

Visual Computing and 4D and Quantum / Al Department Vision Group

Shape-from-Template Goal

Input Vide

Novel View

Ground Truth

Previous Best

 $\exists \psi$

: Monocular RGB video of a deforming Input surface and it's 3D shape for the first frame : 3D surface tracking *i.e.* spatio-temporally Output coherent reconstructions

Challenges: Depth ambiguity, occlusions and texture vs. wrinkles etc...

Why SotA Methods Fail?

SotA? Physics-based Shape-from-Template (Stotko *et al.*, ϕ -SfT)

Mesh-based Differentiable Physics Simulator

- Discrete and non-adaptive
- Resolution-sensitive simulation
- Non-differentiability with remeshing

Mesh-based Differentiable Renderer

Consequence? Failure to track fine-grained folds and wrinkles

Our Key Insights

Continuous & adaptive Continuous thin deformation field shell physics prior

 $\Psi d\Omega dt$

Surface-induced 3D Gaussians

Thin-Shell-SfT: Fine-Grained Monocular Non-rigid 3D Surface Tracking with Neural Deformation Fields

Navami Kairanda¹, Marc Habermann^{1,2}, Shanthika Naik³, Christian Theobalt^{1,2}, Vladislav Golyanik¹ ¹MPI for Informatics, SIC ²VIA Research Center ³IIT Jodhpur

Method Overview

Conclusion & Future Works References

- We accurately reconstruct the challenging fine-grained deformations.
- Self-collisions and textureless surface tracking remain as open problems

4dqv.mpi-inf.mpg.de/ThinShellSfT

Results and Comparisons

Input Image

Normal Map

54.69

10.87

5.92*

Normal Map ϕ -SfT

Kairanda *et al.*, Phi-SfT, CVPR 2022 Stotko et al., Physics-guided Shape-from-Template. CVPR 2024 Kairanda et al., NeuralClothSim, NeurIPS 2024