

IMAGE-GUIDED SHAPE-FROM-TEMPLATE USING MESH INEXTENSIBILITY CONSTRAINTS

ICCV 2025

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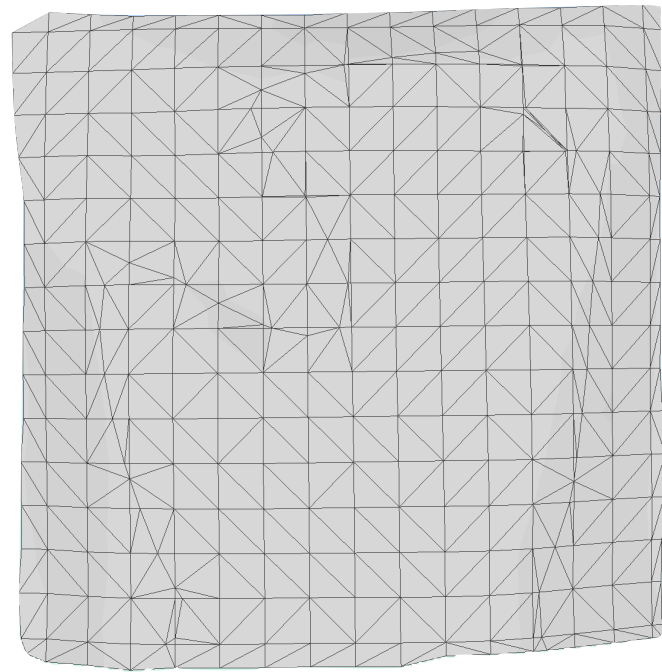


Shape-from-Template (SfT)

Template

RGB Video

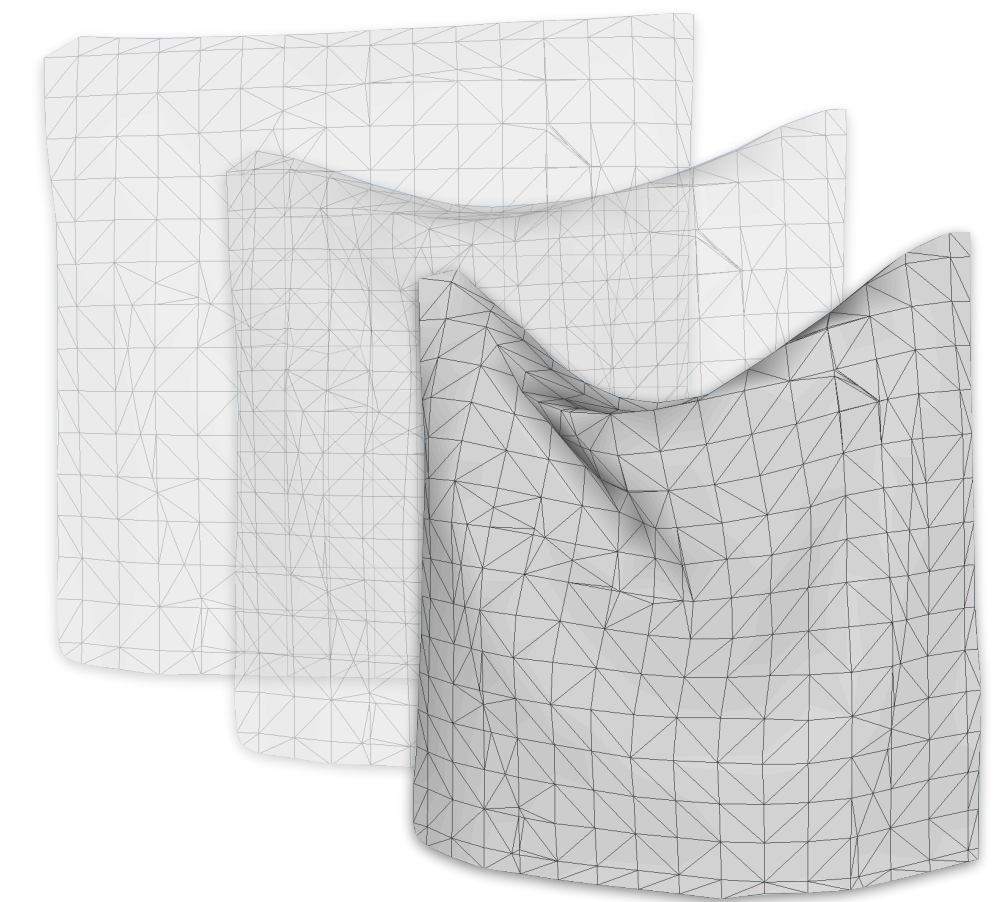
3D Shapes



Mesh

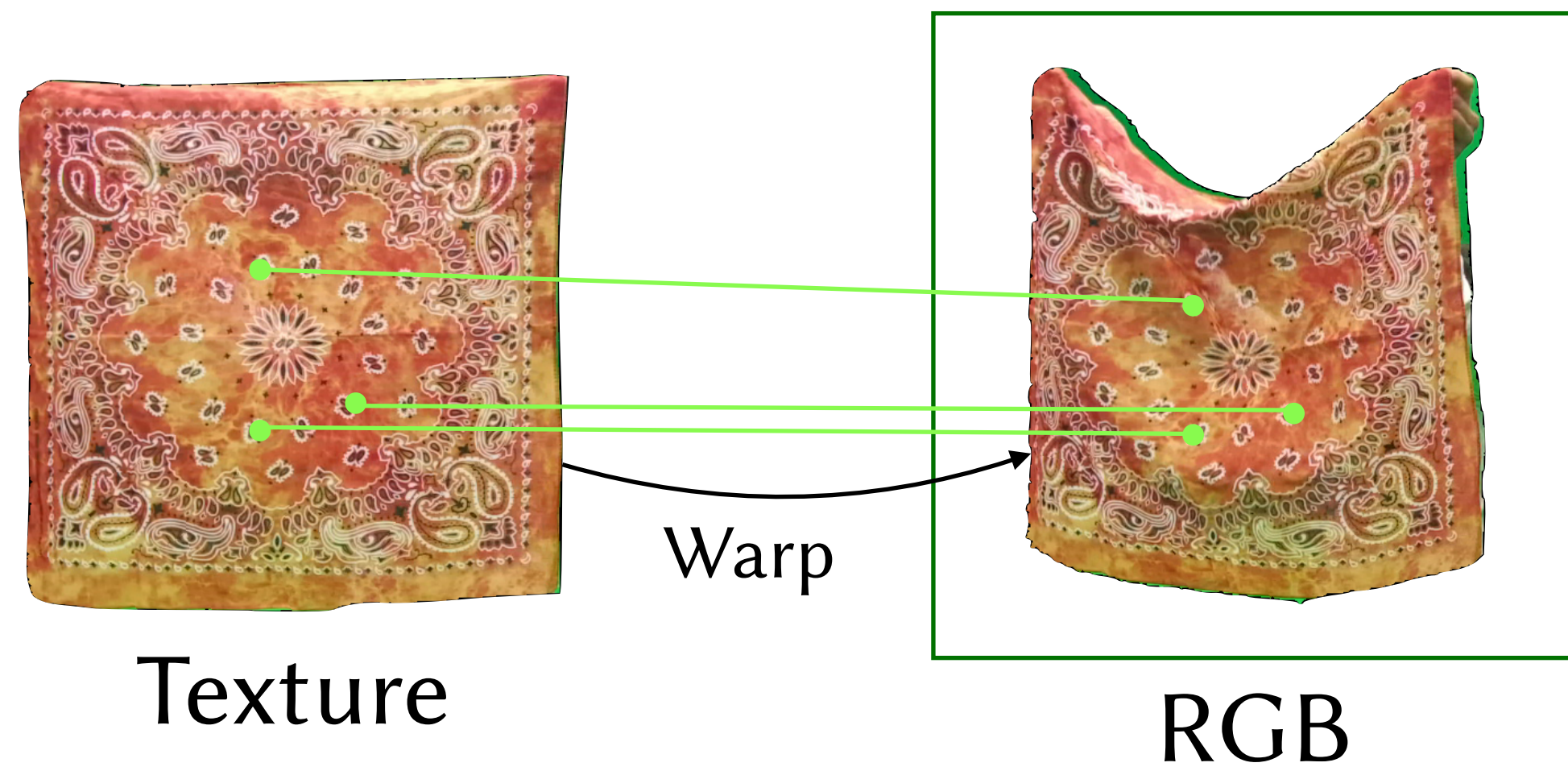


Texture



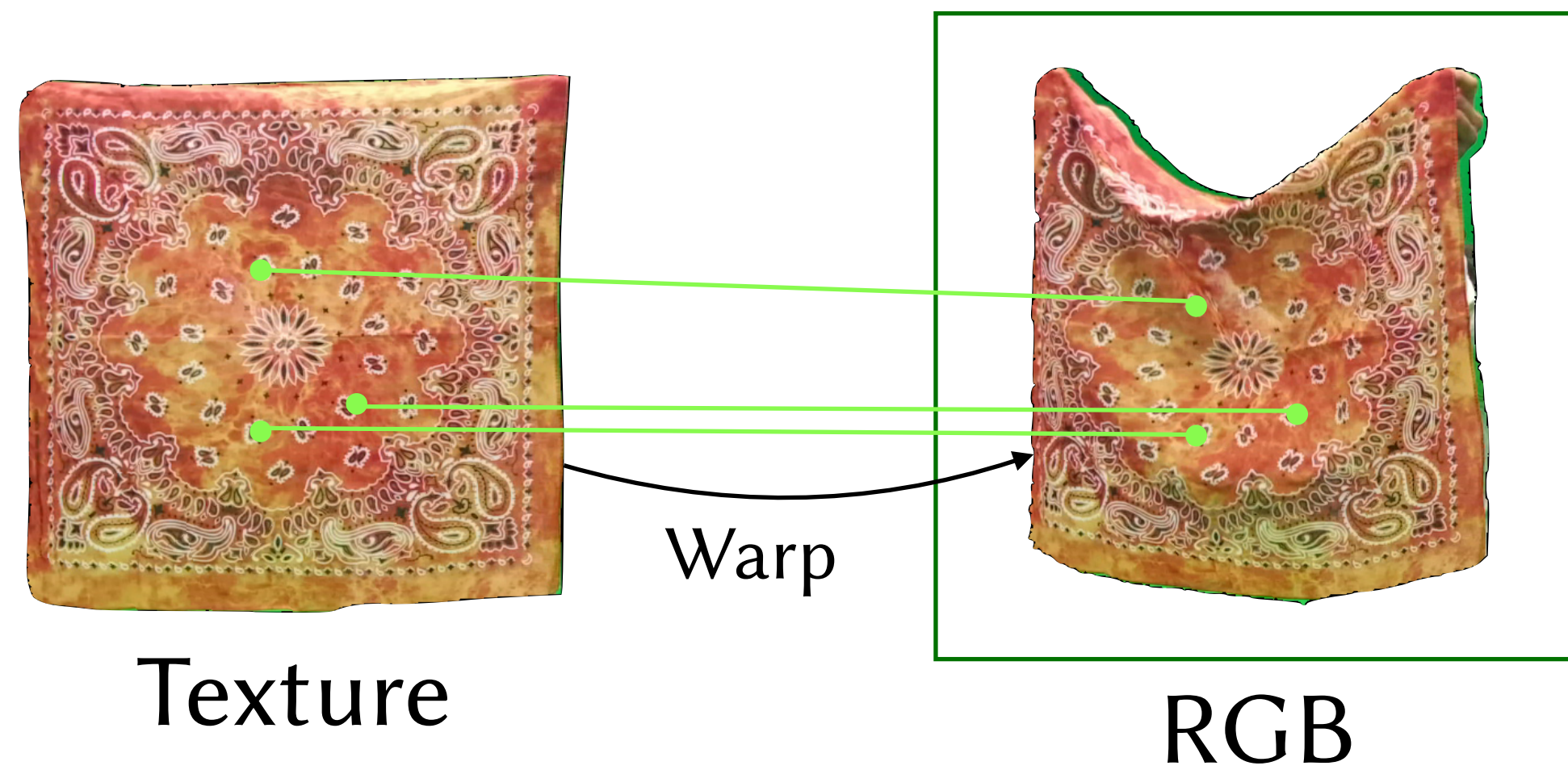
SOTA Approaches

Keypoint-based

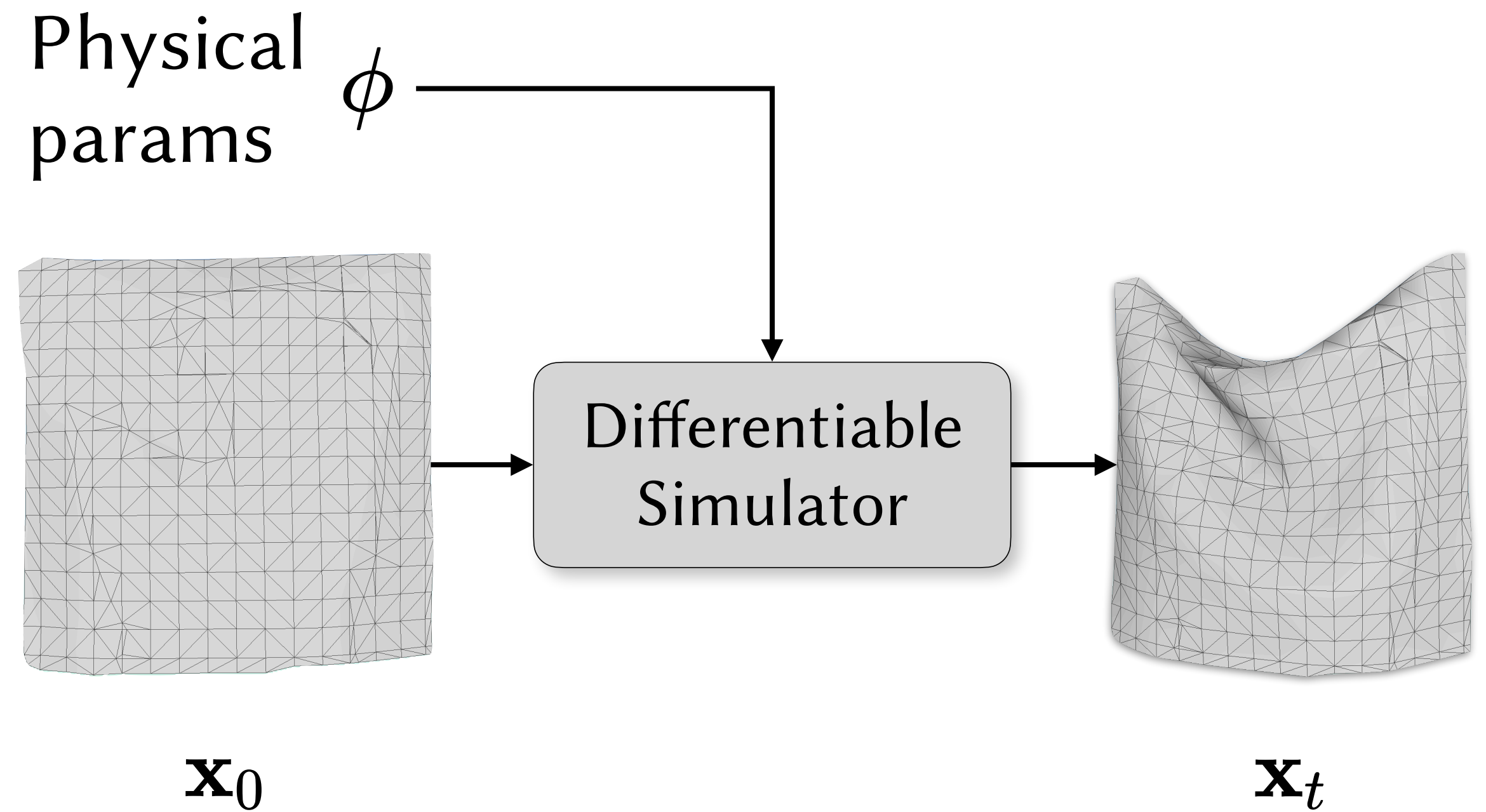


SOTA Approaches

Keypoint-based

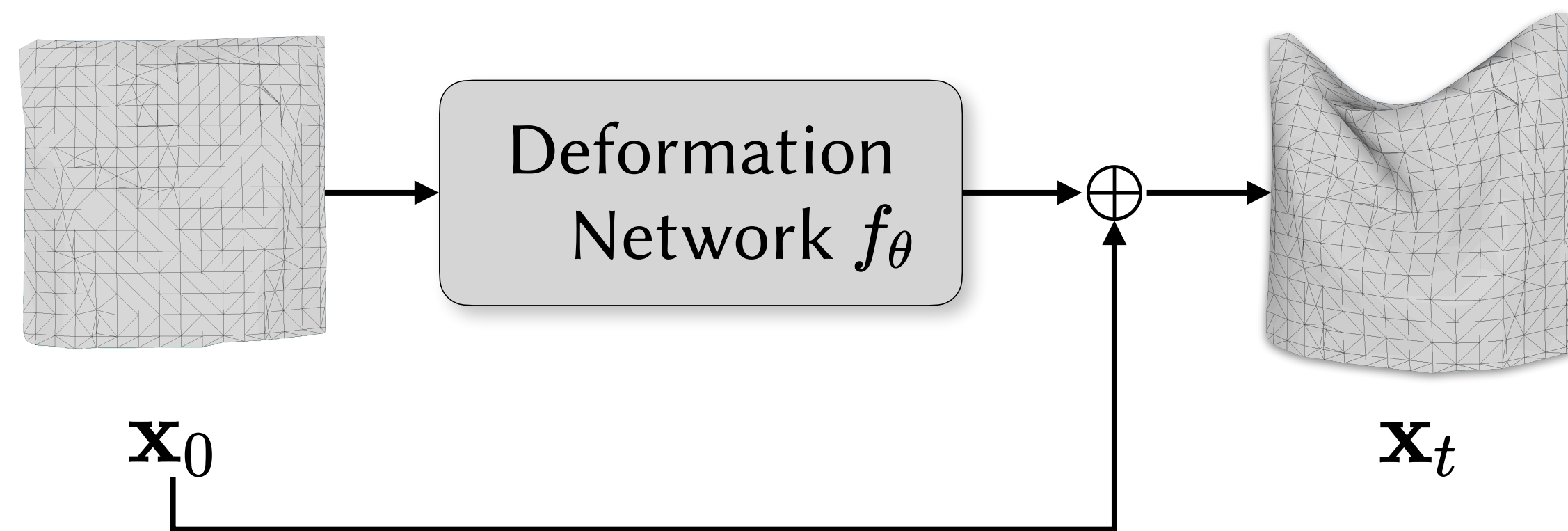


Physics-based



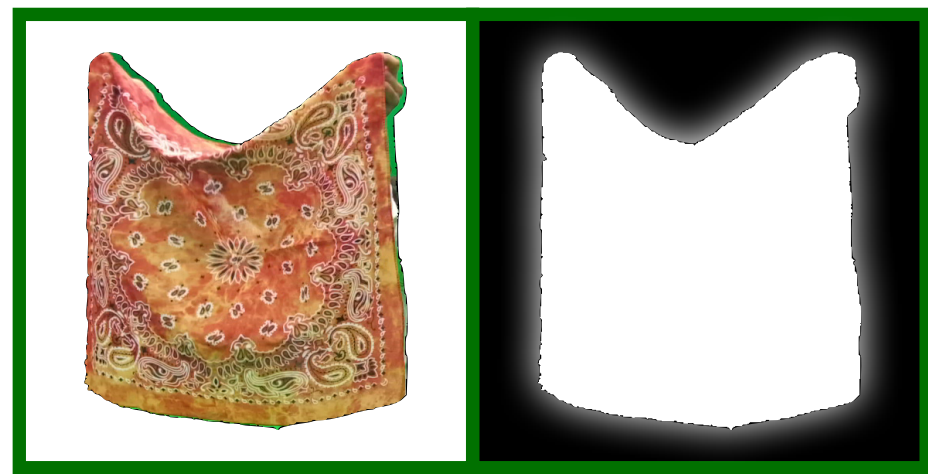
Method

Method: Deformation Network



Method: Per-frame Optimization

Current-frame Input

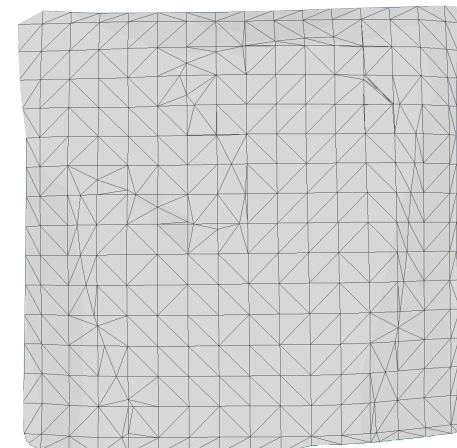


I_t

S_t

$$\mathcal{L}_{\text{rgb}} + \mathcal{L}_{\text{grad}} + \mathcal{L}_{\text{sil}}$$

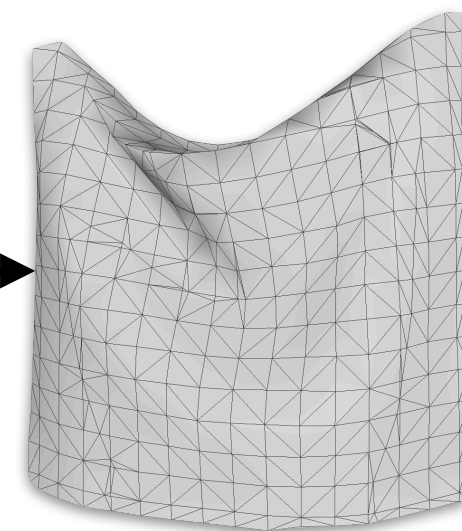
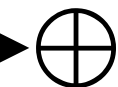
Template



Texture

$\mathbf{x}_0$

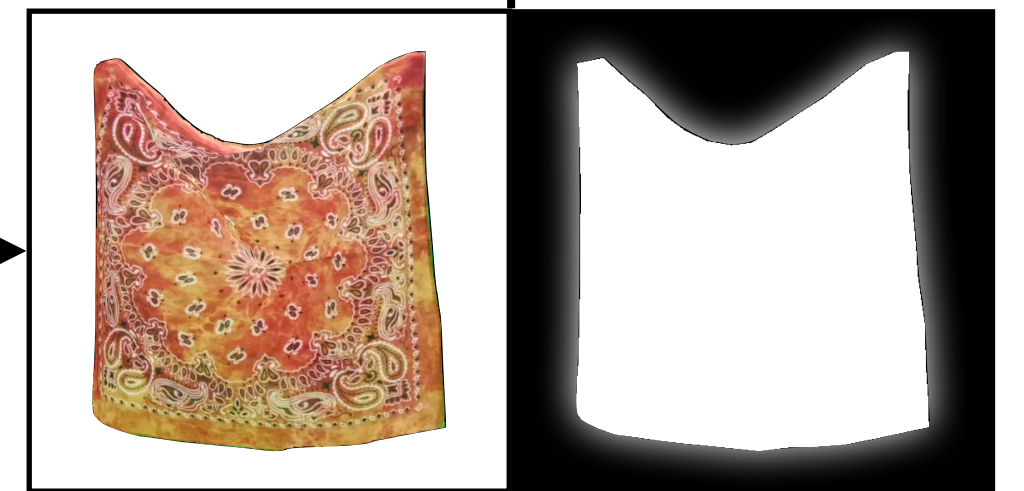
Deformation
Network f_θ



$\mathbf{x}_t$

$\mathcal{L}_{\text{inext}}$

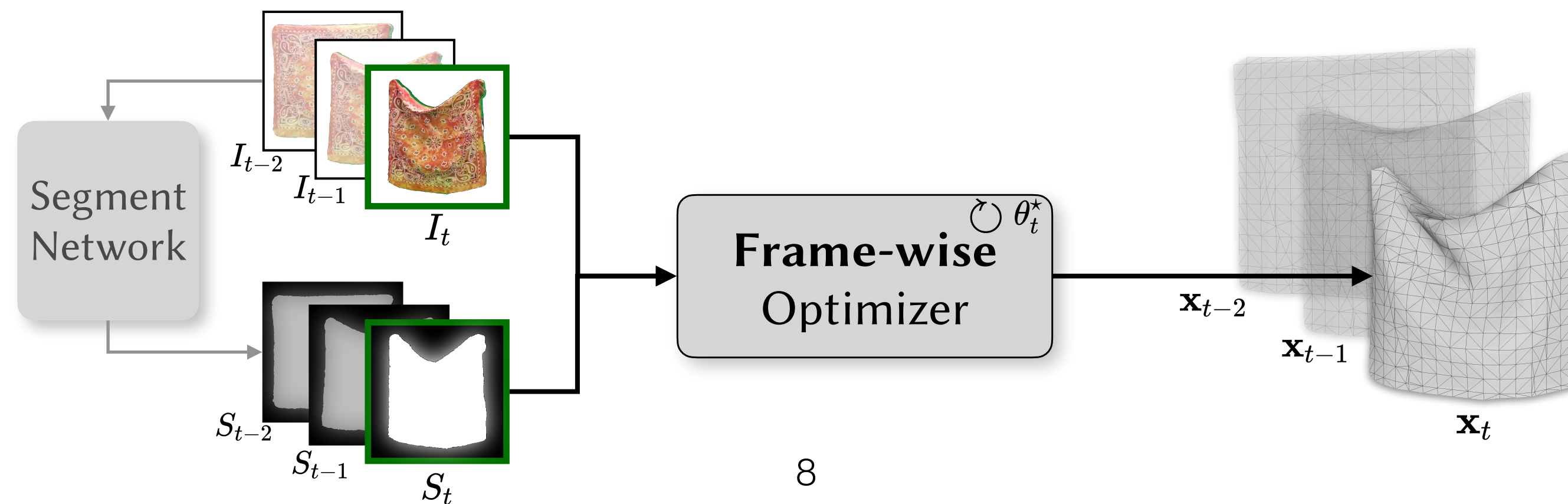
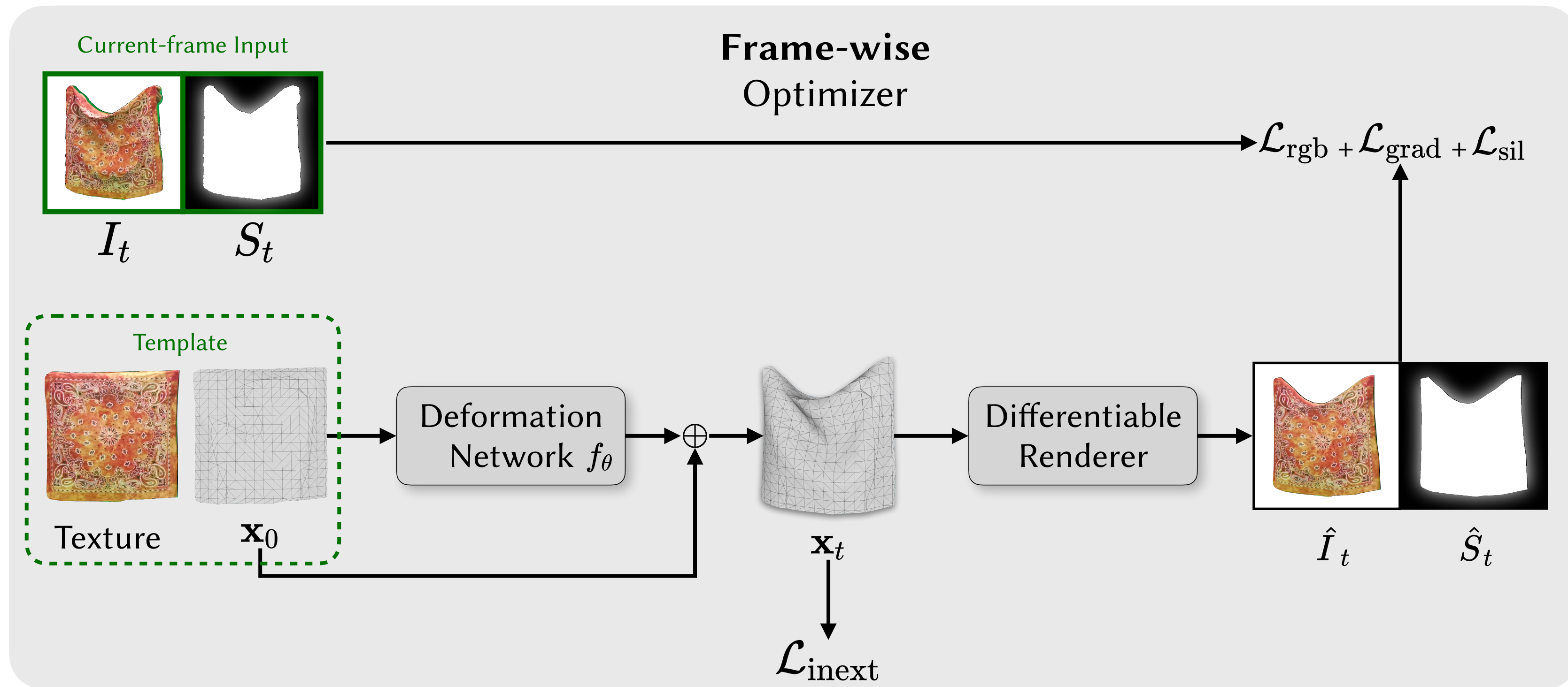
Differentiable
Renderer



$\hat{I}_t$

$\hat{S}_t$

Method: Frame-wise Strategy



SOTA Comparison

Phi-SfT R6

GT



Phi-SfT [1]



Error: 9.95

Runtime: hours

PGSfT [2]



Error: 15.46

Runtime: 2.36 mins

Ours



Error: 3.37

Runtime: 2.91 mins

[1] Kairanda, et al. *f-sft: Shape-from-template with a physics-based deformation model*. CVPR (2022)

[2] Stotko, et al. *Physics-guided Shape-from-Template: Monocular Video Perception through Neural Surrogate Models*. CVPR (2024)

SOTA Comparison

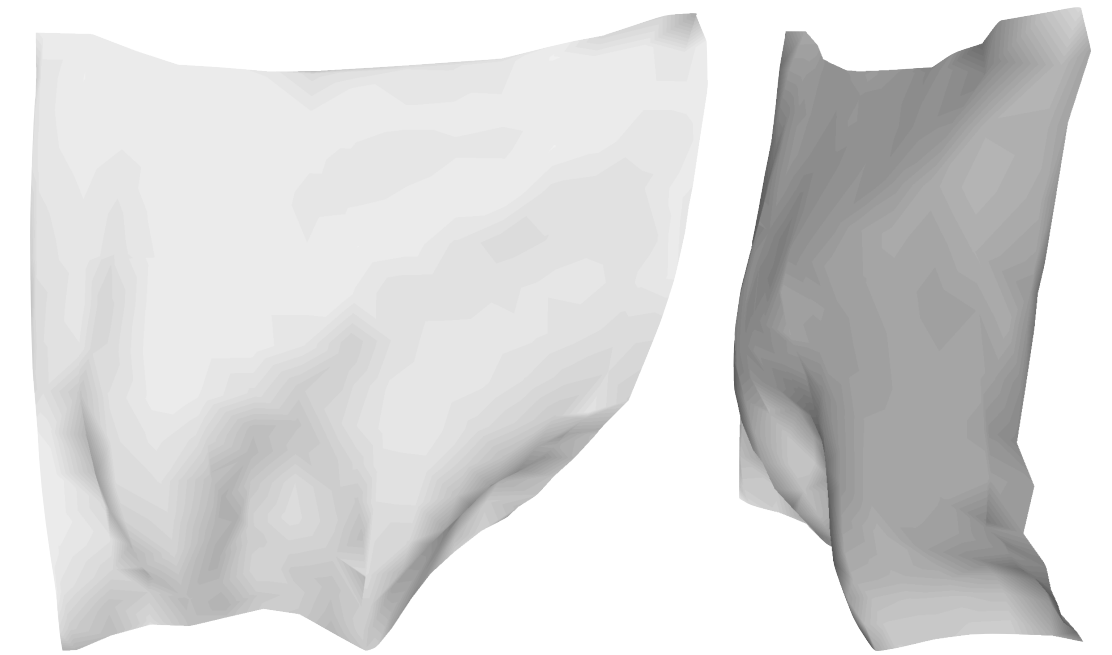
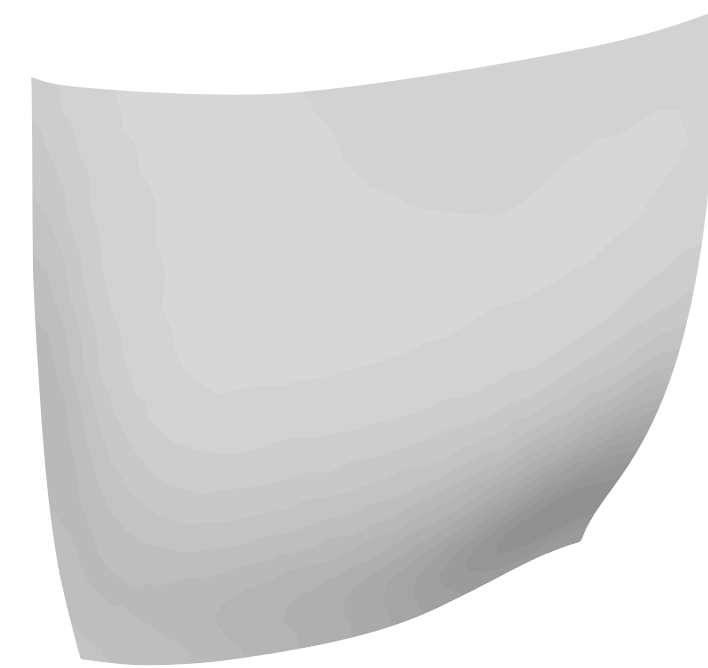
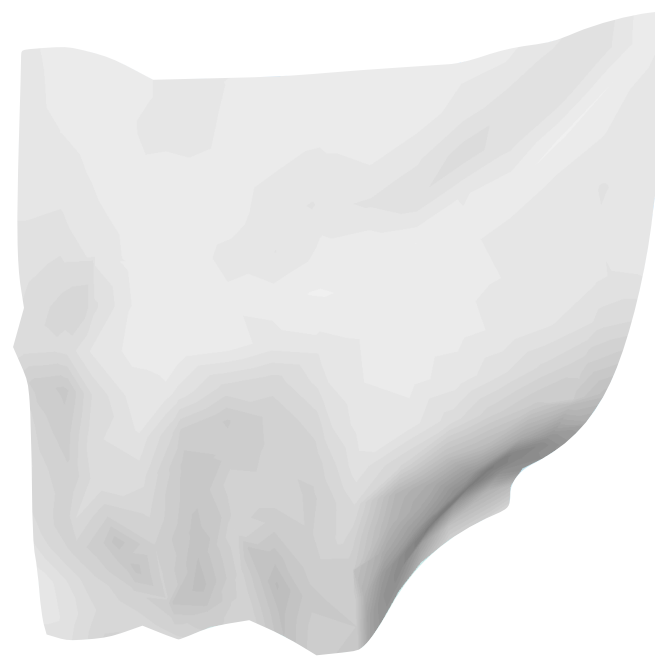
GT

Phi-SfT [1]

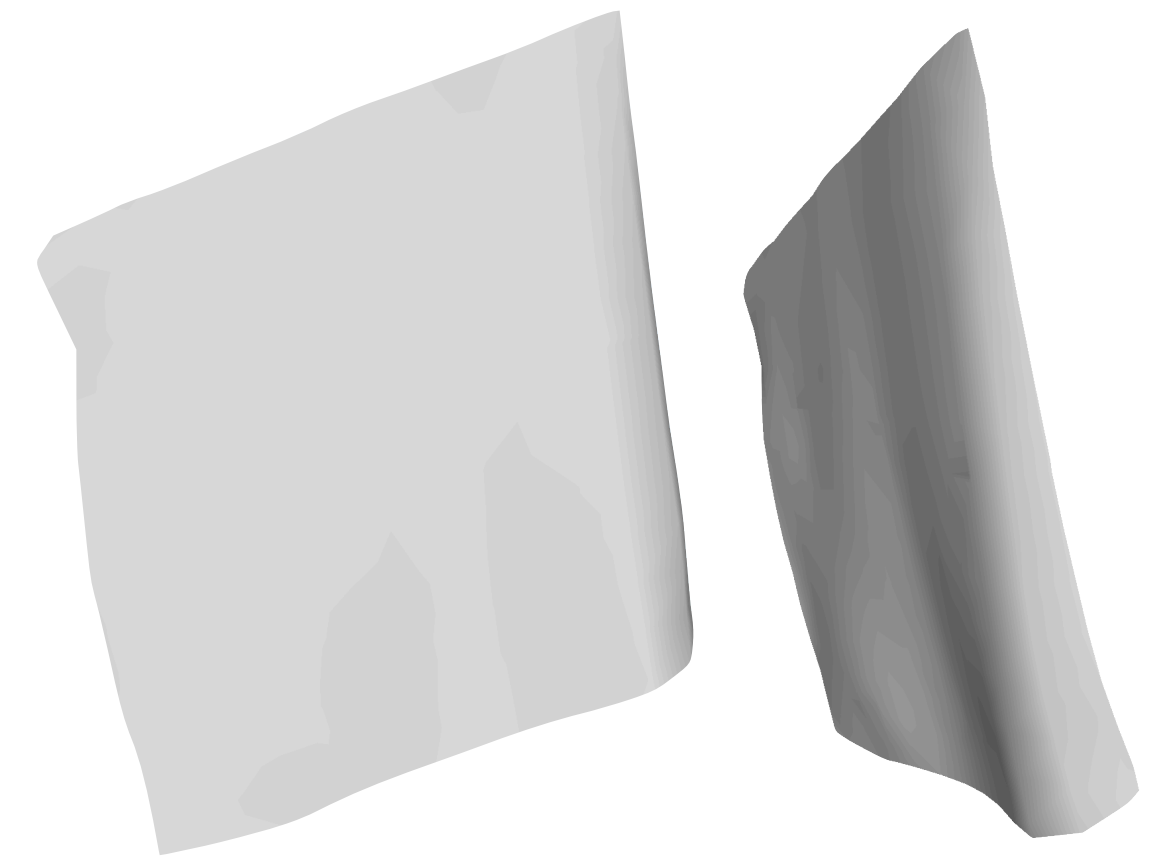
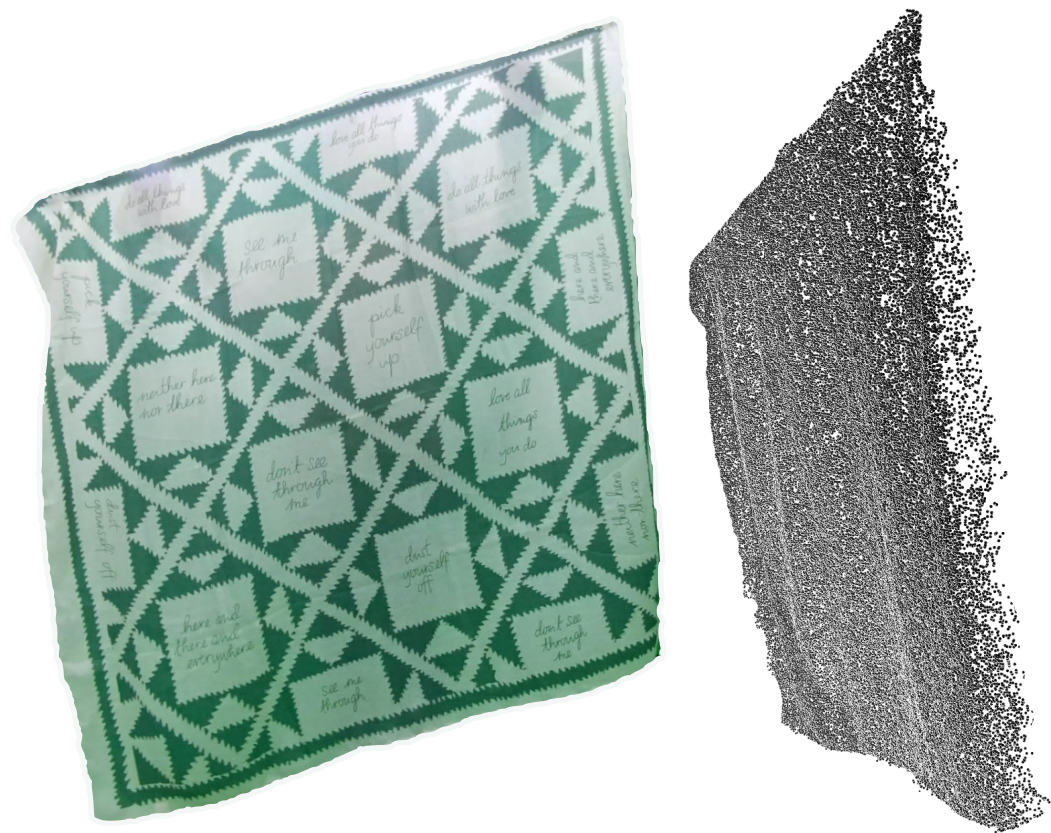
PGSfT [2]

Ours

Seq. R4
Frame 35



Seq. R6
Frame 39



Ablation Study: Loss Functions

Phi-SfT R3

Without

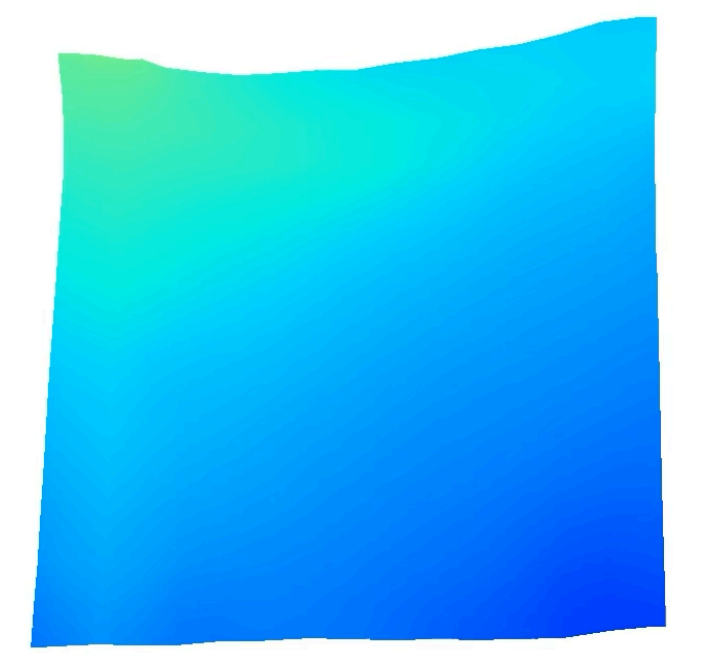
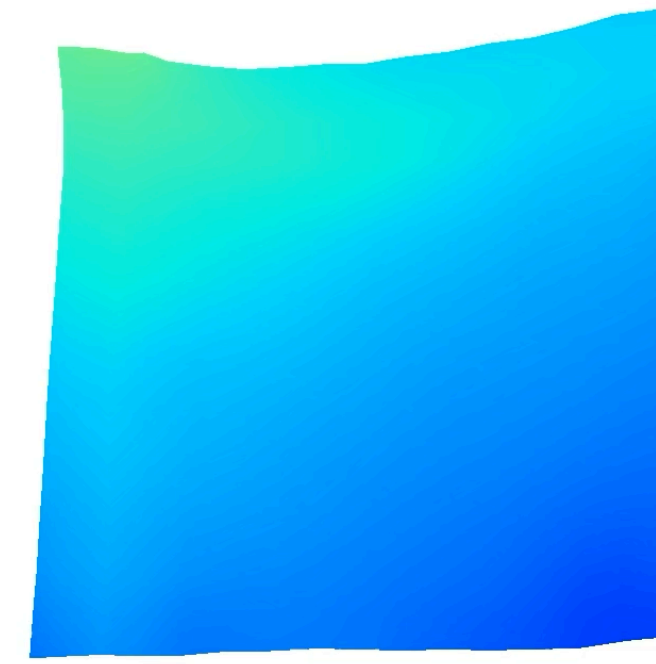
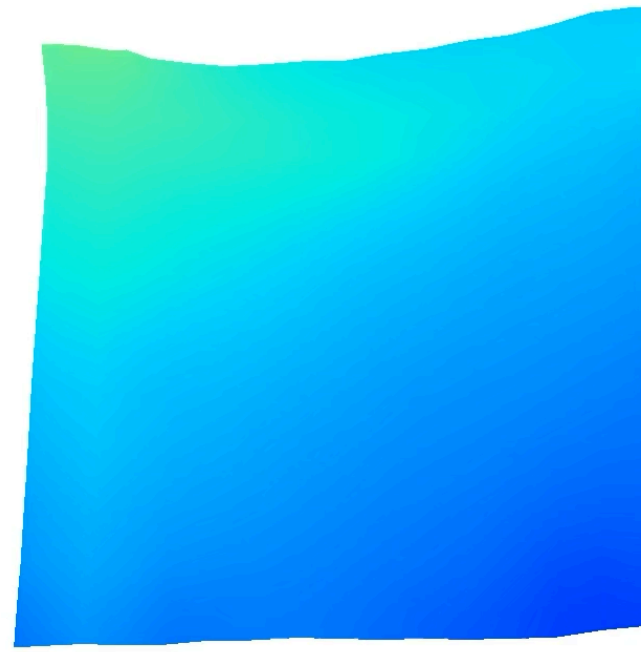
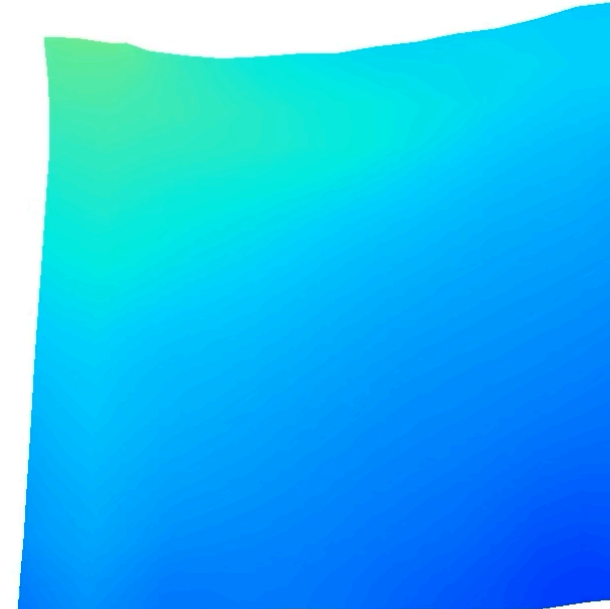
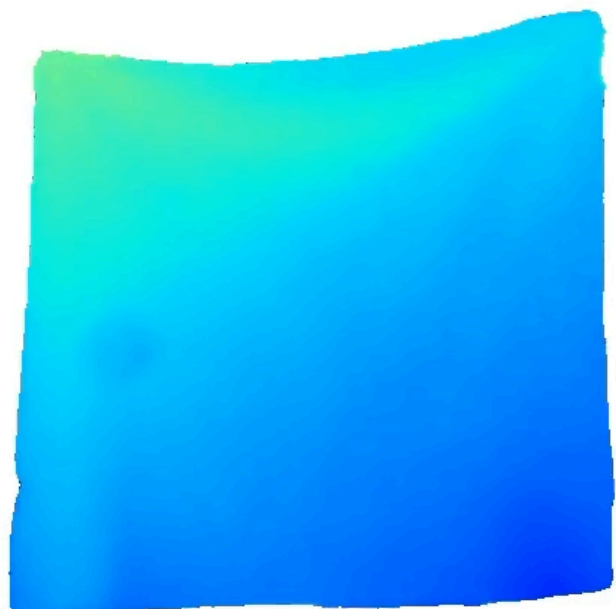
GT

Image gradient

Adaptive data loss

Silhouette

Default



Ablation Study: Loss Functions

Phi-SfT R4

Without

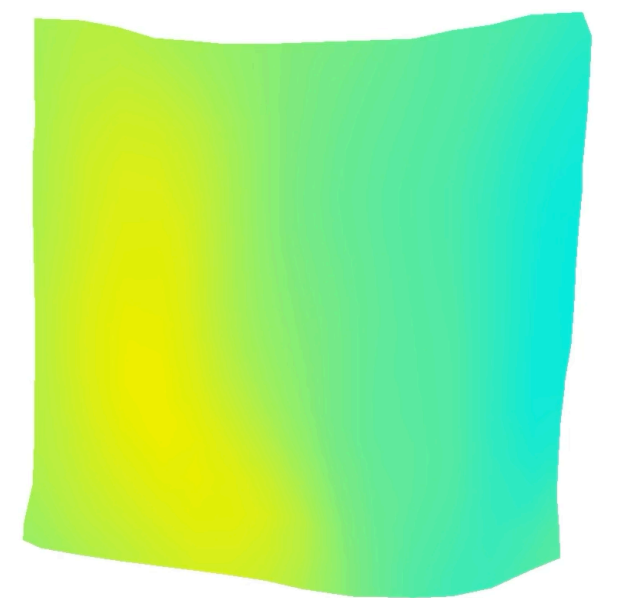
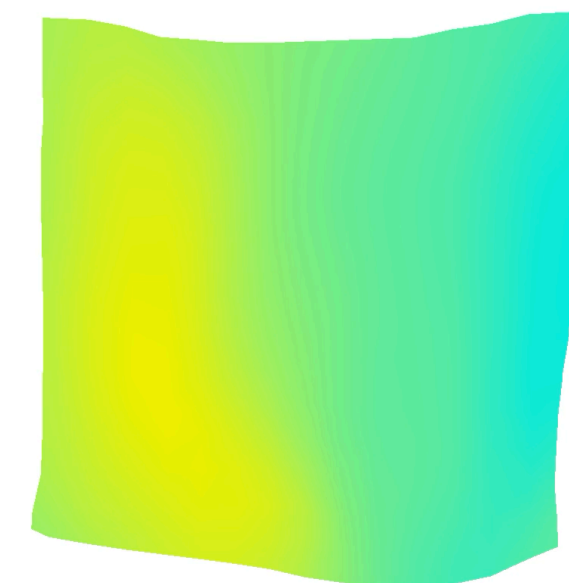
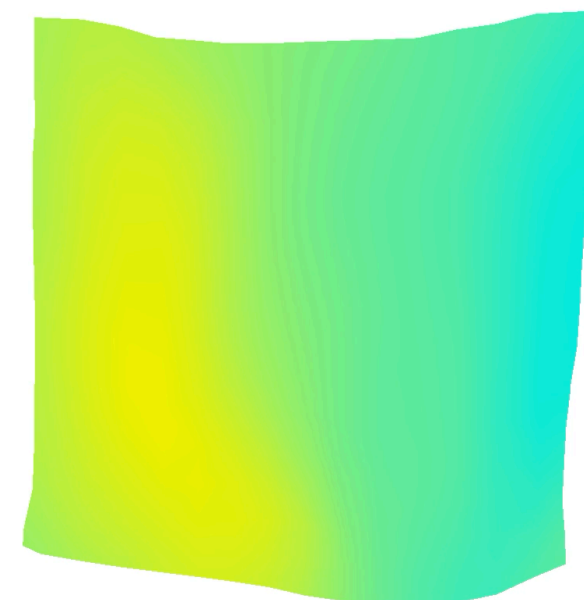
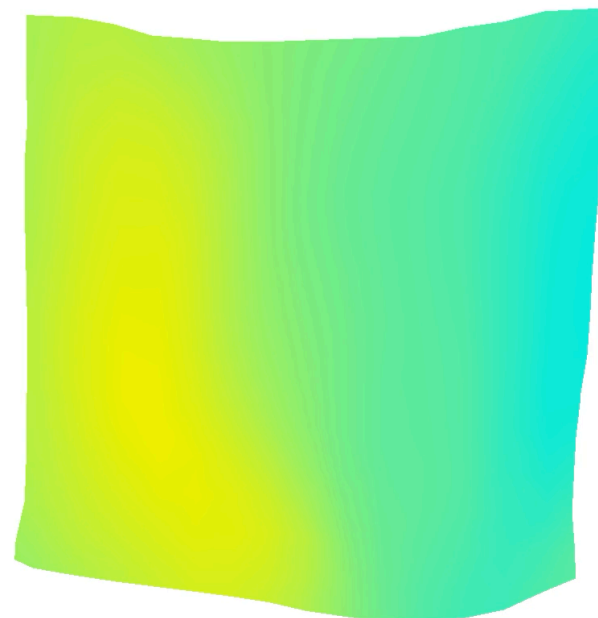
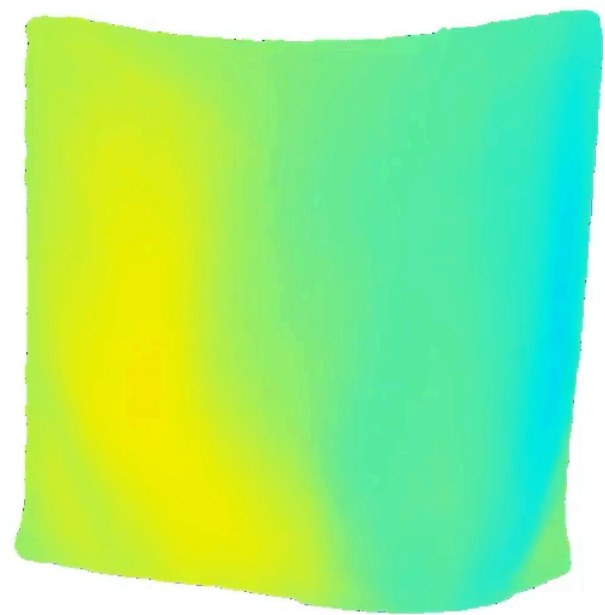
GT

Image gradient

Adaptive data loss

Silhouette

Default



Ablation Study: Deformation Network

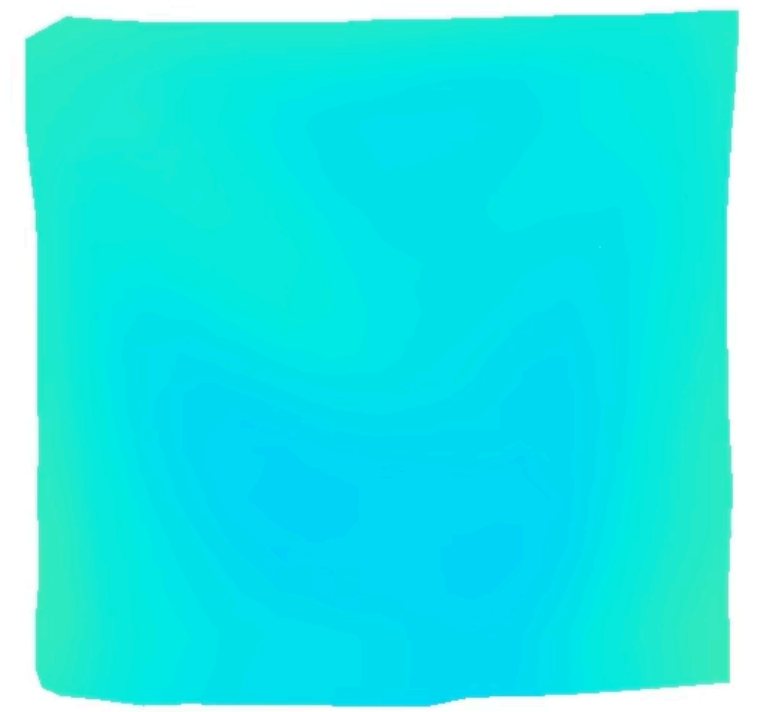
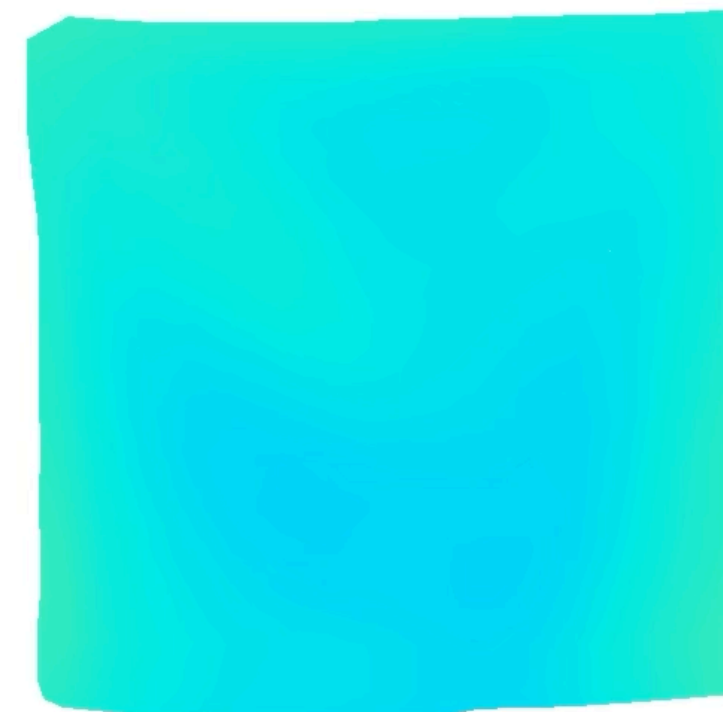
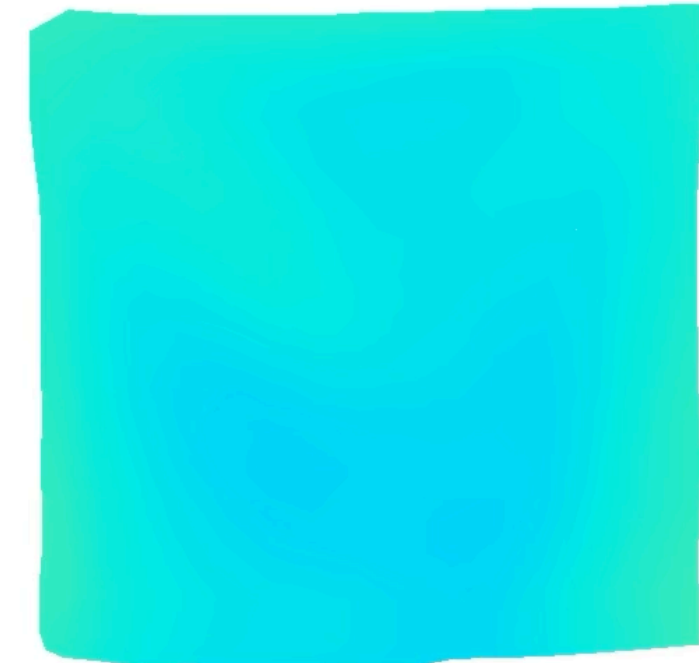
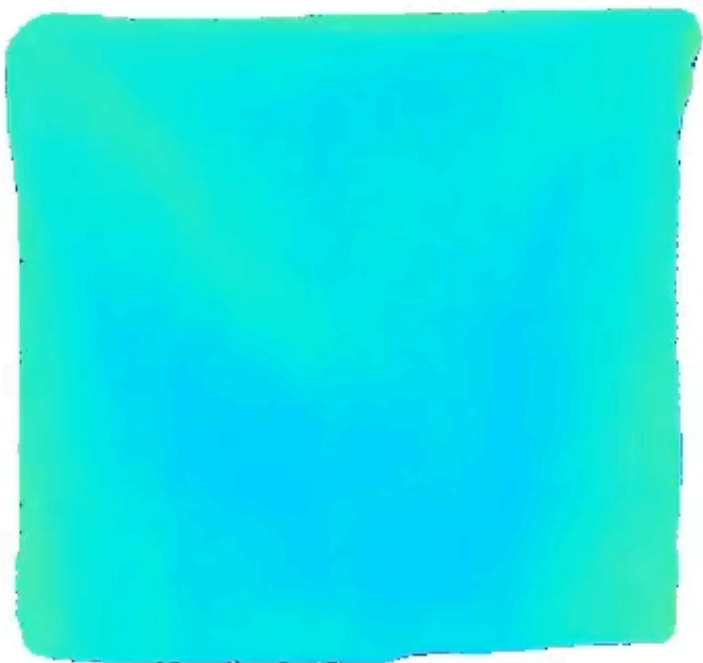
Phi-SfT R2

GT

Vertex Offset

Vertex Offset + Bending

Network



Ablation Study: Deformation Network

Phi-SfT R5

GT



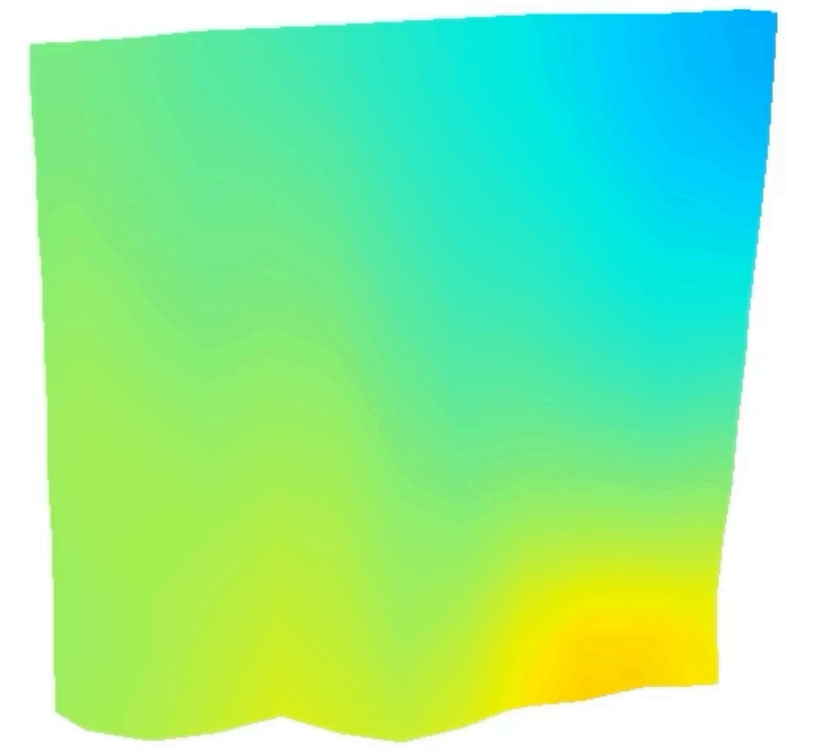
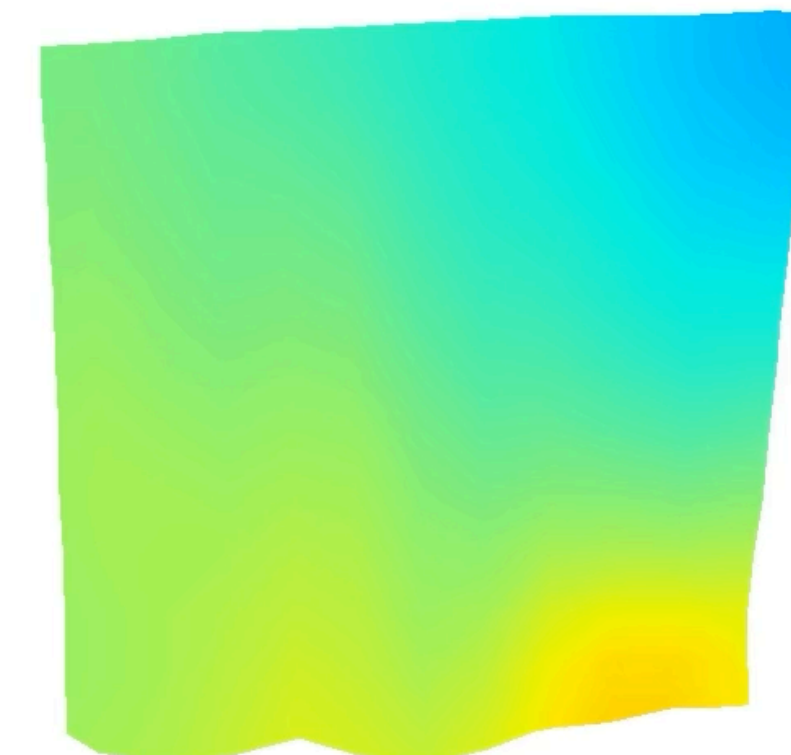
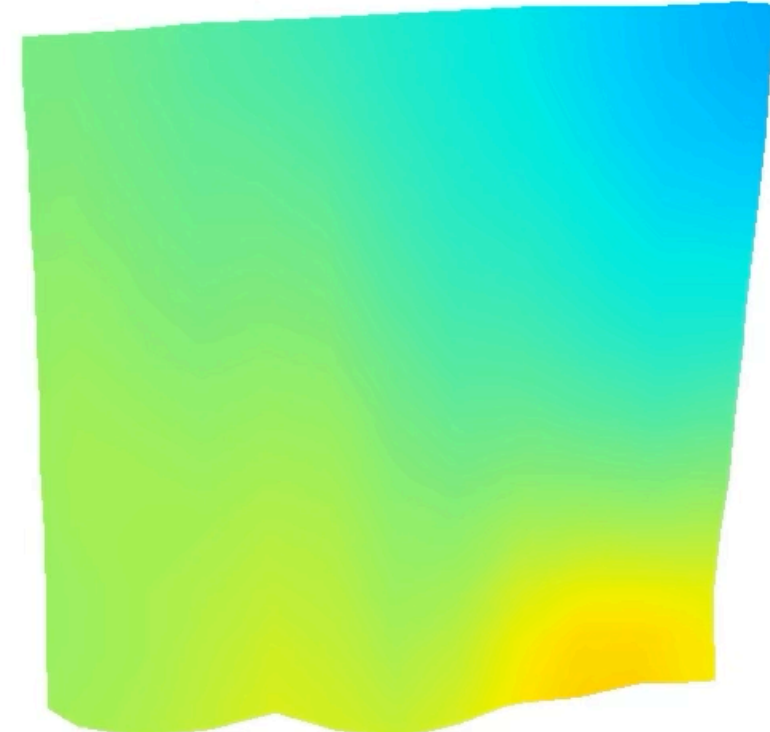
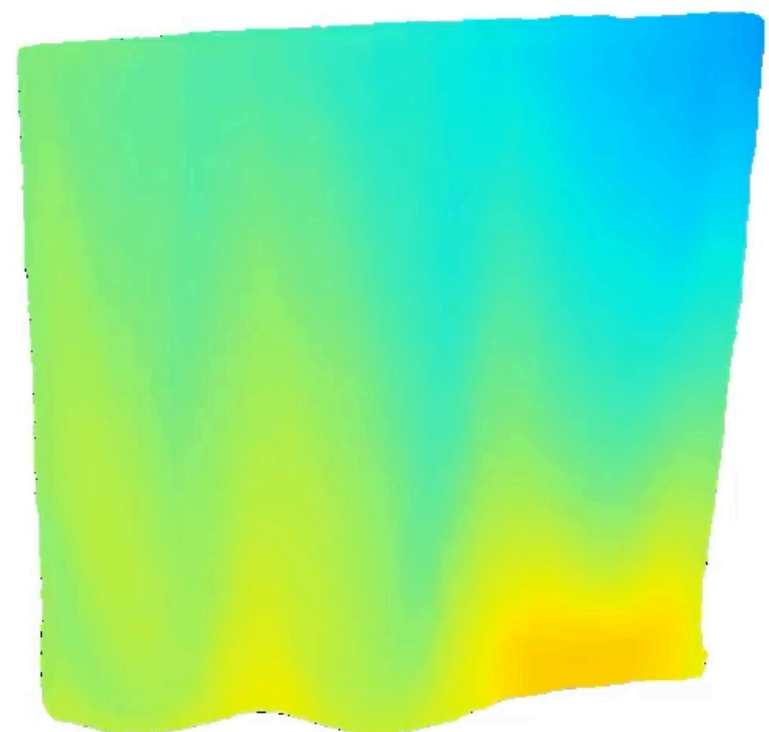
Vertex Offset



Vertex Offset + Bending



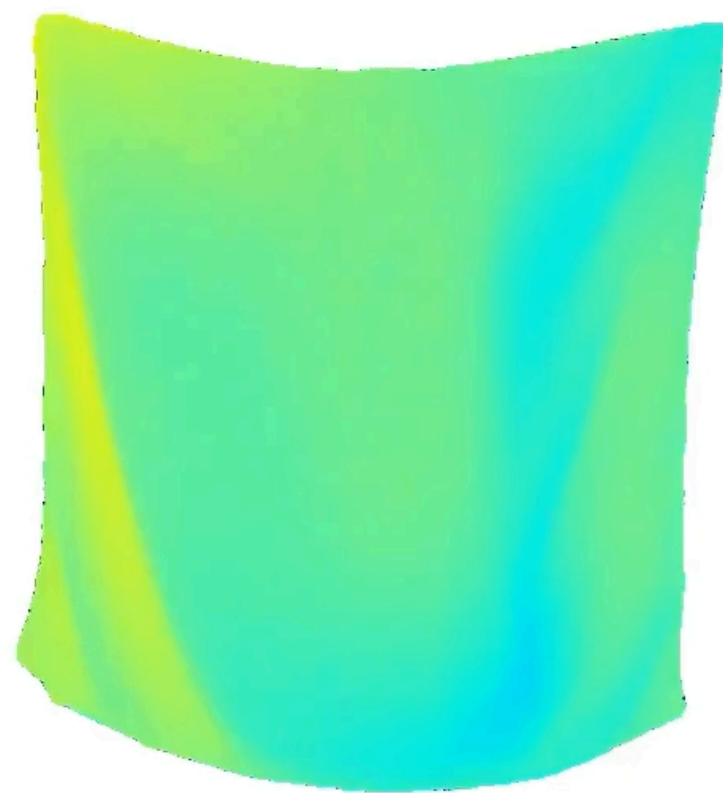
Network



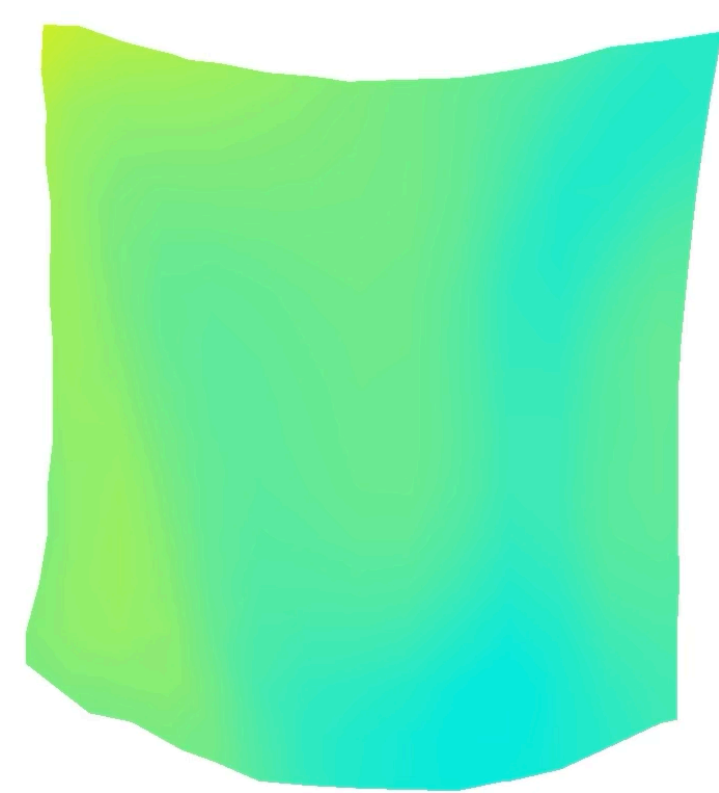
Ablation Study: Network Architecture

Phi-SfT R7

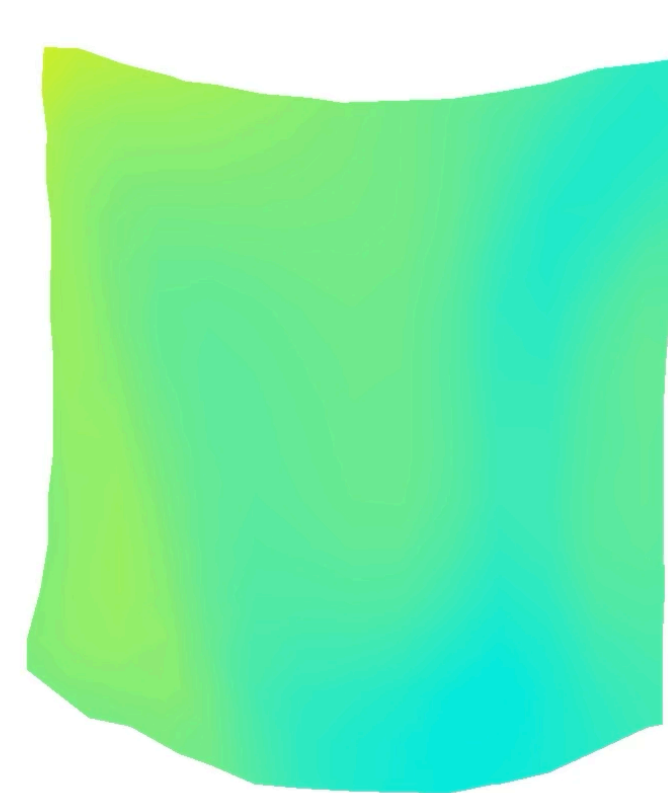
GT



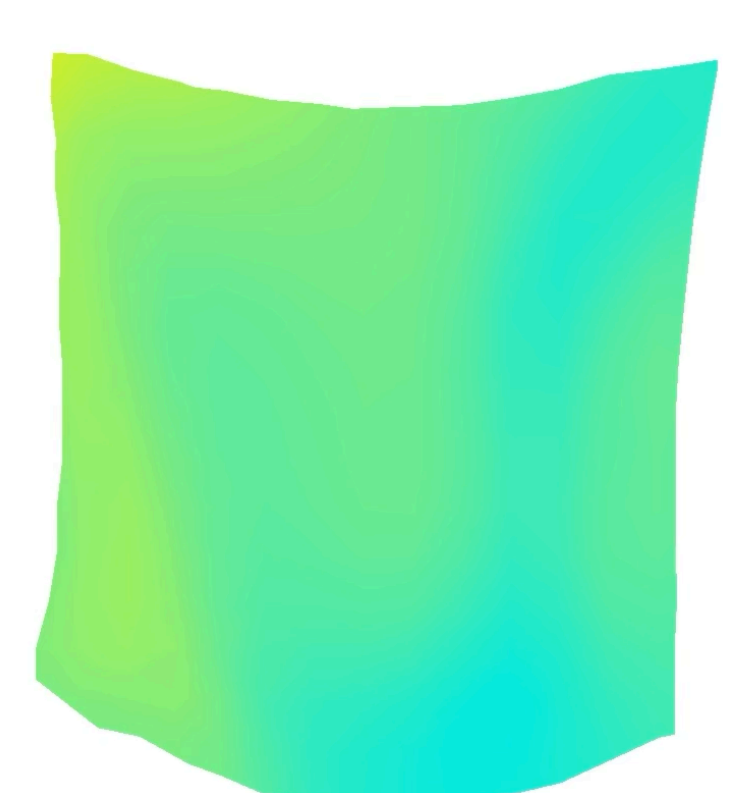
Small MLP



Default MLP



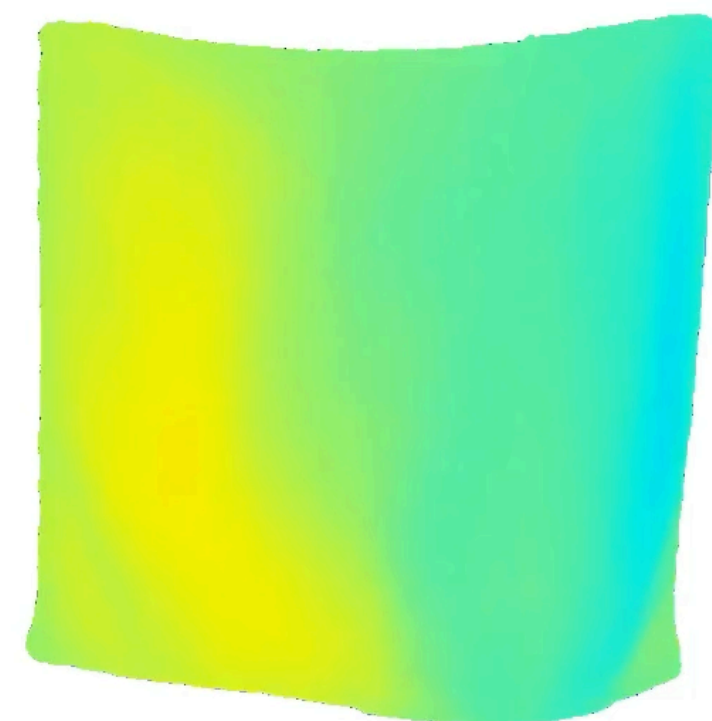
Large MLP



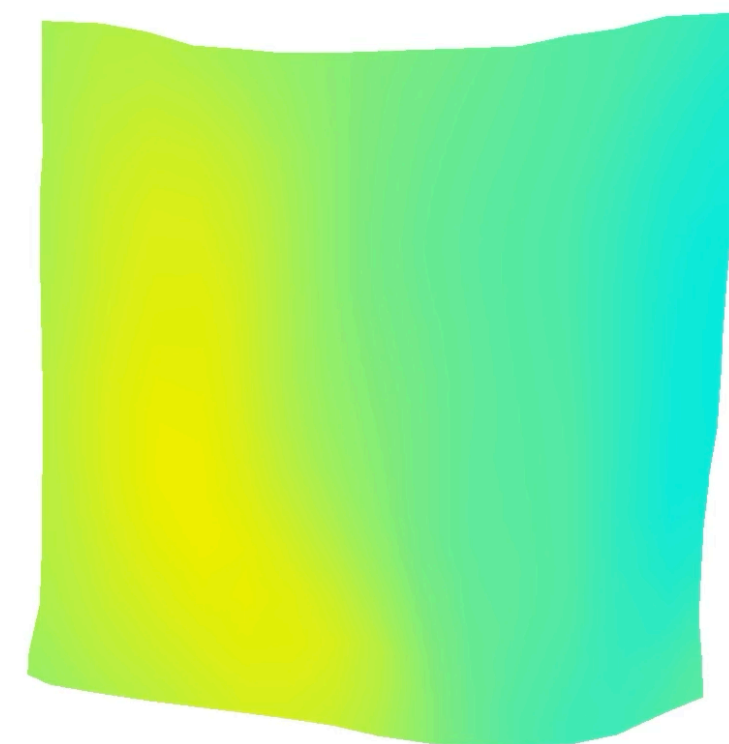
Ablation Study: Network Architecture

Phi-SfT R4

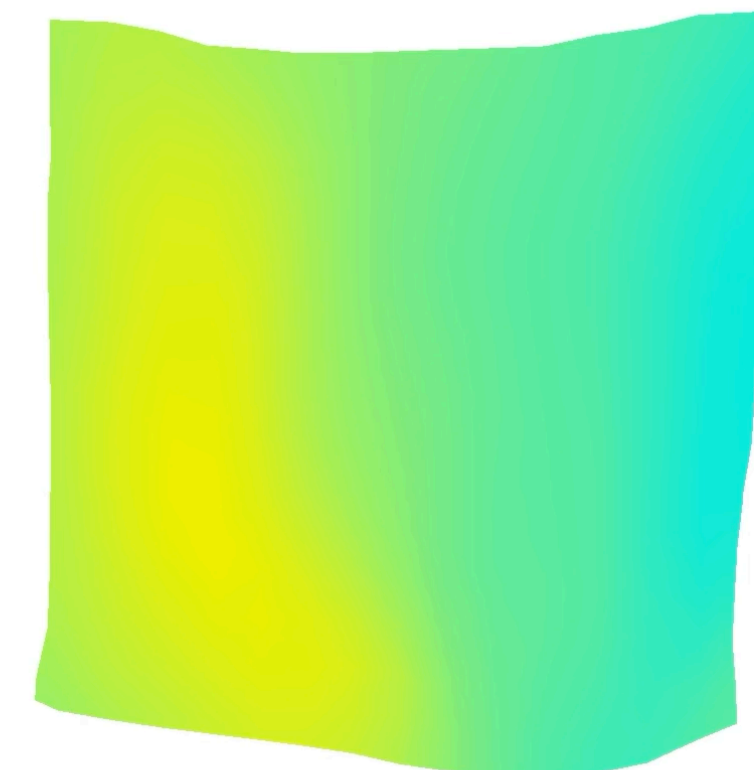
GT



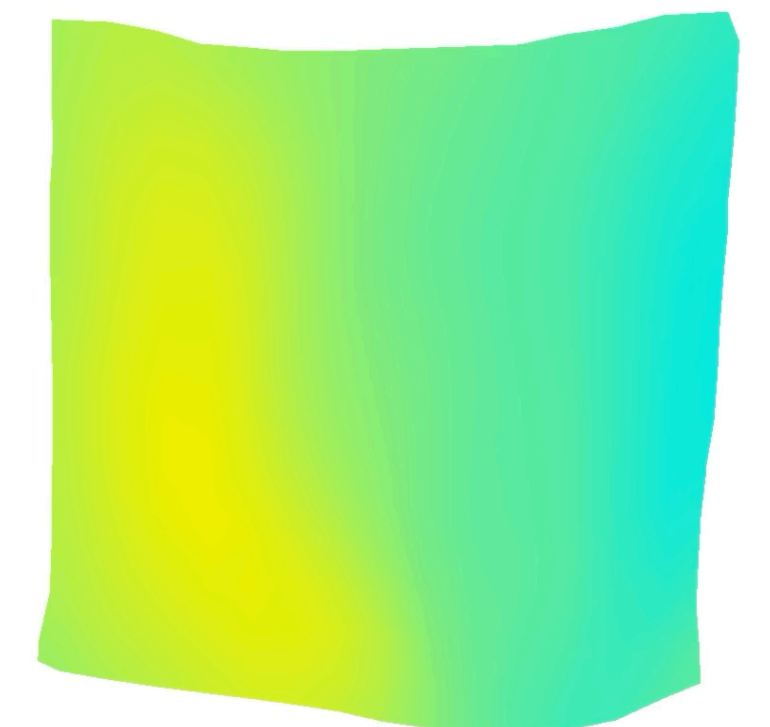
Small MLP



Default MLP



Large MLP



THANK YOU !