Multi-Robot Assembly of Deformable Linear Objects Using Multi-Modal Perception

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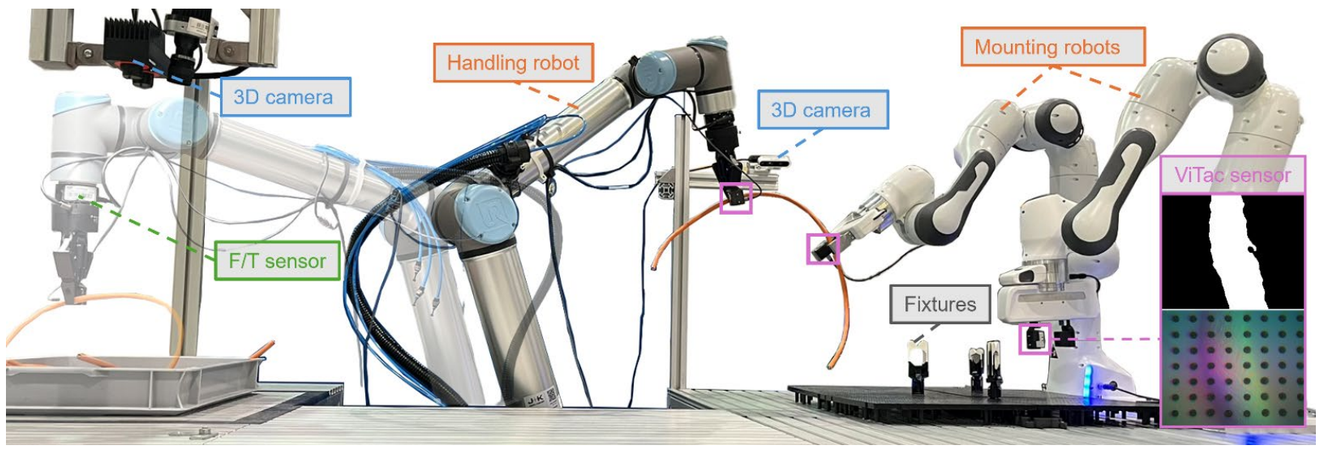
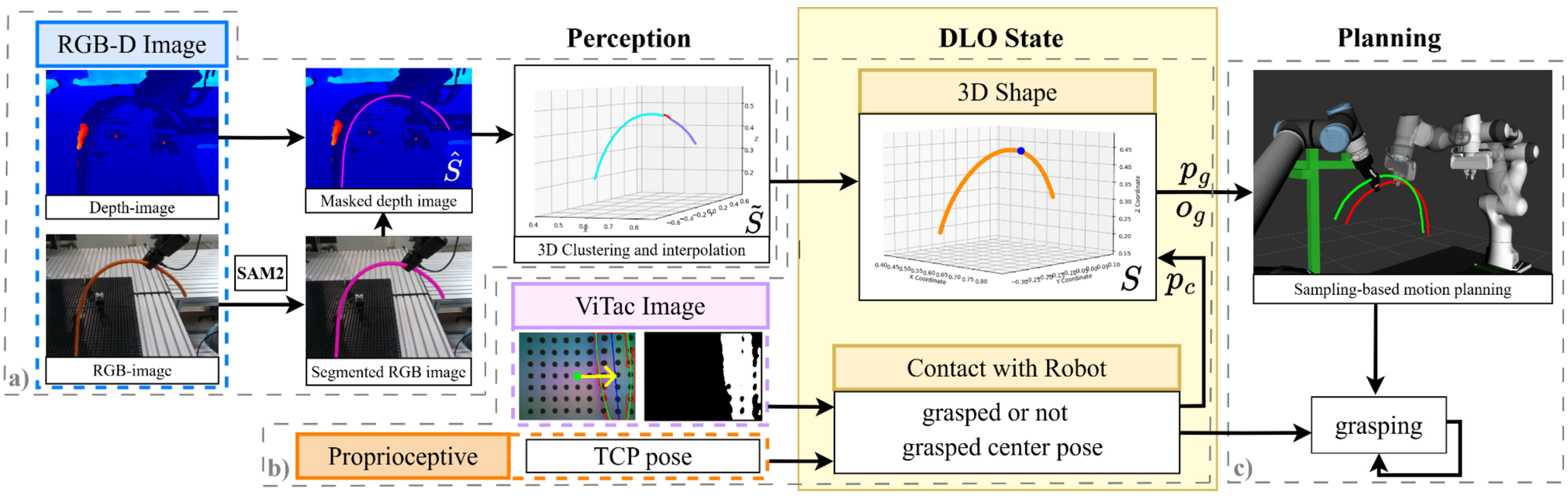
Motivation

- Deformable linear objects (DLOs) are still assembled manually in industry [1].
- Uncertainties regarding the shape as well as the dynamic behavior of the DLO make perception and control difficult [2].
- Multi-modal sensing enables coherent DLO state estimation [3].

Introduce a tracking and planning framework which leverages visual and tactile perception for DLO manipulation across multiple robots.



Methodology



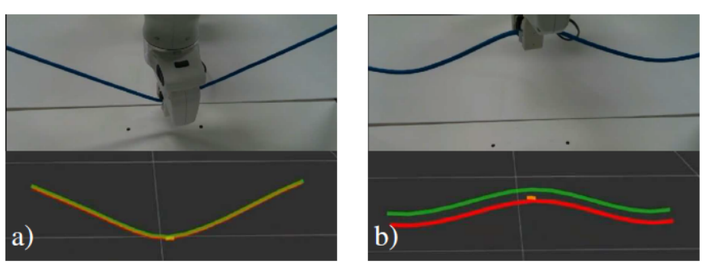
a) After extraction from 2D segmentation by SAM2 [4], the DLO's raw 3D points are clustered by DBSCAN (blue and purple), and the missing part is interpolated (red) to form an initial 3D model.

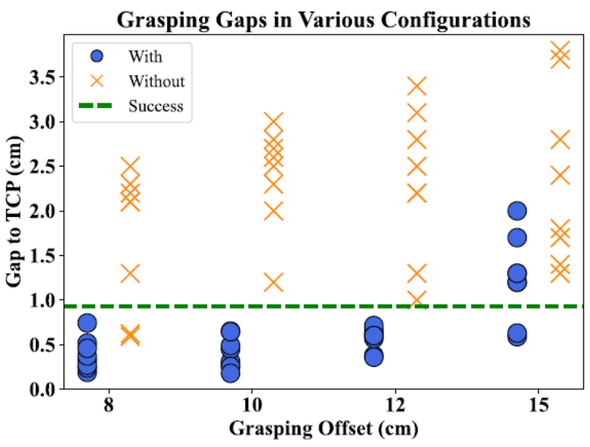
b) The grasping status as well as the grasping center are derived from the in-hand ViTac images and the robot's TCP pose. The yellow arrow on the ViTac image points from TCP to the grasping center. The final 3D shape (orange) is corrected with the grasp center point.

c) Based on the corrected shape (red), the grasping for the second robot (Franka) is planned.

Experiments

- **Tracking Corrections**

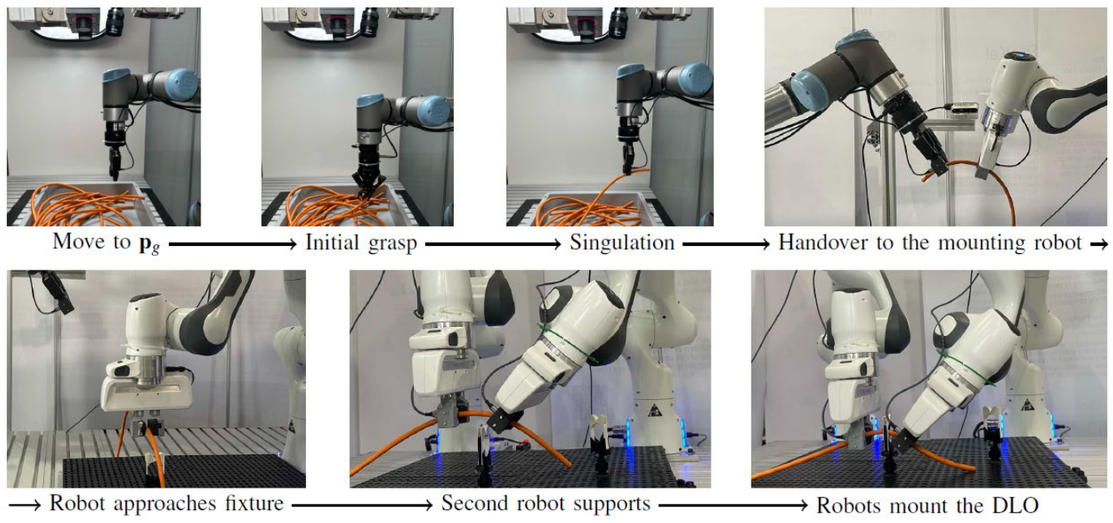




a) and b) Examples of small and large corrections. Raw visual estimation in green and the corrected model in red.

c) Gaps between the grasping point and the robot's TCP with (circle) and without (cross) local correction.

- **Assembly Process**



References

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