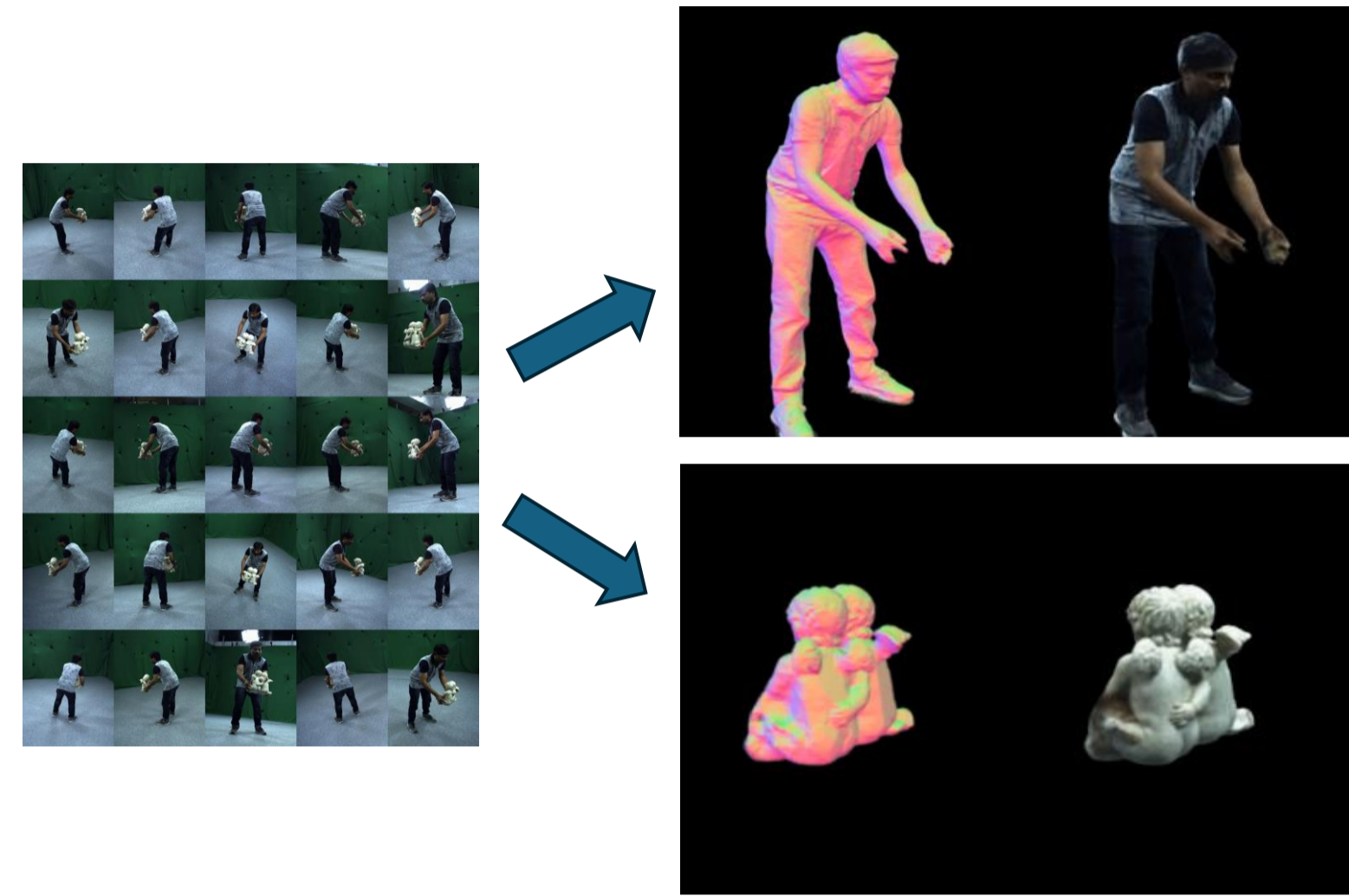# Betsu-Betsu: Multi-View Separable 3D Reconstruction of Two Interacting Objects

Suhas Gopal[1]   Rishabh Dabral[2]   Vladislav Golyanik[2]   Christian Theobalt[2]

[1]Saarland University, SIC   [2]Max Planck Institute for Informatics, SIC

MAX PLANCK INSTITUTE FOR INFORMATICS

SIC Saarland Informatics Campus

4D and Quantum Vision Group $\langle \triangle | \psi \rangle$
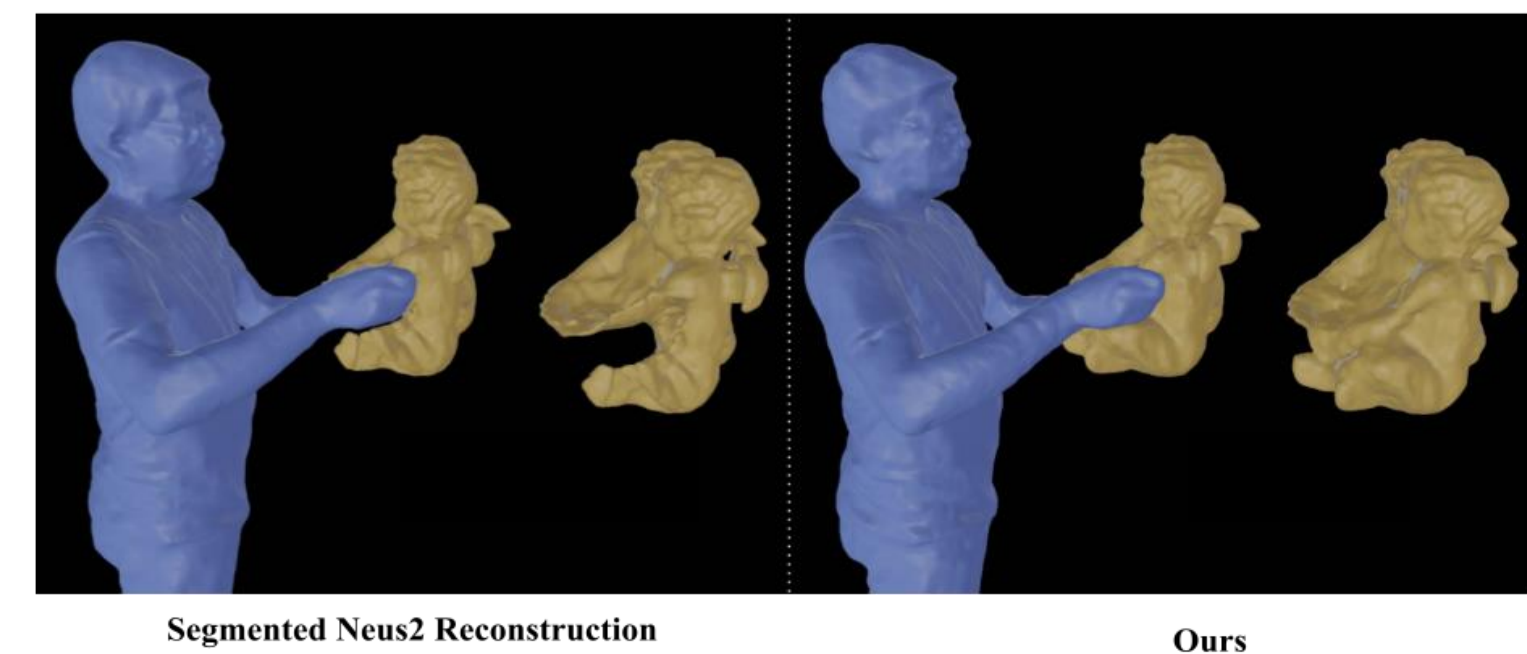
Overview

We present a novel marker-less and category-agnostic approach for high-quality separable 3D reconstruction of two interacting objects from multi-view RGB inputs.
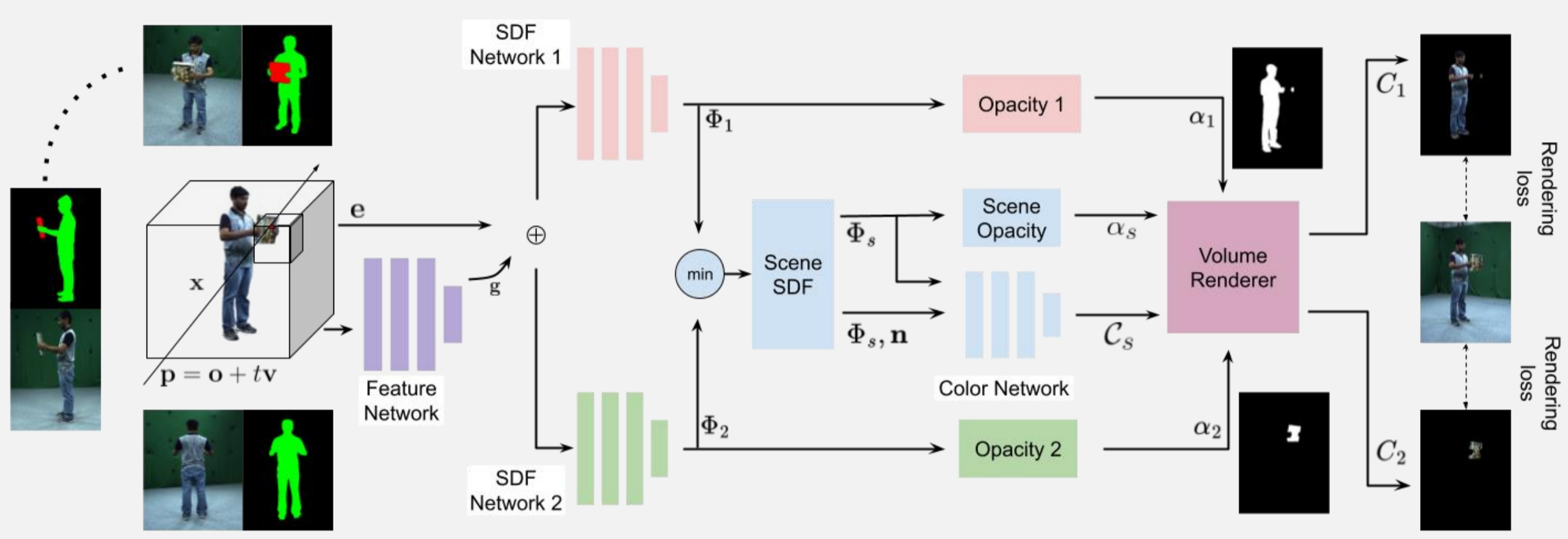
Challenges

Extreme Occlusions (different scales)   Intricate Interactions
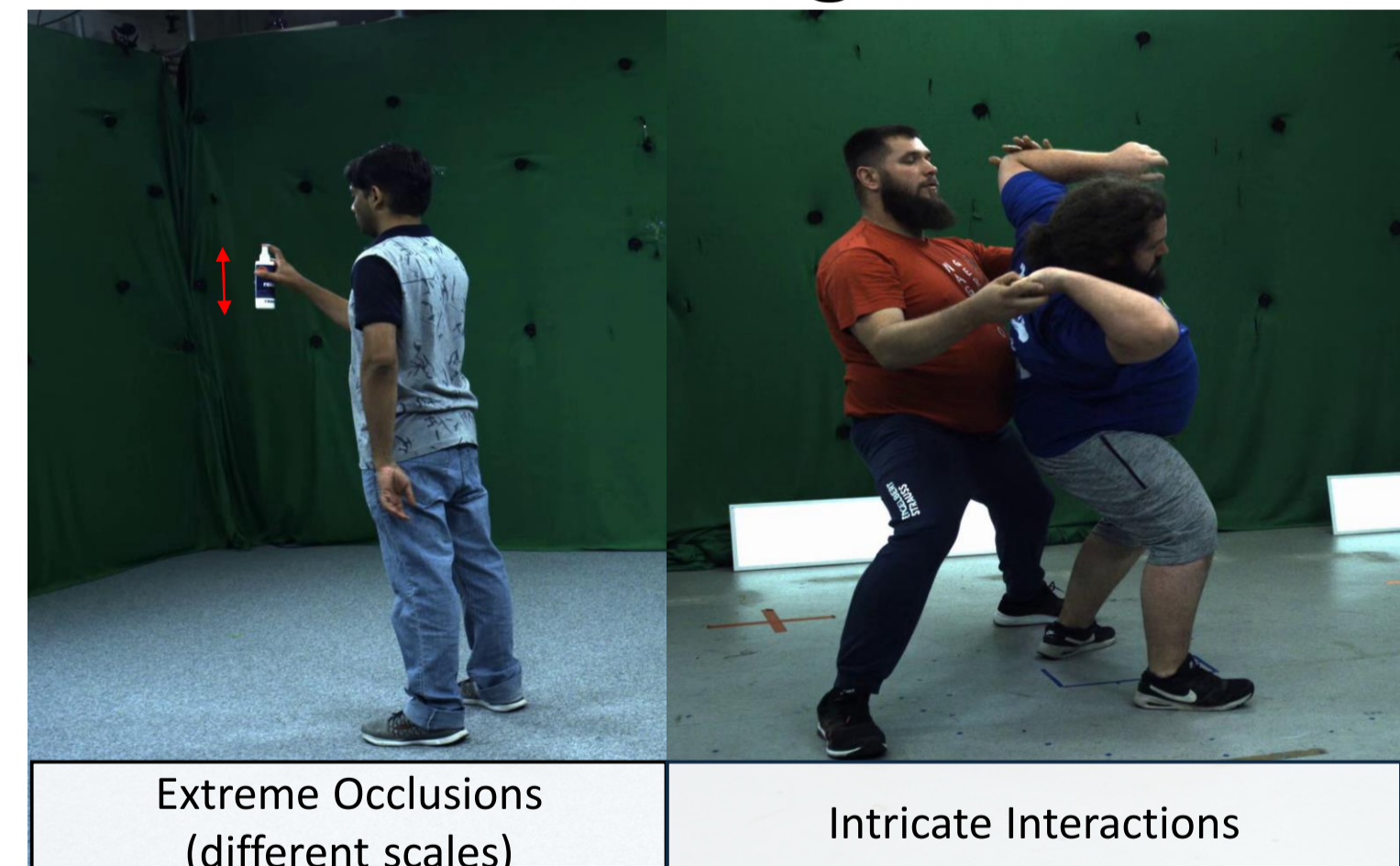
Naïve Reconstruction vs Ours

Segmented Neus2 Reconstruction   Ours

Method

Alpha-Blending Regularisation

We formulate the total colour as the α-blending of the individual objects in the scene, and use in rendering loss.

$$\hat{\mathbf{C}}(\mathbf{r}) = \sum_i^N T_s^{(i)} \alpha_s^{(i)} c_s^{(i)}$$

$$\hat{\mathbf{C}}(\mathbf{r}) = \sum_i^N T_s^{(i)} \left(\alpha_h^{(i)} + \alpha_o^{(i)} - \alpha_h^{(i)} \alpha_o^{(i)} \right) c_s^{(i)}$$

$$\hat{\mathbf{C}}(\mathbf{r}) = \sum_i^N T_s^{(i)} \alpha_h^{(i)} c_s^{(i)} + \sum_i^N T_s^{(i)} \alpha_o^{(i)} c_s^{(i)} - \overset{0}{\sum_i^N T_s^{(i)}(\alpha_h^{(i)} \alpha_o^{(i)}) c_s^{(i)}}$$

$T_s^{(i)}$	Accumulated Transmittance
$\alpha_s^{(i)}$	Scene Opacity
$c_s^{(i)}$	Scene Colour
$\alpha_h^{(i)}$	Human Opacity
$\alpha_o^{(i)}$	Object Opacity

Training Losses

$$\mathcal{L}_{\text{alpha}} = \sum_p \left(\exp(\frac{\beta}{\lambda_t}.\alpha_1(\mathbf{p}).\alpha_2(\mathbf{p})) - 1 \right)$$
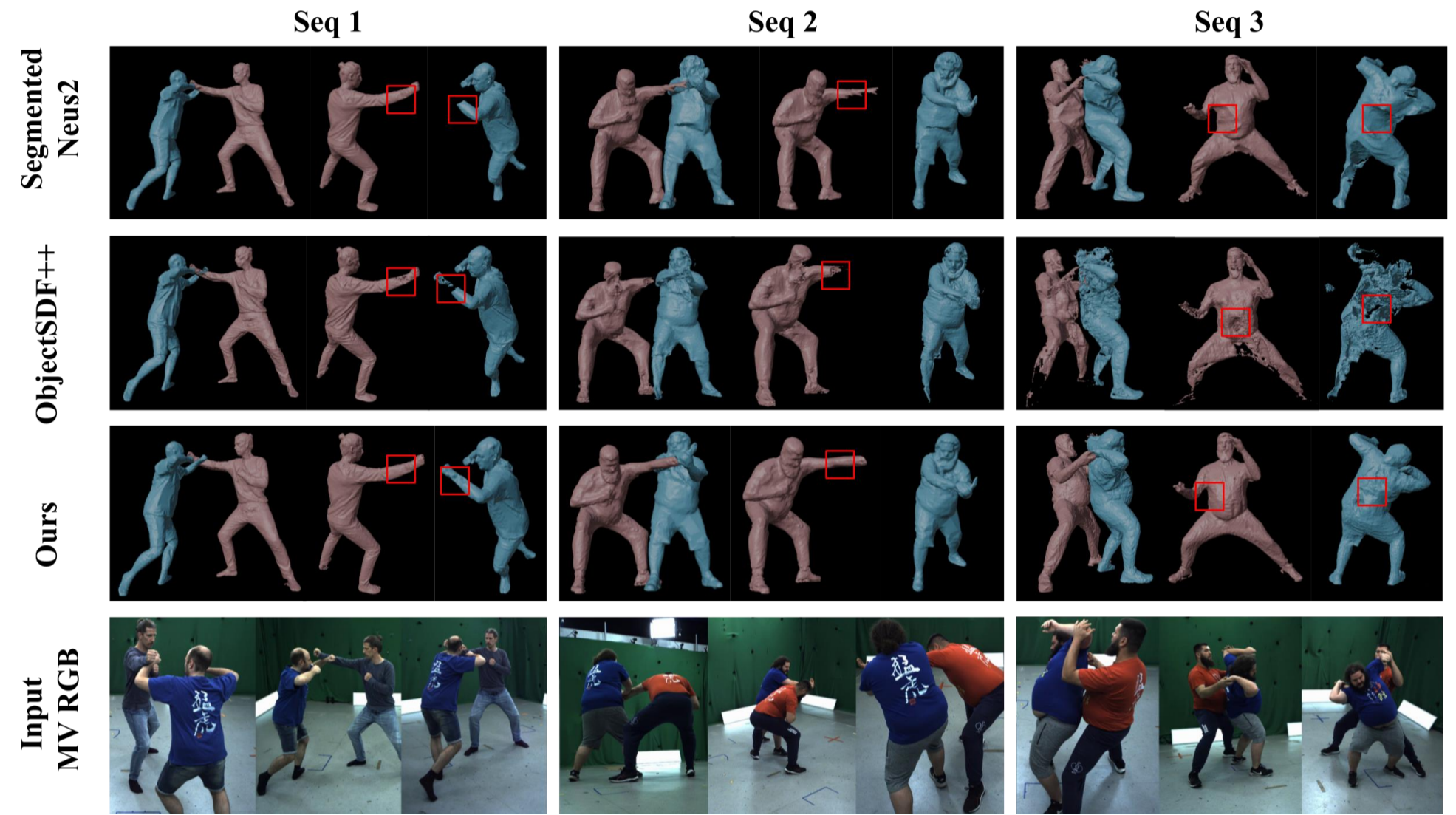
$$\mathcal{L}_{\text{recon}} = \mathcal{L}_{\text{color}} + \lambda_\alpha \mathcal{L}_{\text{alpha}} + \lambda_{\text{eik}} \mathcal{L}_{\text{eik}}$$
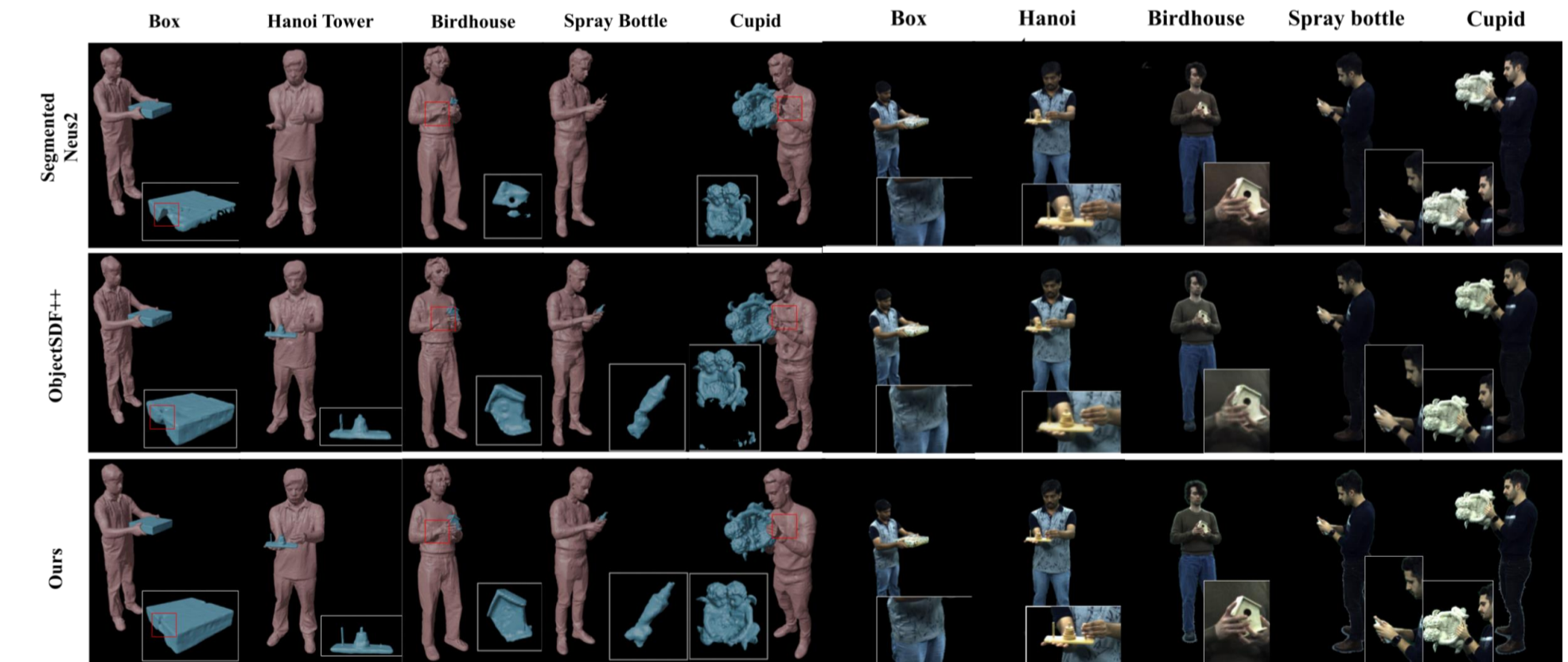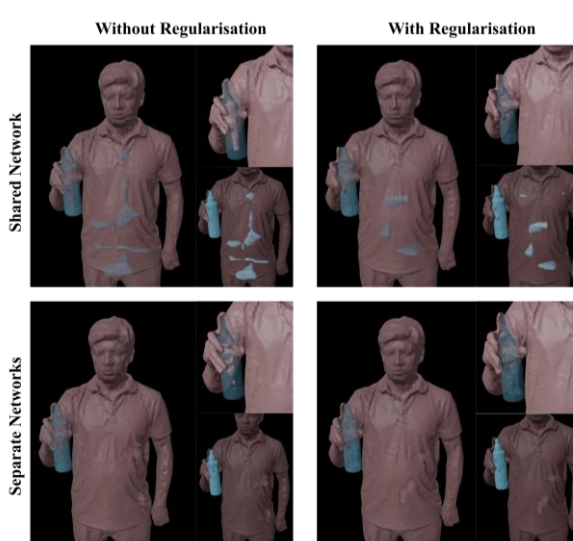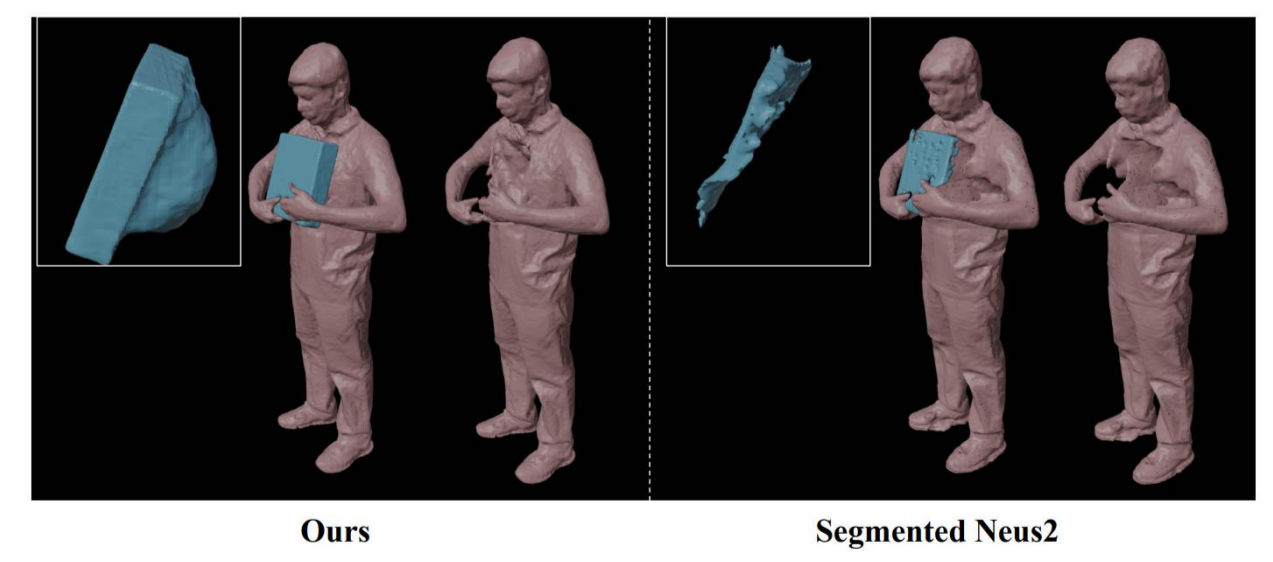
Dataset Objects

Spray Bottle   Hanoi Tower   Birdhouse   Book   Cupid   Box

Experiments

Human-Human Interactions

Seq 1   Seq 2   Seq 3

Segmented Neus2   ObjectSDF++   Ours   Input MV RGB

Human-Object Interactions

Box   Hanoi Tower   Birdhouse   Spray Bottle   Cupid   Box   Hanoi   Birdhouse   Spray bottle   Cupid

Segmented Neus2   ObjectSDF++   Ours

Ablations

Without Regularisation   With Regularisation

Shared Network   Separate Networks

Limitations

Ours   Segmented Neus2

VIA RESEARCH CENTER