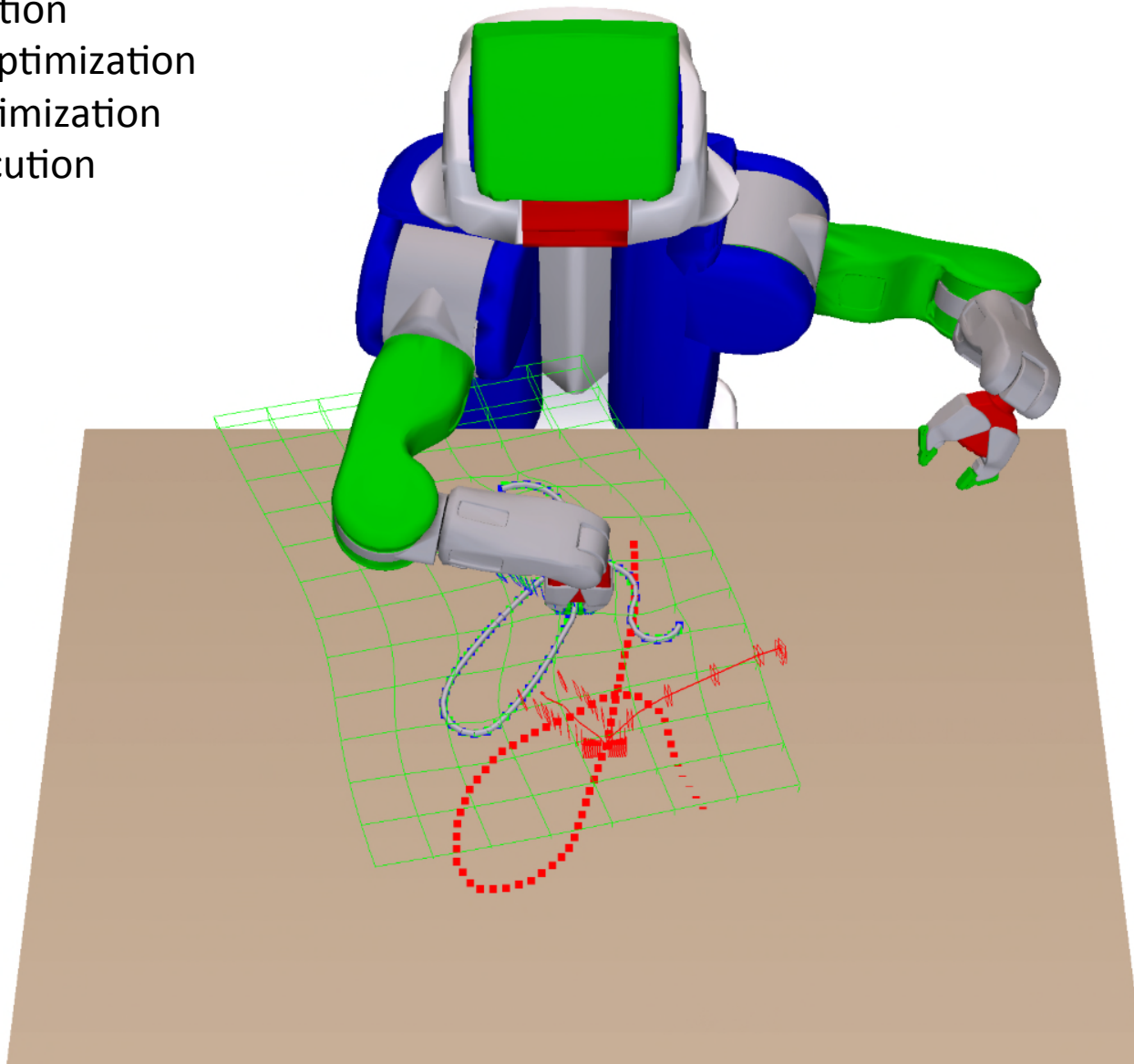
$$+ \text{trajectory_error}(f(\tau_{\text{demo}}), \tau) \\ \text{s.t. } \tau \text{ is feasible and collision-free}$$

Application to Manipulation of Deformable Objects



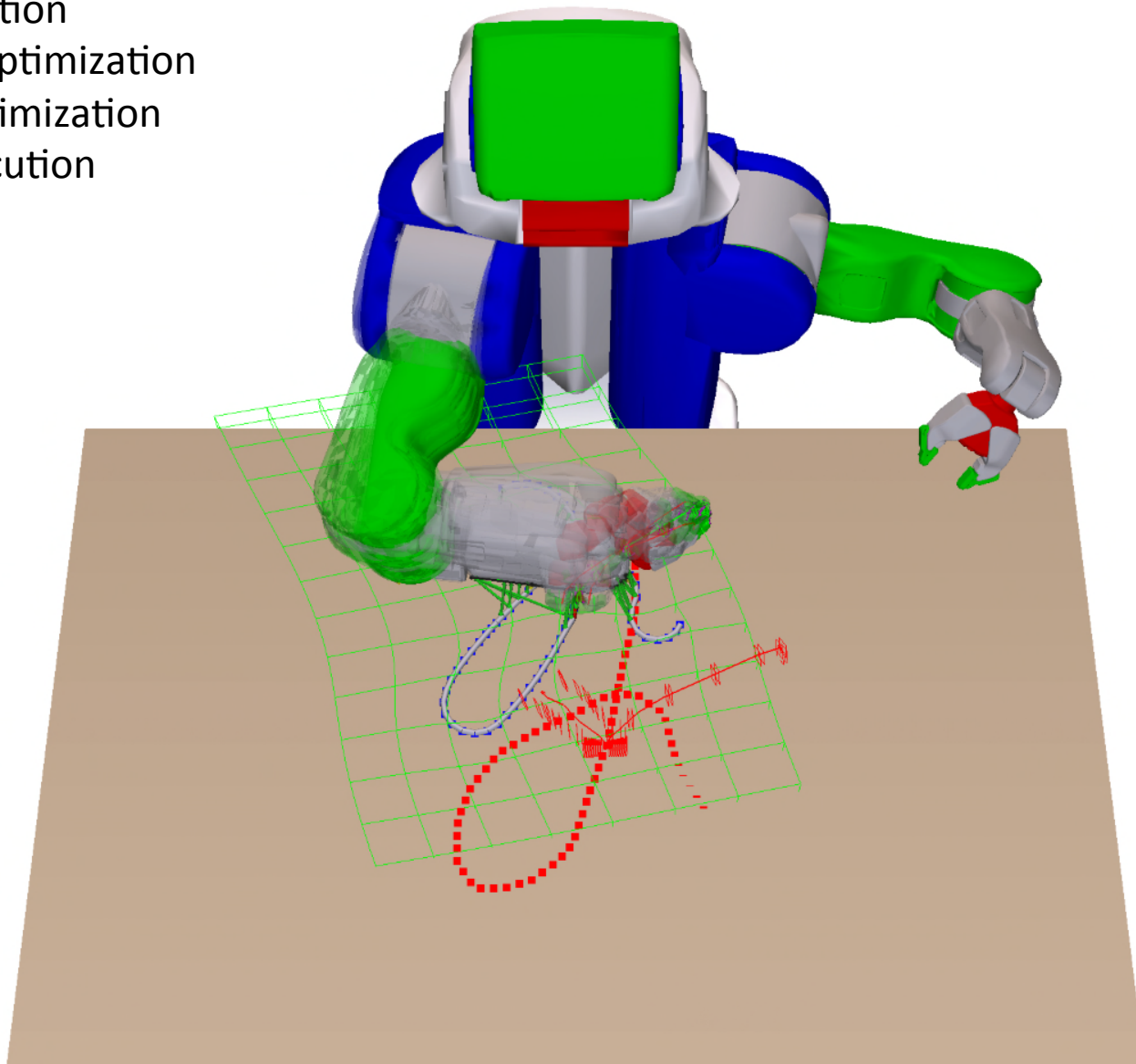
Application to Manipulation of Deformable Objects

- demonstration
- two-step optimization
- unified optimization
- actual execution



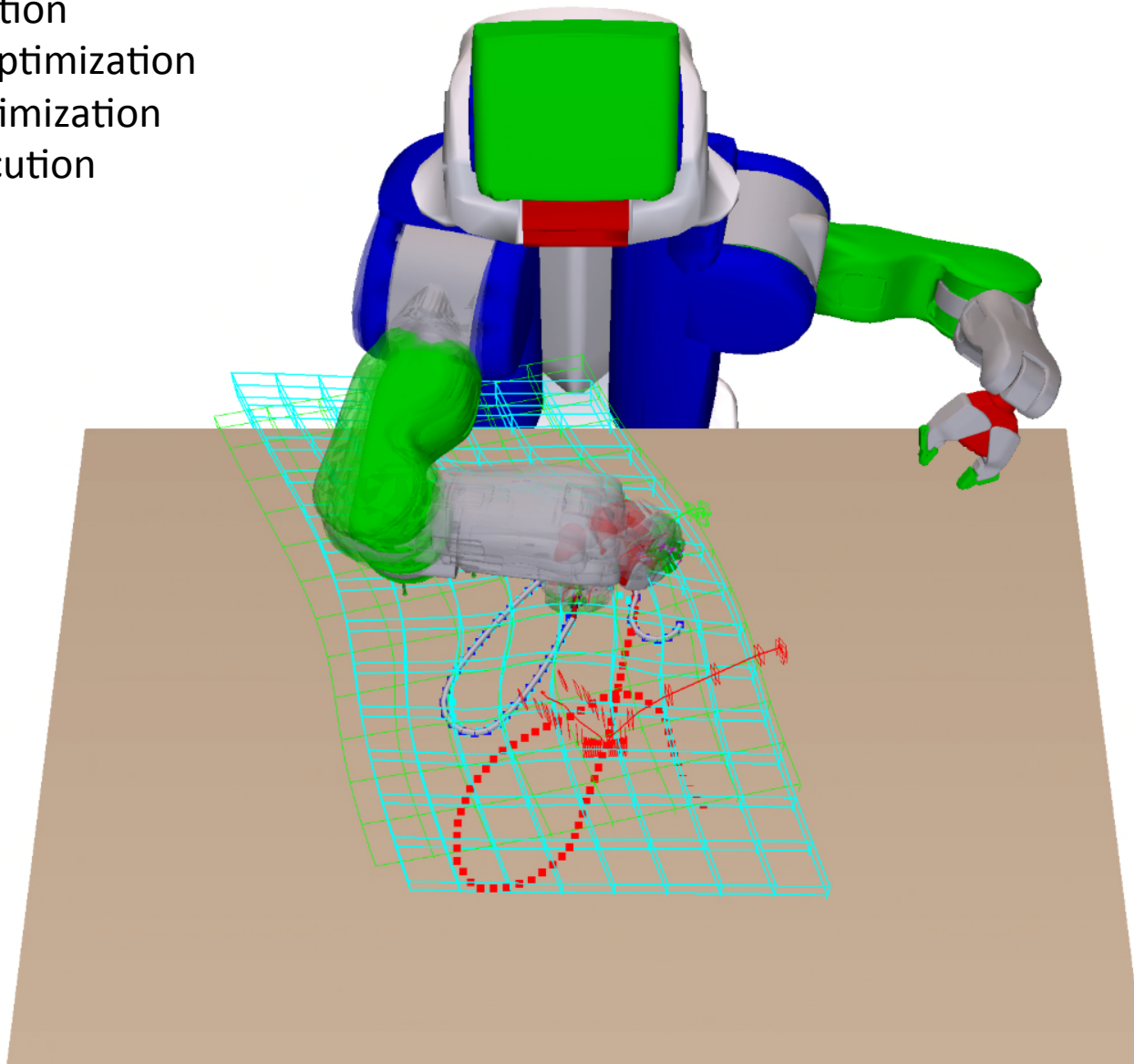
Application to Manipulation of Deformable Objects

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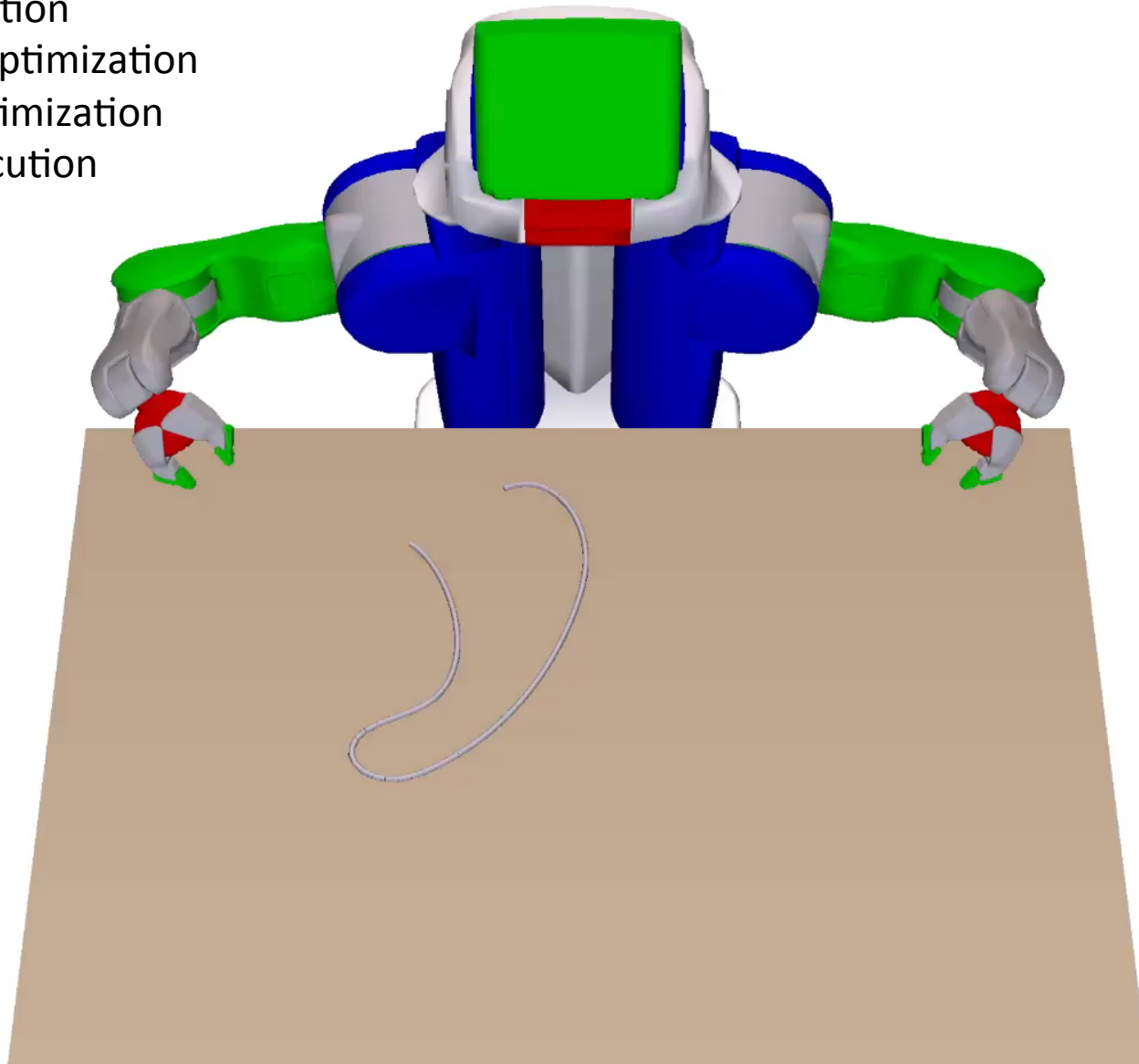
Application to Manipulation of Deformable Objects

- demonstration
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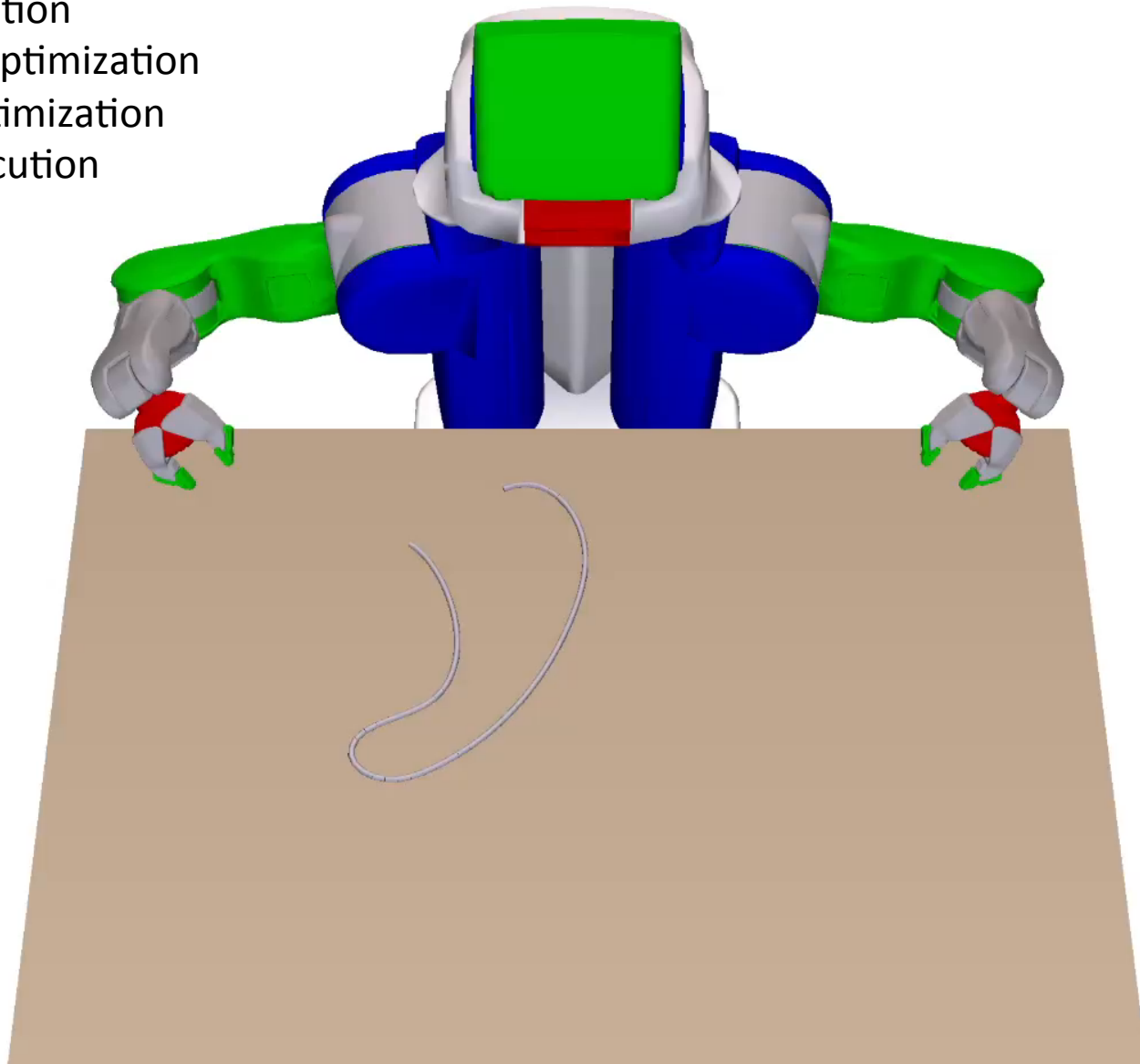
Application to Manipulation of Deformable Objects

- demonstration
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Application to Manipulation of Deformable Objects

- demonstration
- two-step optimization
- unified optimization
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Thank you