

# GelSLAM: A Real-Time, High-Fidelity, and Robust 3D



## Tactile SLAM System

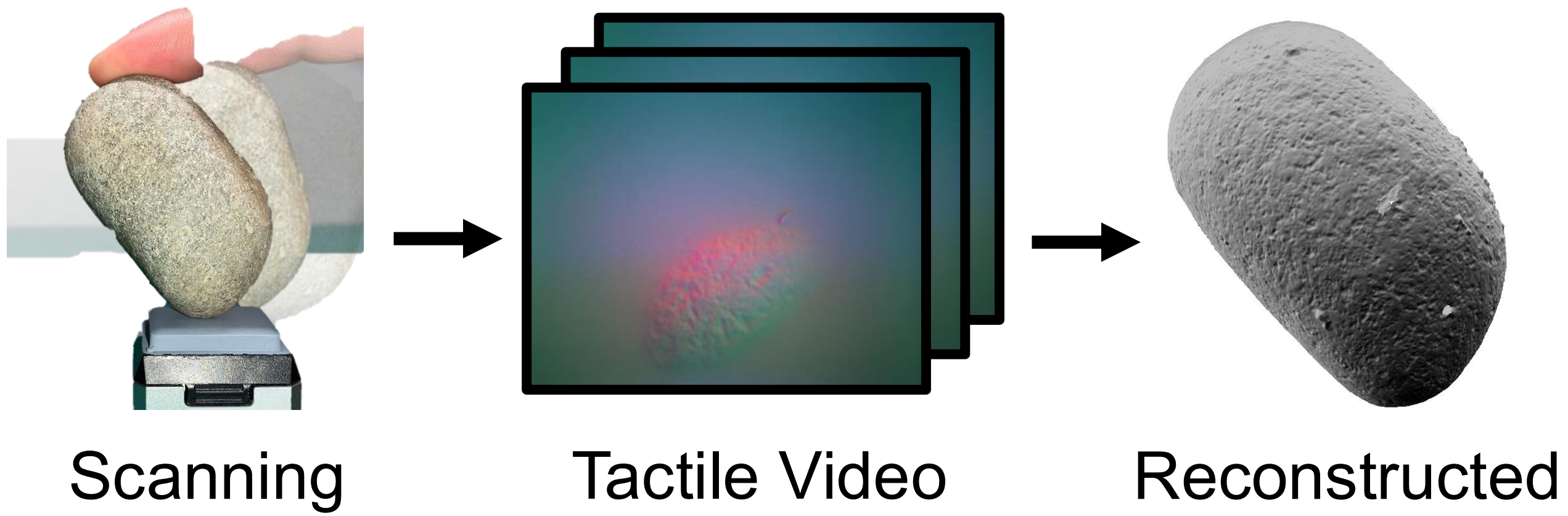
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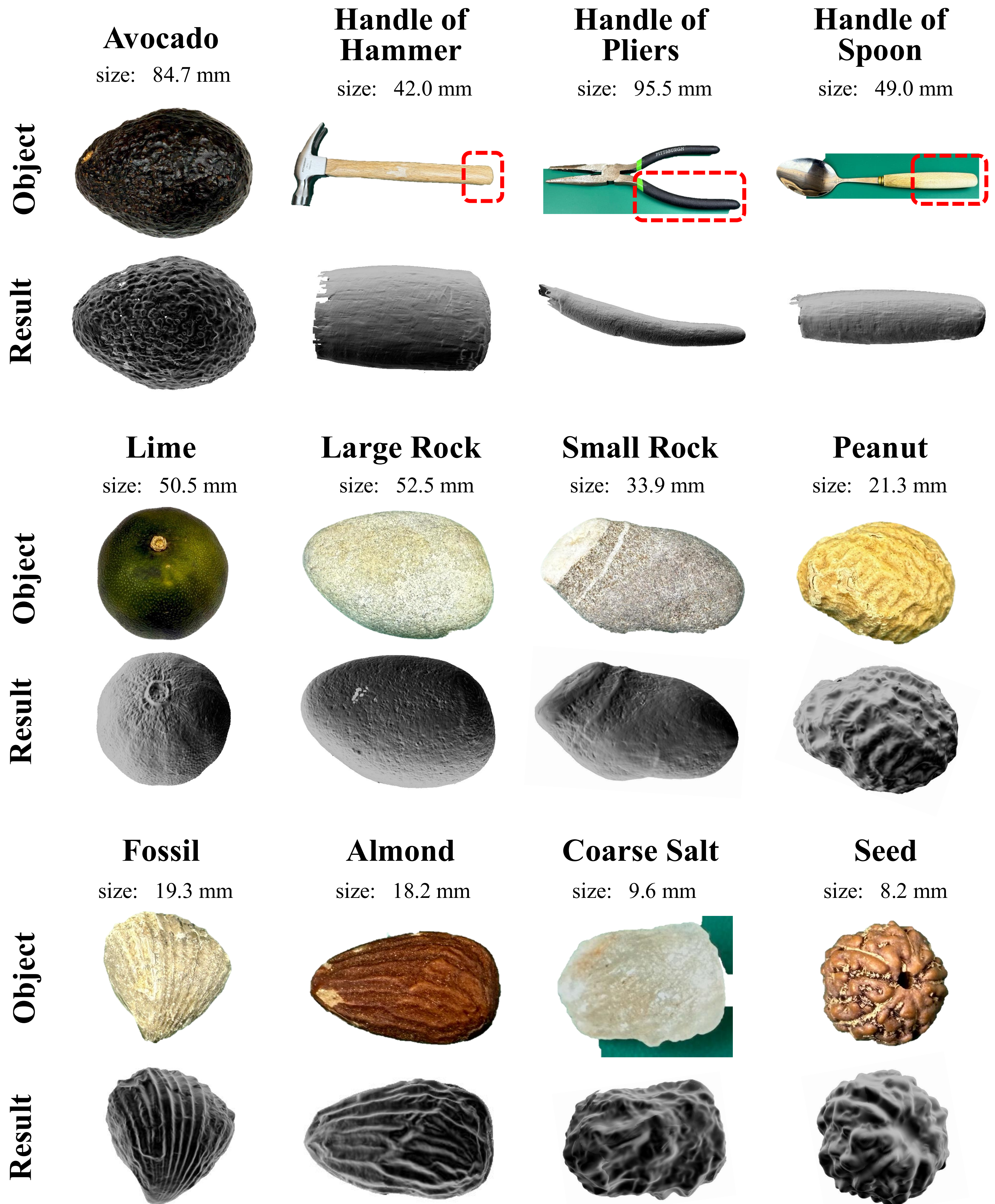
<sup>1</sup> Carnegie Mellon University <sup>2</sup> University of Illinois Urbana-Champaign

### Task: Object 3D Reconstruction

We aim to reconstruct high-fidelity 3D geometry of small objects using only tactile sensing.

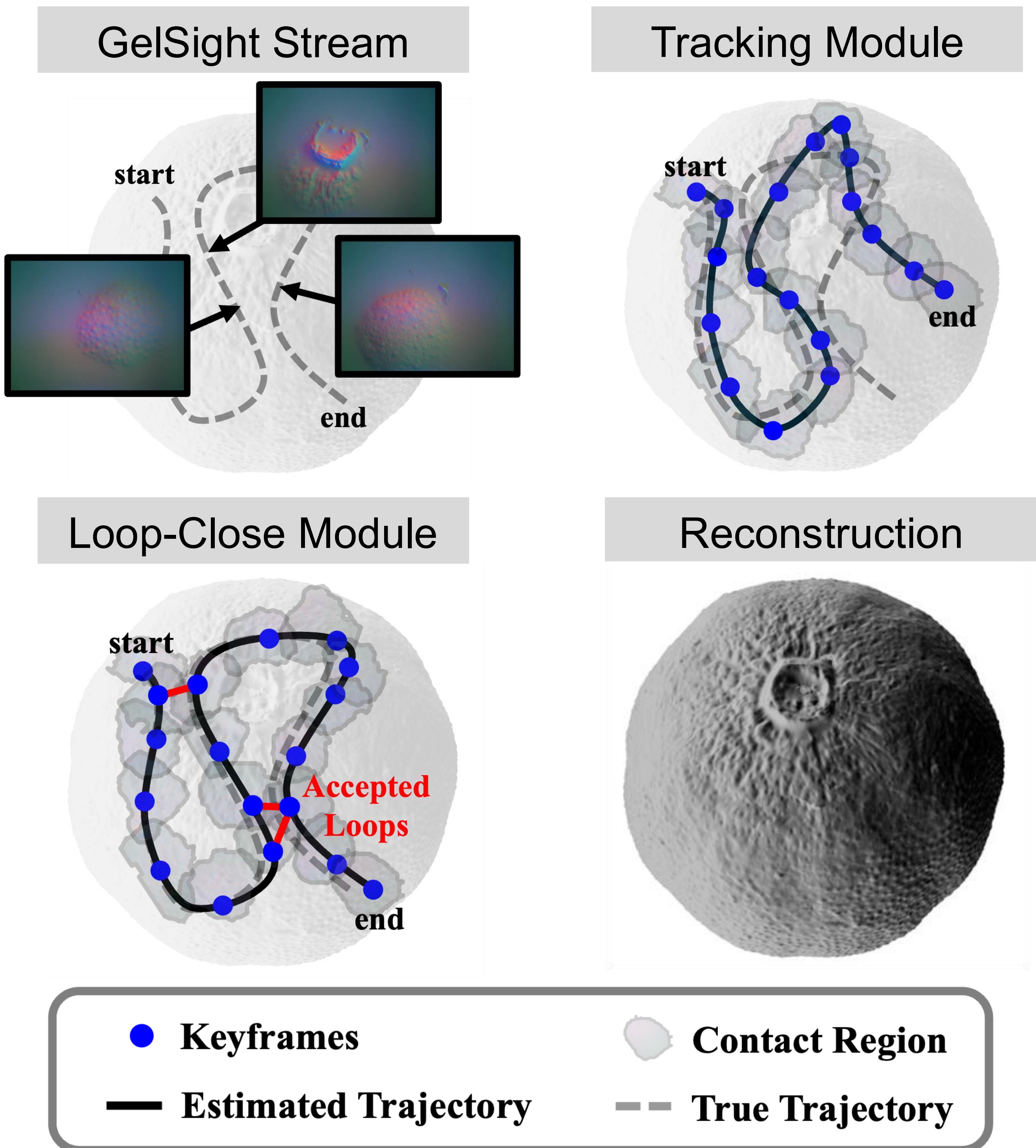


### Result: Object 3D Reconstruction



### Pipeline

We track relative poses between frames, detect loops, solve pose graph and register each tactile patch using the solved poses.

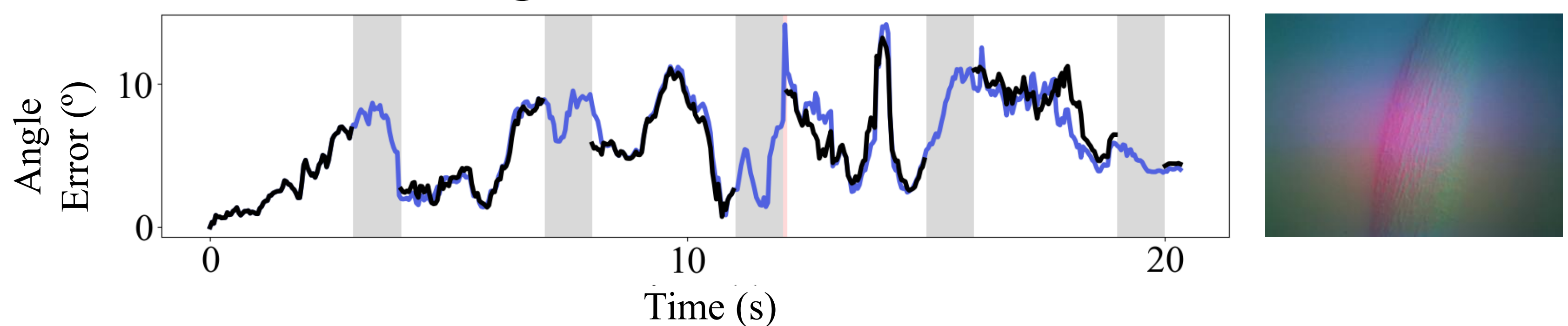


### Result: Long-Horizon 6DoF Tracking

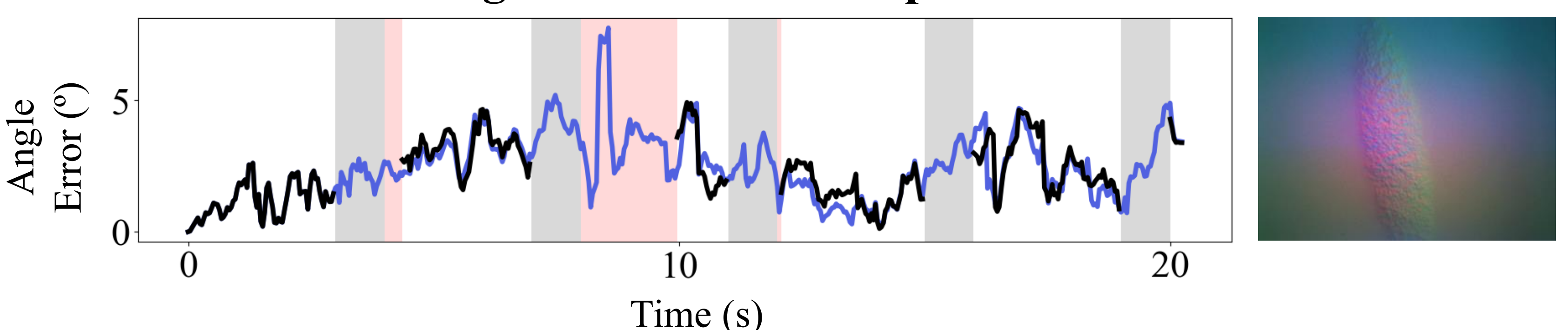
On 20 objects, GelSLAM robustly and accurately tracks 6DoF object pose, even with contact breaks.

Method	$\theta_x$ (°)	$\theta_y$ (°)	$\theta_z$ (°)	x(mm)	y(mm)	z(mm)
ICP	13.0	13.9	23.9	8.14	9.94	6.73
NormalFlow	7.11	7.53	7.63	1.13	1.21	0.92
GelSLAM	<b>4.06</b>	<b>4.38</b>	<b>3.57</b>	<b>1.00</b>	<b>0.96</b>	<b>0.72</b>

#### Tracking and Re-localize: Pliers



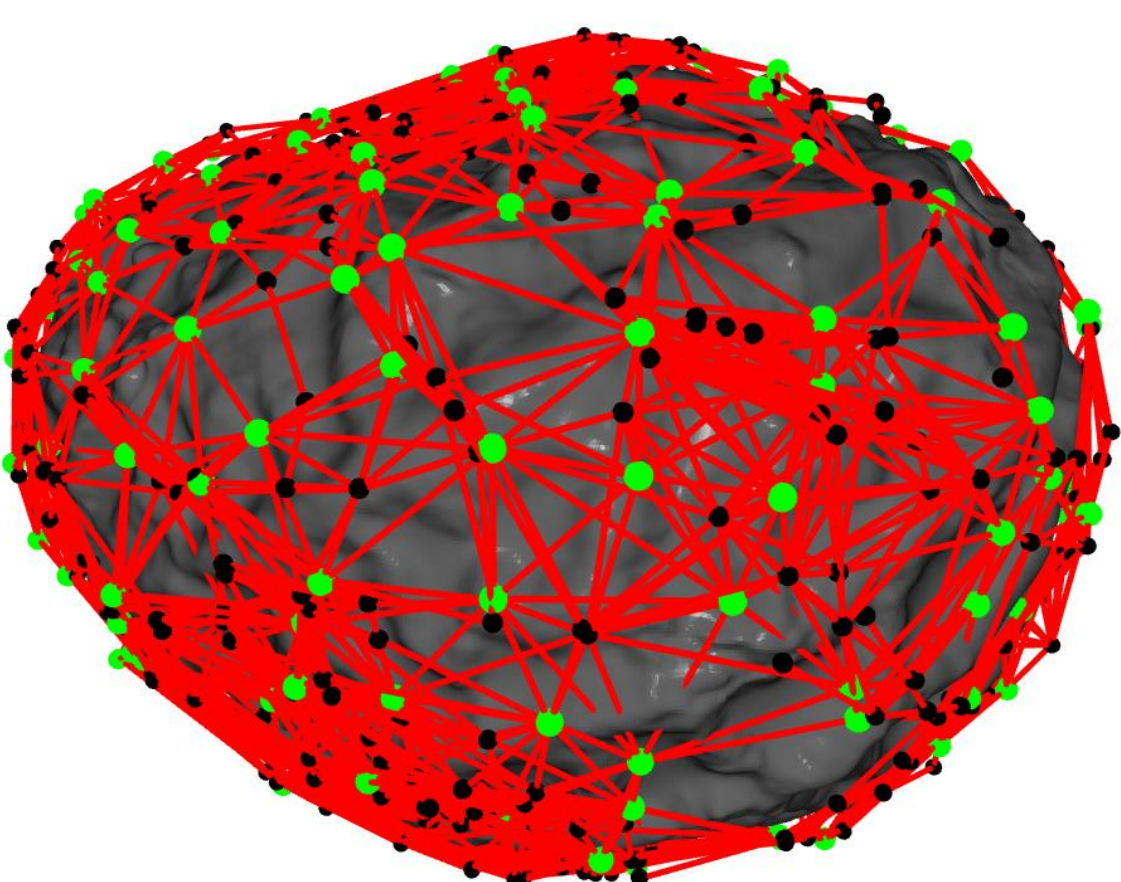
#### Tracking and Re-localize: Spatula



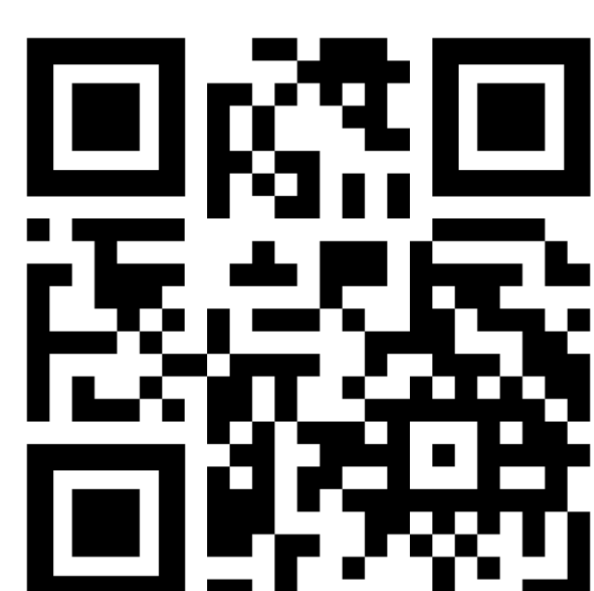
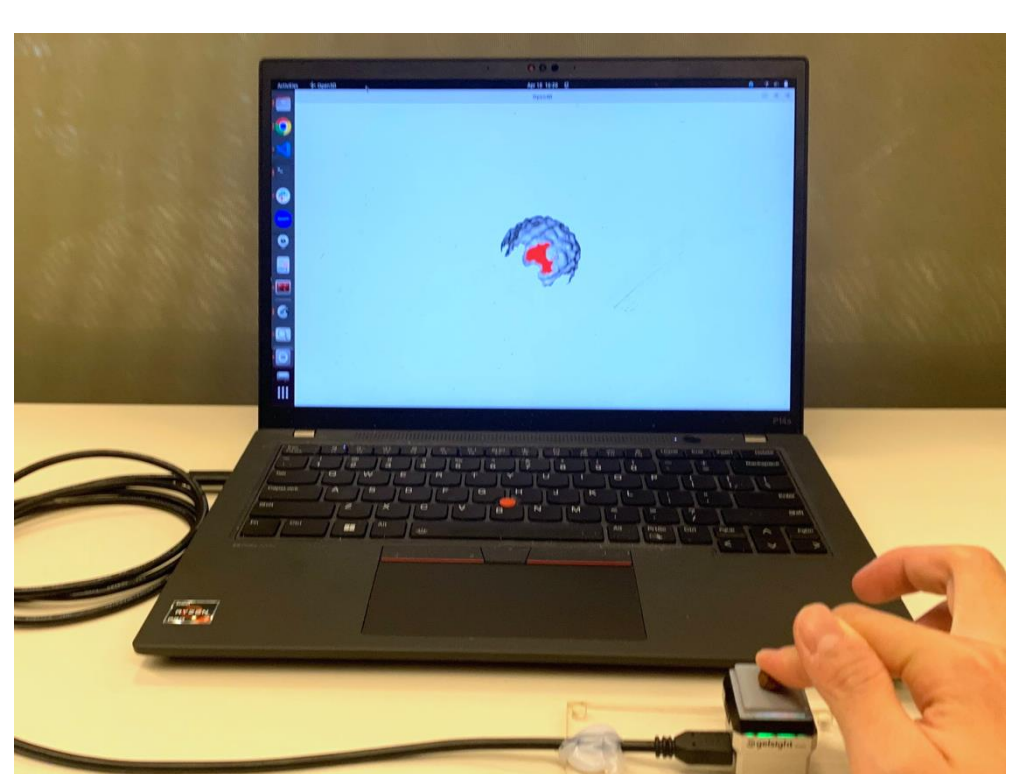
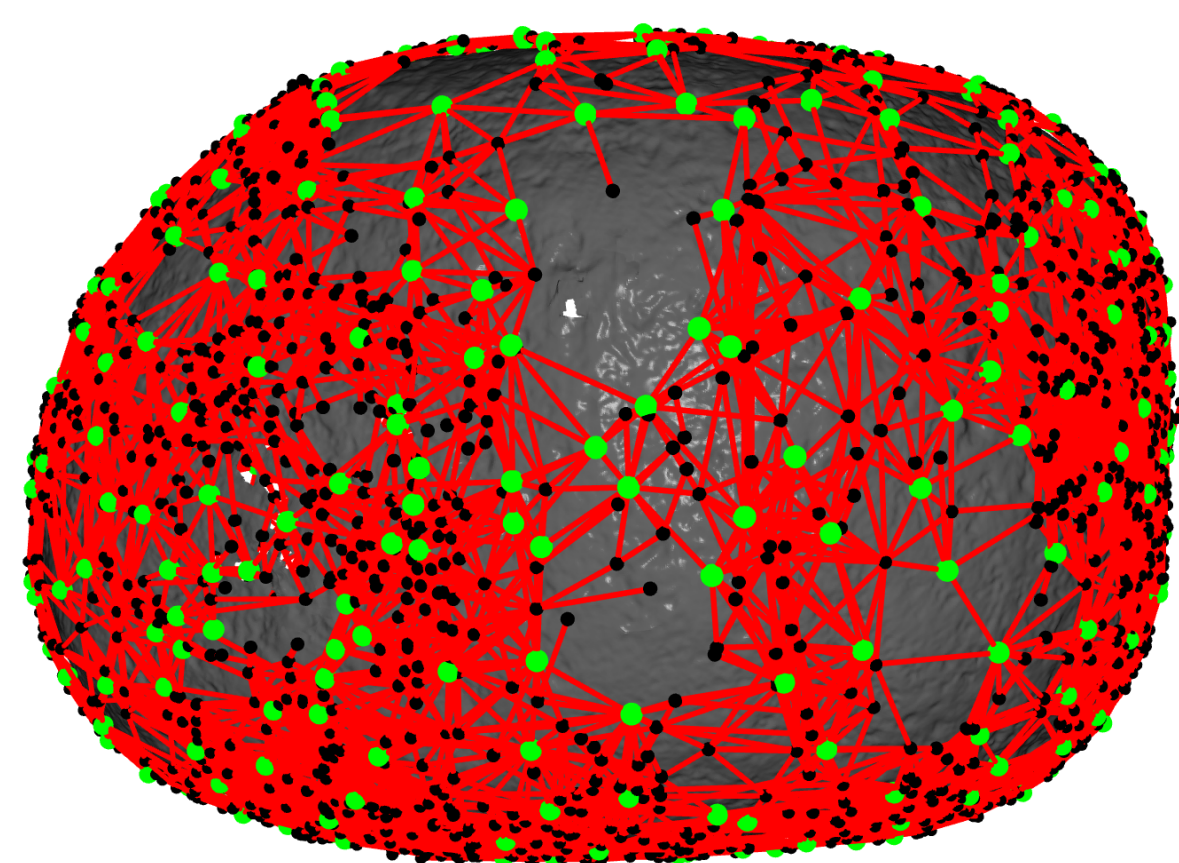
— Ground Truth      — Tracking Result  
 — No Contact      — Contacted but Not Relocalized

### Pose Graph Examples

Peanut



Large Rock



Website



Code