



Neural Rendering for Stereo 3D Reconstruction of Deformable Tissues in Robotic Surgery

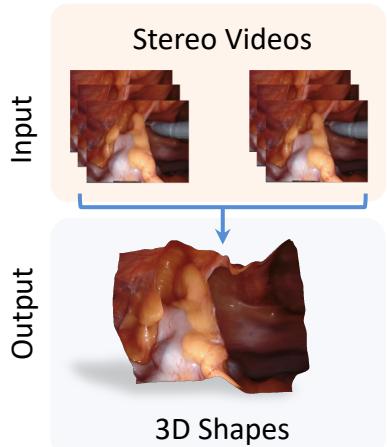


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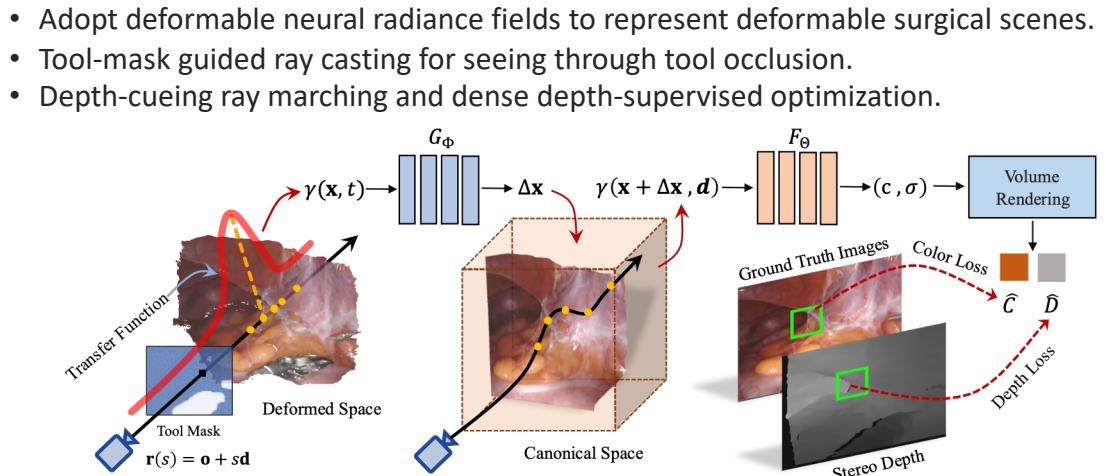
Motivation & Problem Setting



Key Challenges in Surgical Scene 3D Reconstruction

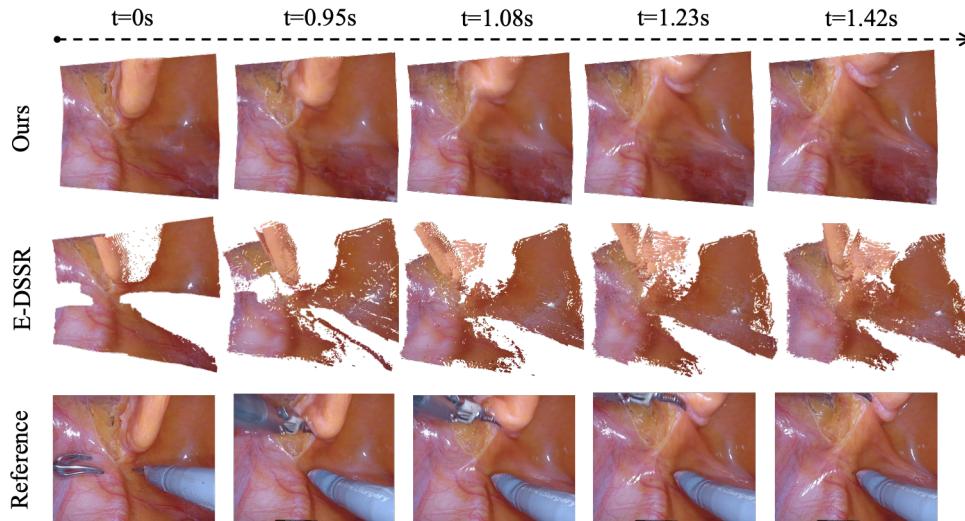
1. Surgical scenes are **highly deformable with tremendous topology changes**, requiring dynamic reconstruction to capture a high degree of non-rigidity.
2. Endoscopic videos show **sparse viewpoints** due to constrained movement in confined spaces, resulting in limited 3D clues of soft tissues.
3. The surgical instruments always **occlude part of the soft tissues**, affecting the completeness of reconstruction.

Neural Rendering Pipeline for Soft Tissue 3D Reconstruction



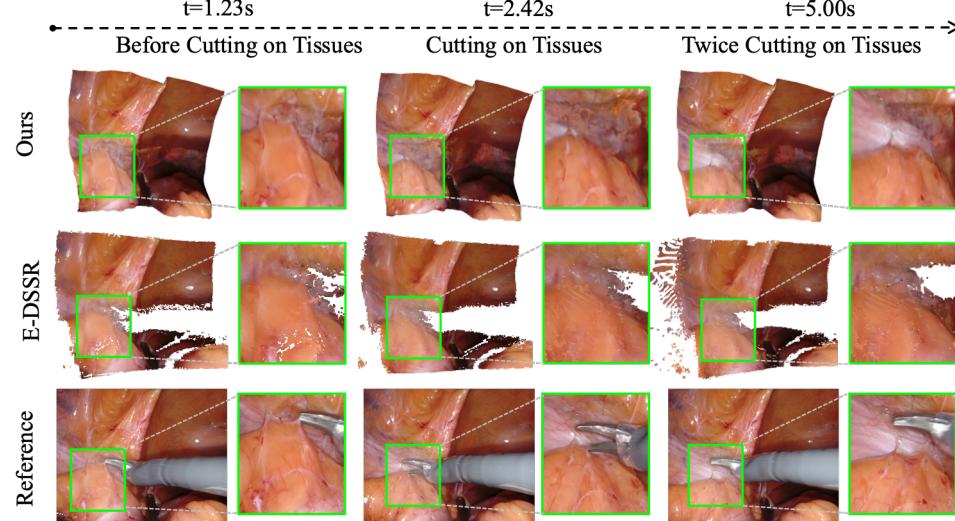
Dynamic Reconstruction Results

Results of “pulling tissues” with large **non-rigid deformations**.



Close-Ups of Reconstruction Results

Results of “cutting tissues twice” with **topology changes**.



Quantitative Results

Quantitative photometric evaluation across 6 typical scenes

Photometric Evaluation

Metrics	Ours	E-DSSR
PSNR	29.831 ± 2.208	13.398 ± 1.387
SSIM	0.925 ± 0.020	0.630 ± 0.057
LPIPS	0.081 ± 0.022	0.423 ± 0.047