

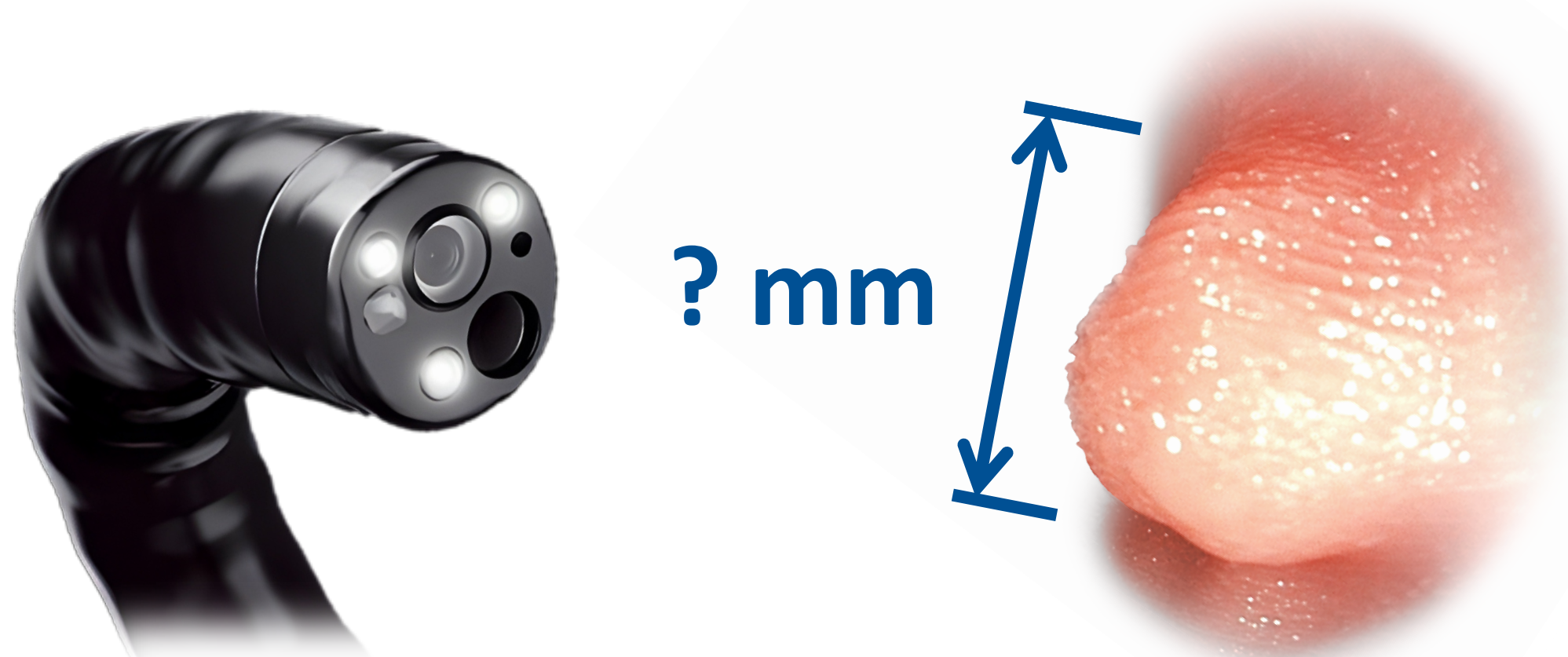
EndoMetric: Near-Light Monocular Metric Scale Estimation in Endoscopy

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Automatic polyp size measurements

NO task-specific learning
NO hardware modifications
ONLY Near-Light Photometry



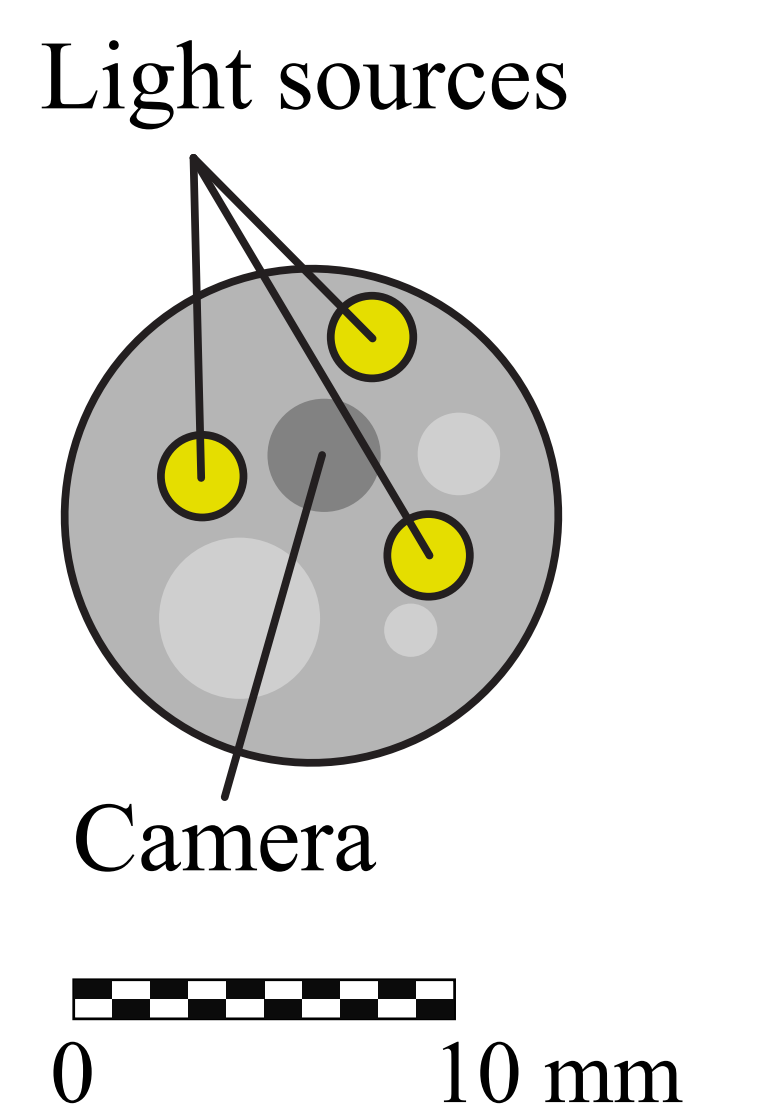
Goal: Metric-scale 3D reconstructions from the **monocular images** of a conventional endoscope, relying only on near-light photometry

Key insight:

Light sources close to the camera and near the surface

+ Photometric calibration

= **Metric scale estimation**



EndoMetric

Near-Light Photometric Model

Pixel brightness depends on the **scale**:

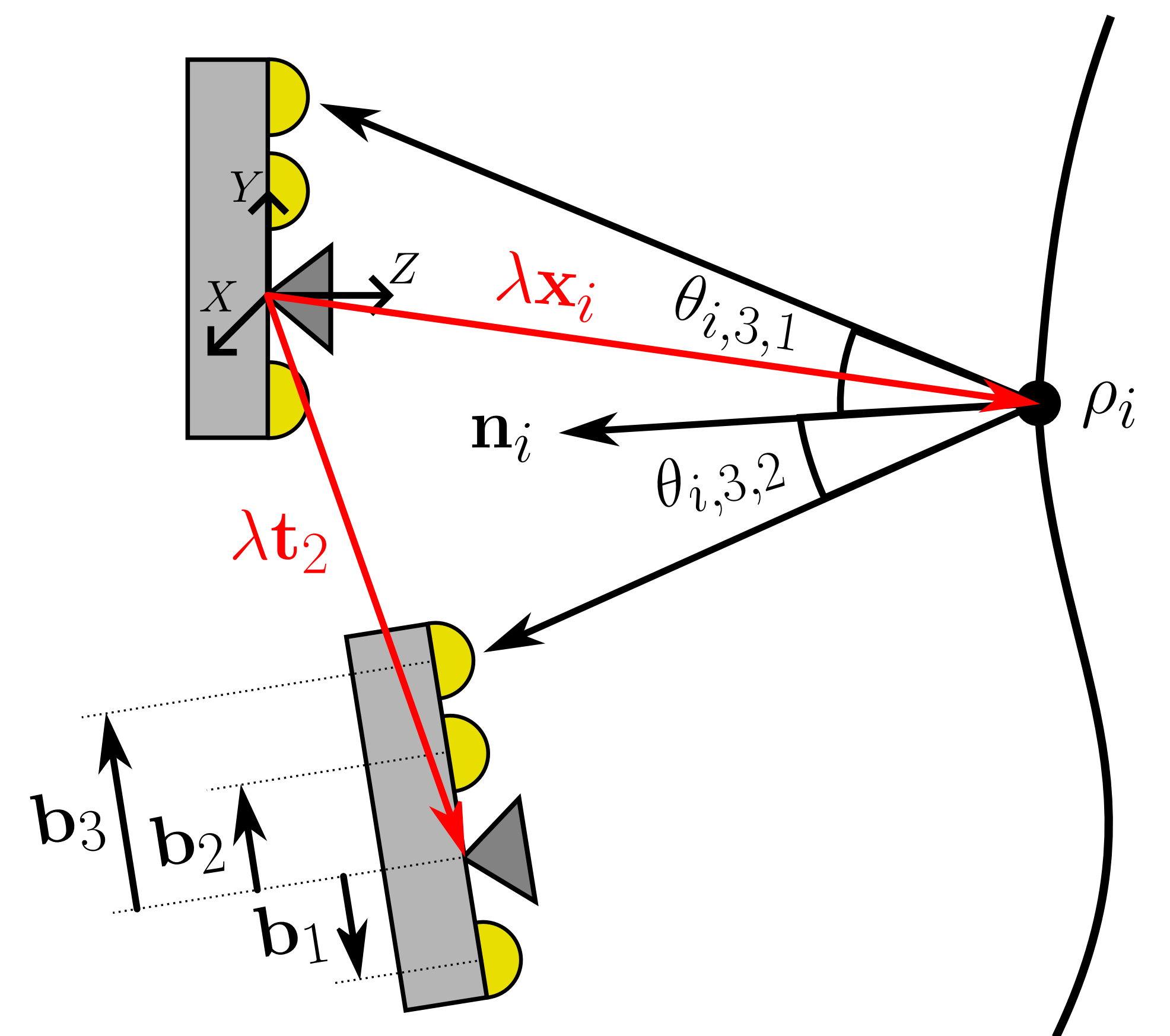
$$\mathcal{I}_{i,k}(\rho'_i, g'_k, \lambda) = \left(\frac{\rho'_i g'_k}{\pi} \sum_{j=1}^r \frac{\cos \theta_{i,j,k}(\lambda)}{\|\lambda \mathbf{x}_i - (\mathbf{R}_k \mathbf{b}_j + \lambda \mathbf{t}_k)\|^2} V(\mathbf{x}_i) \right)^{1/\gamma}$$

Step ① – Up-To-Scale Multi-view Reconstruction (SfM / SLAM)

We get: Geometry + Surface normals + Camera motion

Step ② – Metric Scale Estimation

We get: Metric distances + Per-point albedo + Camera gain

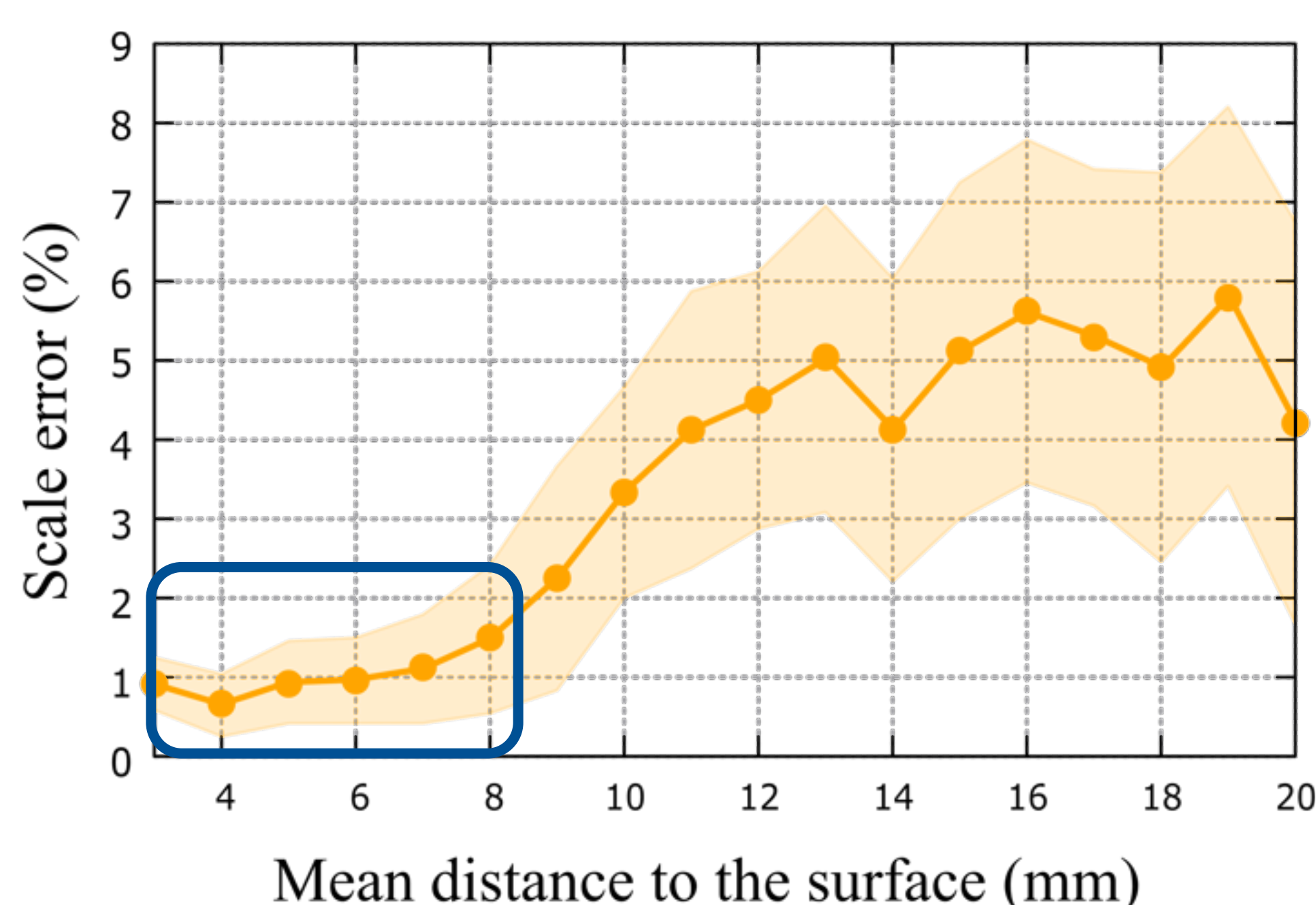


Experiments

EndoMapper dataset

Our method can automatically estimate real polyp sizes with the accuracy of an expert endoscopist

Simulation: <2% error up to 8mm



	Seq_041 Polyp A	Seq_34 Polyp A	Seq_058 Polyp A	Seq_041 Polyp D	Seq_022 Polyp A
Image					
3D					
Normals					
Result					
Our method	10.4mm	11.4mm	2.7mm	11.8mm	4.2mm
Endoscopist	10mm	10mm	3mm	8–10mm	4–5mm
Discrepancy	0.4mm (4%)	1.4mm (14%)	0.3mm (10%)	2.8mm (31%)	0.3mm (7%)

Real polyps measured with our method and compared with an endoscopist

