Detection and segmentation of polyps in colonoscopic images

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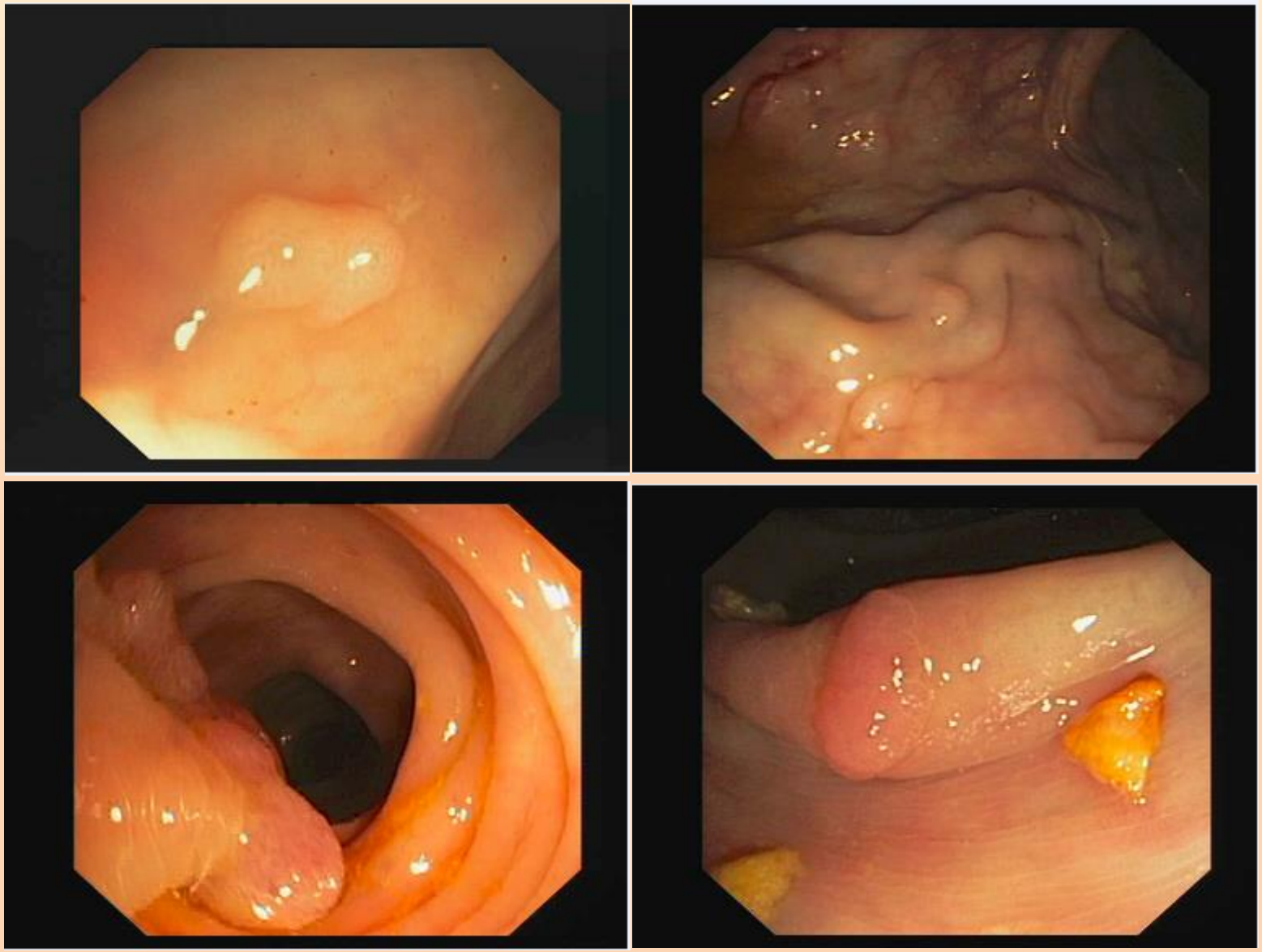
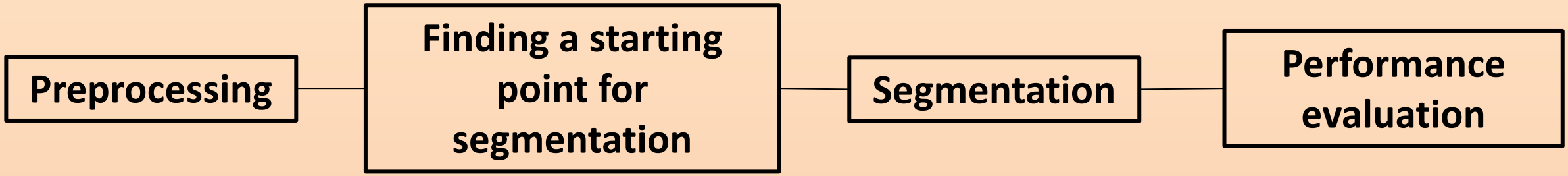
Data

- Used dataset: CVC-ClinicDB
- 612 images from 31 videos + binary masks
- Very diverse polyp appearance
- Statistical analysis

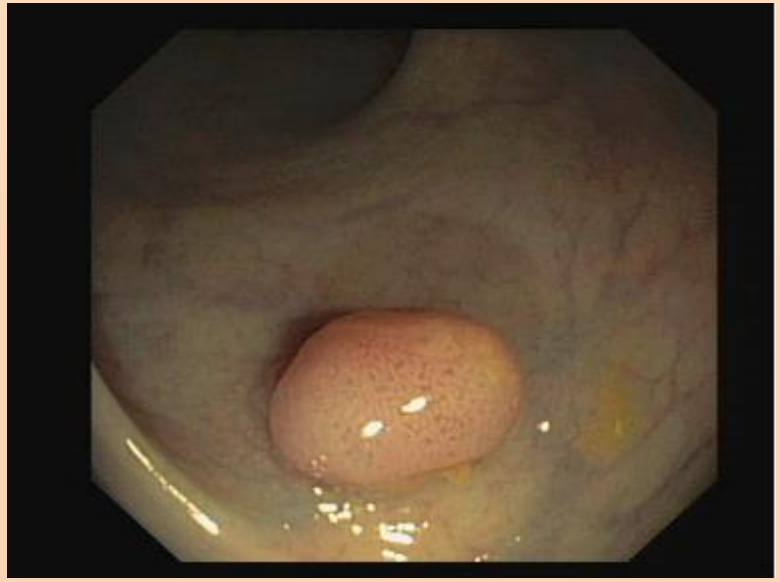


Block diagram

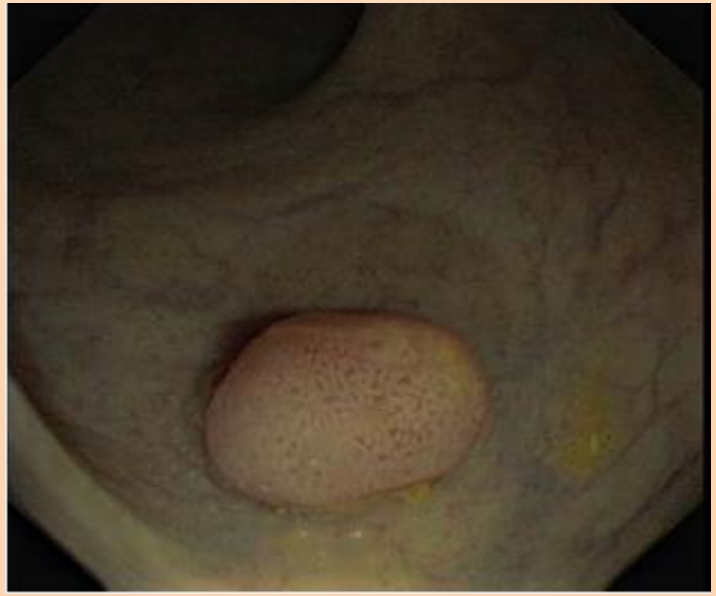


Modification of image

- Frame removal
- Elimination of reflection
- Lighting correction



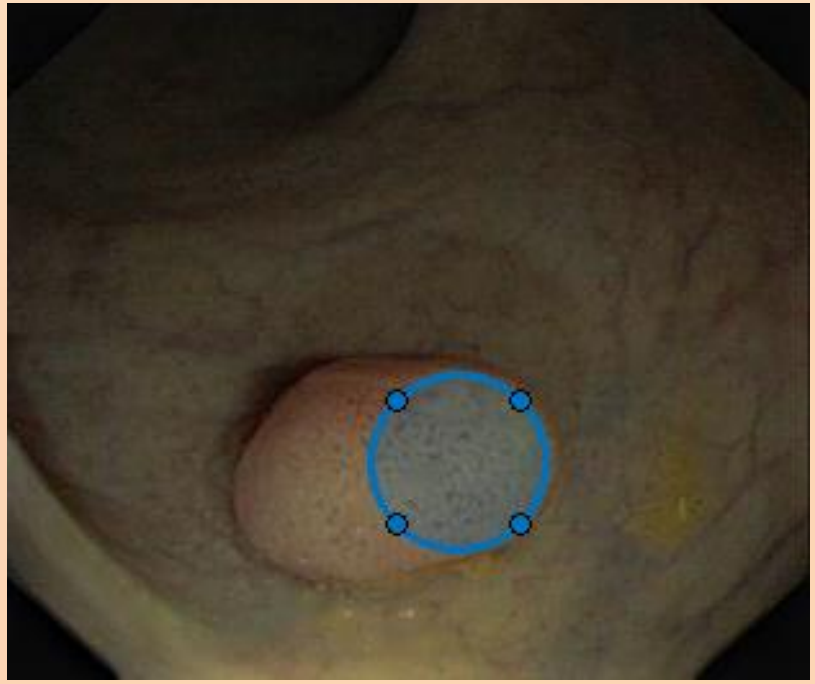
Original image



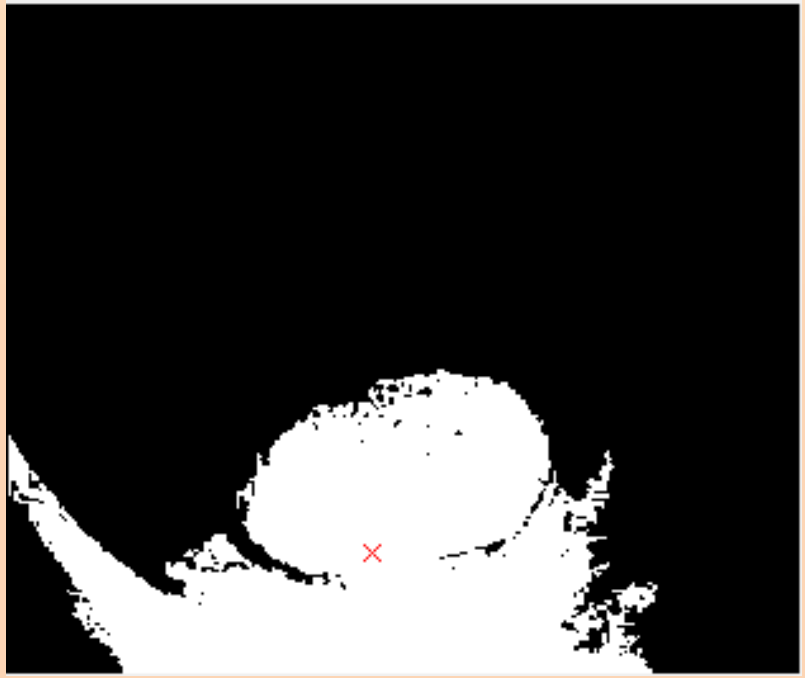
Modified image

Finding a starting point

- Hough transform for circles (using thresholded image of local standard deviation)
- Hysteresis thresholding



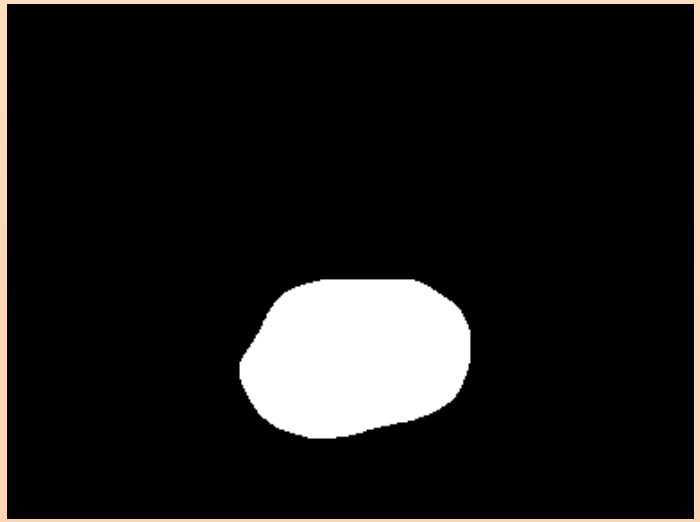
Hough Transform



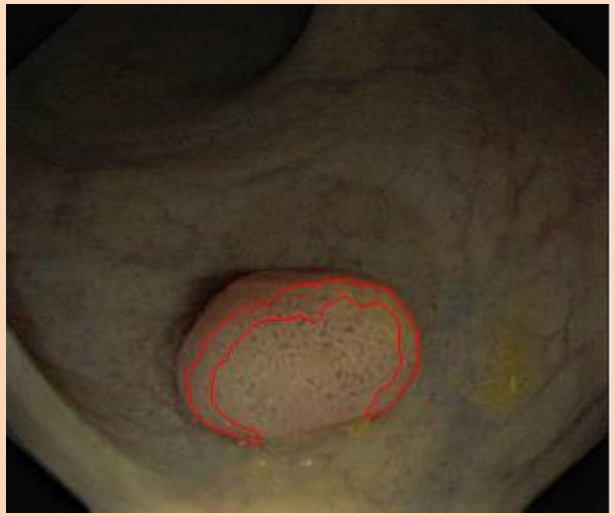
Hysteresis Thresholding

Segmentation

- Region Growing ✓
- Parametric contours **X**
- Others (Geometric contours etc.) **X**



Mask of Image

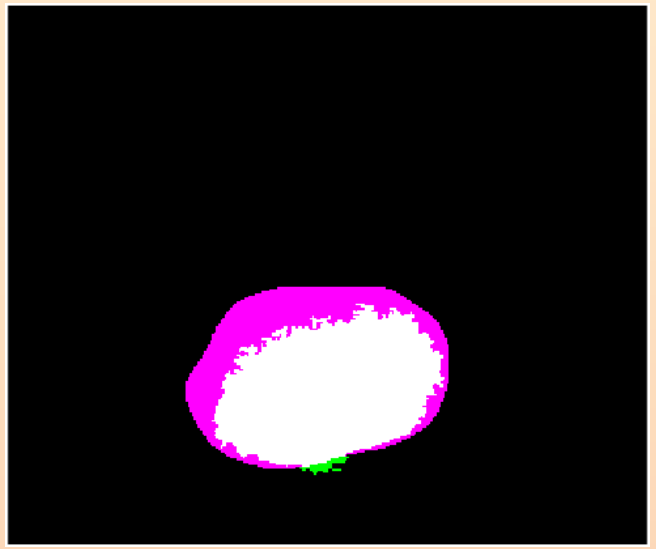


Parametric contours

Result‘s examples

StdThRd + HT + RGRd

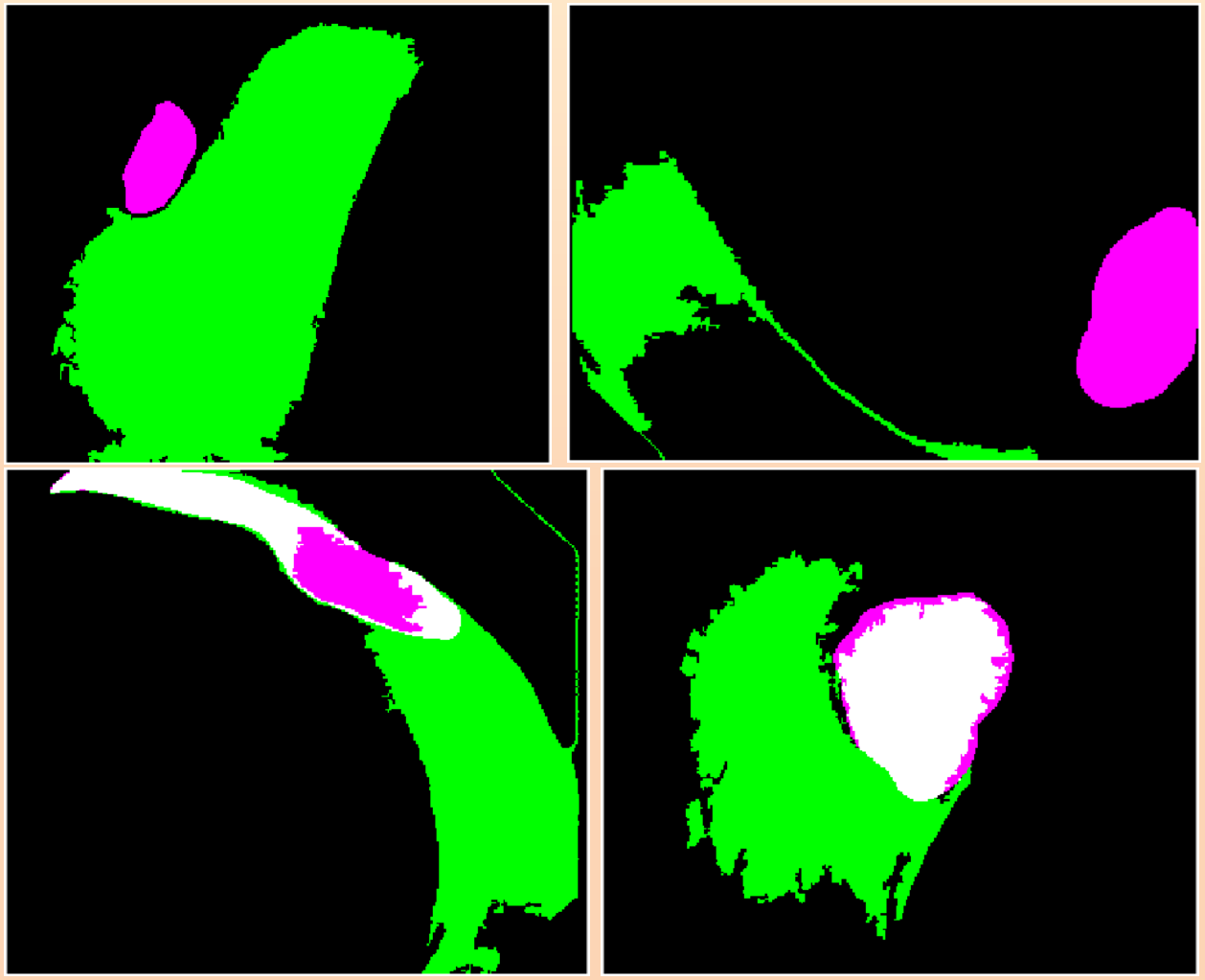
- Purple – mask
- White – intersection of ground truth mask and our output mask



HyTh + centroid + RGRd

- Green – segmented area outside of polyp

Examples of bad detection



Results

Dataset: CVC-ClinicDB

Method	Acc	μ_{IoU}	μ_{Dice}	σ_{IoU}	σ_{Dice}	Se	PPV	TP (IoU>0.5)	n (IoU = 0)
HyTh + centroid + RGRd	0,5922	0,1633	0,2473	0,1776	0,2236	1	0,0637	39	88
StdThRd + HT + RGRd	0,6533	0,1973	0,2844	0,2107	0,2607	1	0,1176	72	87

Acc – pixel accuracy
HyTh – Hysteresis thresholding of grayscale image (Otsu method)
HT – Hough Transform for circles
StdThRd(Bl) – Thresholding the local standard deviation of red channel (or blue channel) (Otsu method)
RGRd(Bl) – Region growing of red channel (or blue channel)
TP – True positive detection
n – no intersection of masks

Classification of segmentation confidence

- Attempt to find features to represent confidence of our segmentation (maximum of HT, region area and mean…)
- Using Random Forest classifier
- Attempt not successful – 31 of 40 test images misclassified

Other options

- Use of Machine Learning - CNN
- Examples:
  - Automatic polyp detection and segmentation using shuffle efficient channel attention network: 10.1016/j.aej.2021.04.072
  - Real-Time Polyp Detection, Localization and Segmentation in Colonoscopy Using Deep Learning: 10.1109/ACCESS.2021.3063716

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