

# Leveraging Near-Field Lighting for Monocular Depth Estimation from Endoscopy Videos

Akshay Paruchuri, Samuel Ehrenstein, Shuxian Wang, Inbar Fried, Stephen M. Pizer, Marc Niethammer, Roni Sengupta

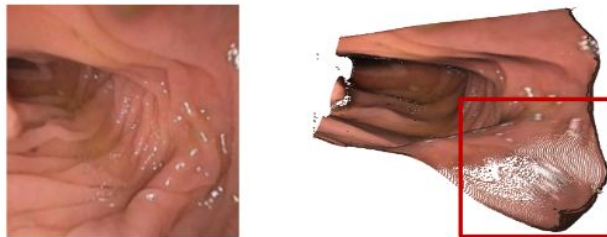


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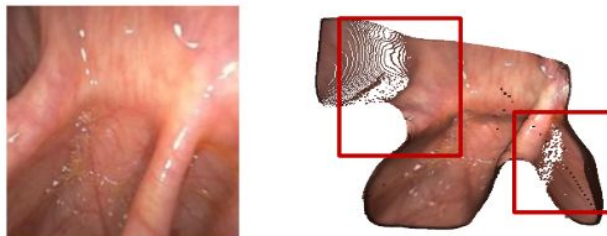
# Motivation

- Existing depth estimation techniques can perform poorly on endoscopy images due to a lack of strong geometric features and challenging illumination effects.

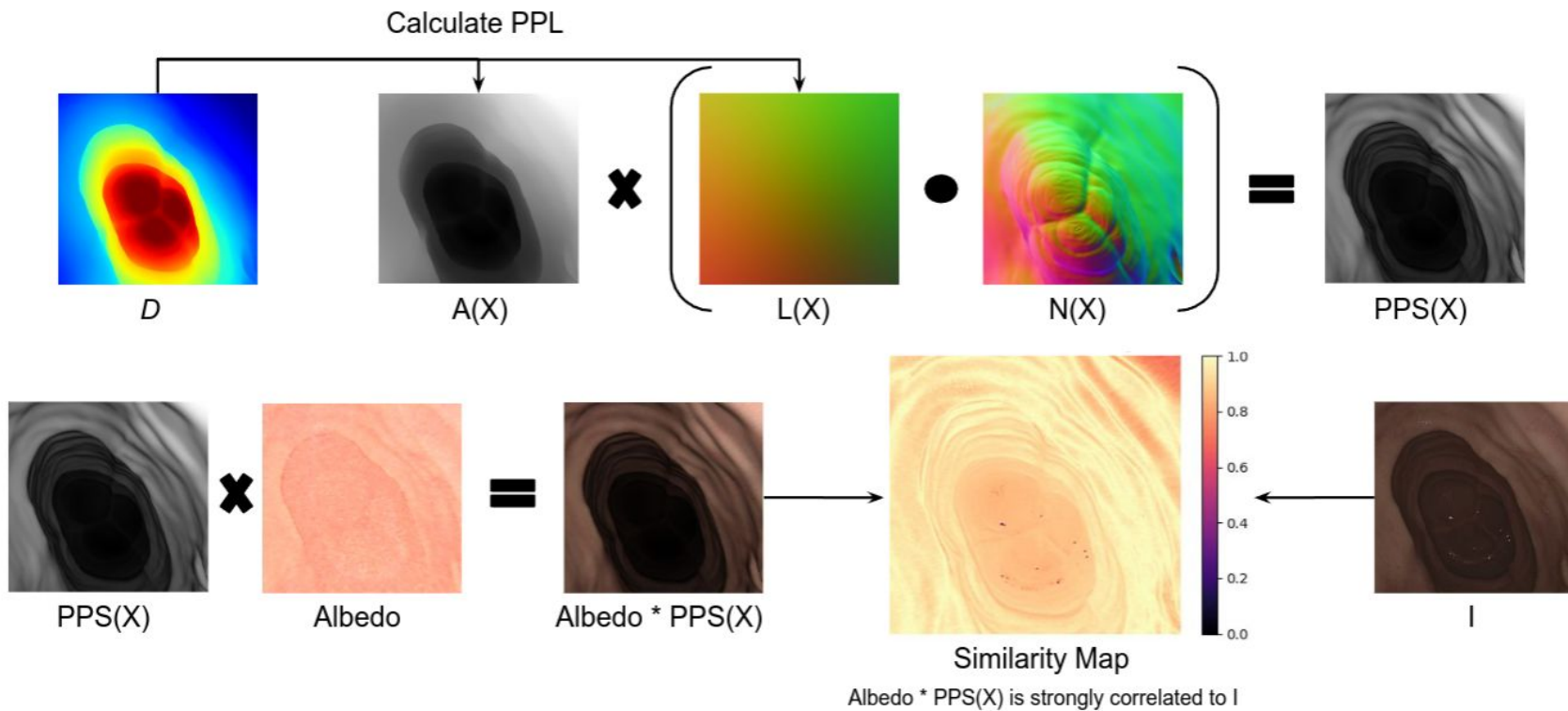
**Axial View**



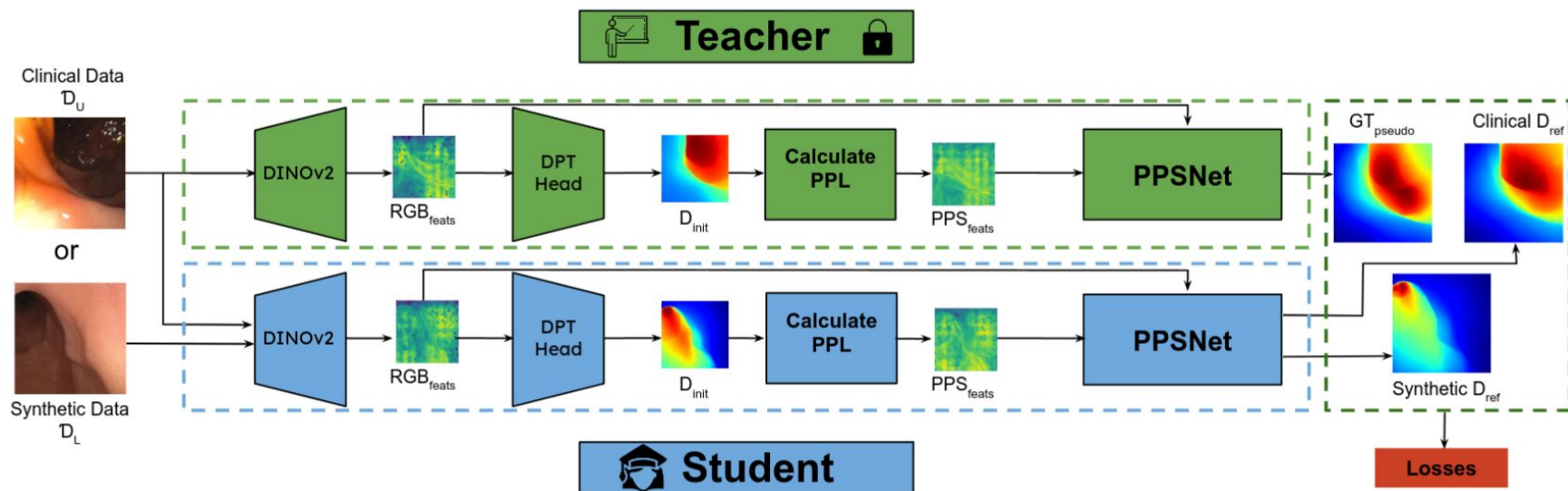
**En Face View**



# Method - Calculation of PPS



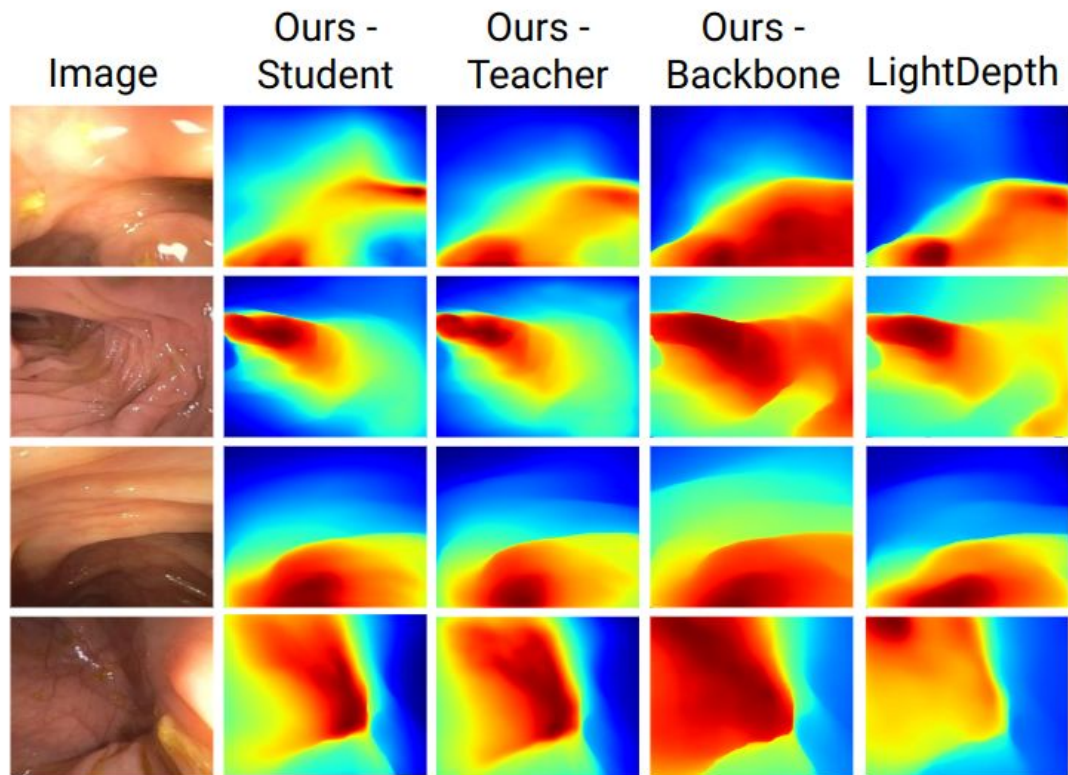
# Method - Overview of Proposed Approach



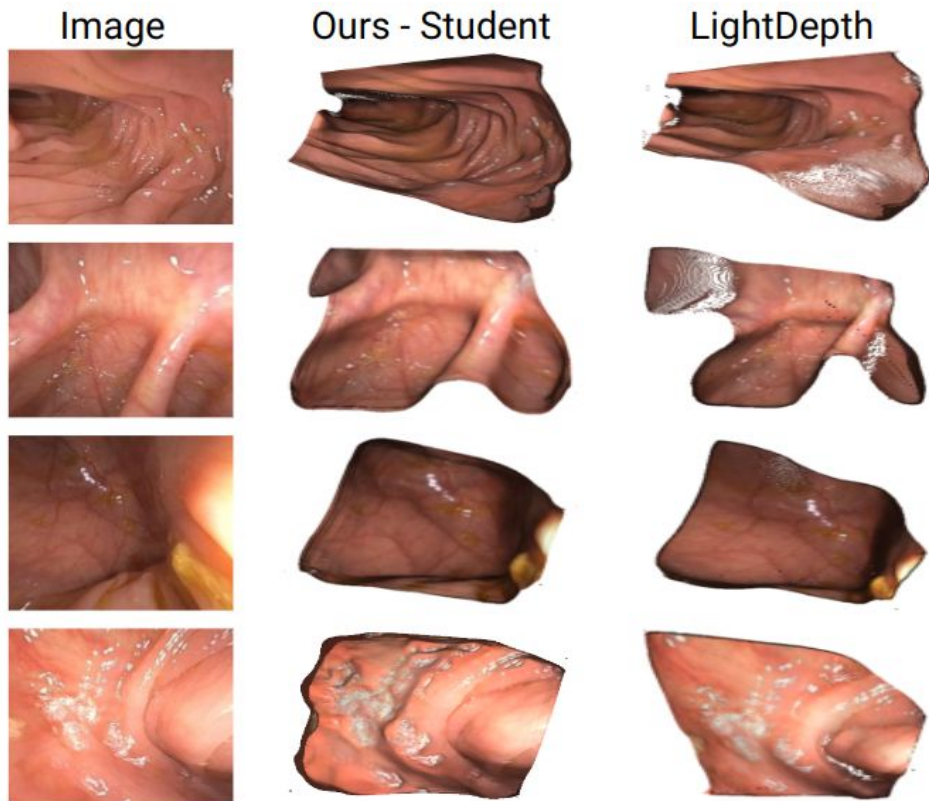
# Results - C3VD

Architecture	Encoder	Supervision	$RMSE \downarrow$	$AbsRel \downarrow$	$SqRel \downarrow$	$\delta < 1.1 \uparrow$
UNet [56]	ResNet18	GT	6.71	0.126	1.72	0.63
MonoDepth2 [14]	ResNet50	SSL	9.11	0.192	2.64	0.43
NormDepth [64]	ResNet50	SSL	9.72	0.164	2.05	0.42
Wang et al. [64]	ResNet50	GT & SSL	7.51	0.155	1.53	0.48
LightDepth DPT [53]	DPT-Hybrid	SSL	6.55	0.0780	1.81	0.56
DepthAnything [67]	DINOv2	GT & SSL	12.76	0.283	6.41	0.34
Ours - Backbone	DPT-Hybrid	GT	3.31	0.0755	1.66	0.72
Ours - Backbone	DINOv2	GT	2.79	0.0622	0.238	0.82
Ours - Teacher	DPT-Hybrid	GT	2.68	0.0716	0.97	0.83
Ours - Teacher	DINOv2	GT	<u>2.15</u>	<u>0.0529</u>	<u>0.147</u>	<u>0.87</u>
Ours - Student	DINOv2	GT & SSL	<b>2.06</b>	<b>0.0491</b>	<b>0.140</b>	<b>0.89</b>

# Results - Clinical Depth



# Results - Clinical Mesh



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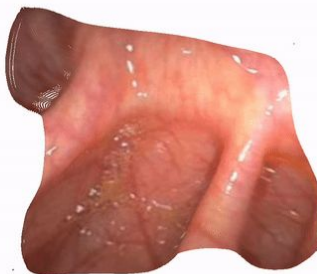


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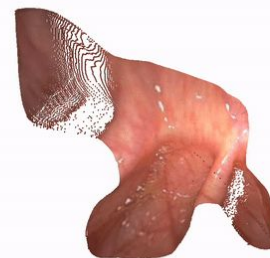
Clinical  
Data



Our  
Clinical Mesh



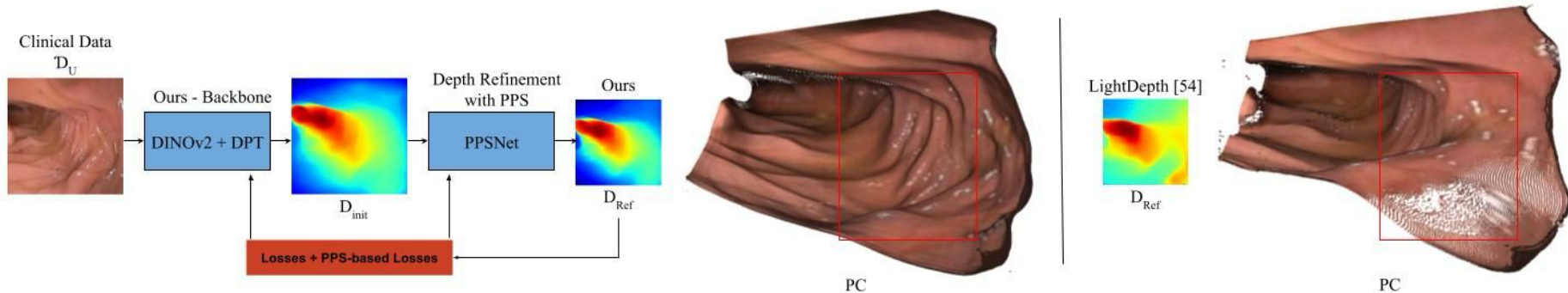
LightDepth  
Clinical Mesh





# PPSNet

- PPS representation for use in...
  - Supervised and self-supervised loss variants
  - Depth refinement
- Teacher-student transfer learning to optimize use of clinical data
- Achieves SOTA!



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See <https://ppsnet.github.io/> for more details!

