Adaptive Specular Reflection Detection and Inpainting in Colonoscopy Video Frames

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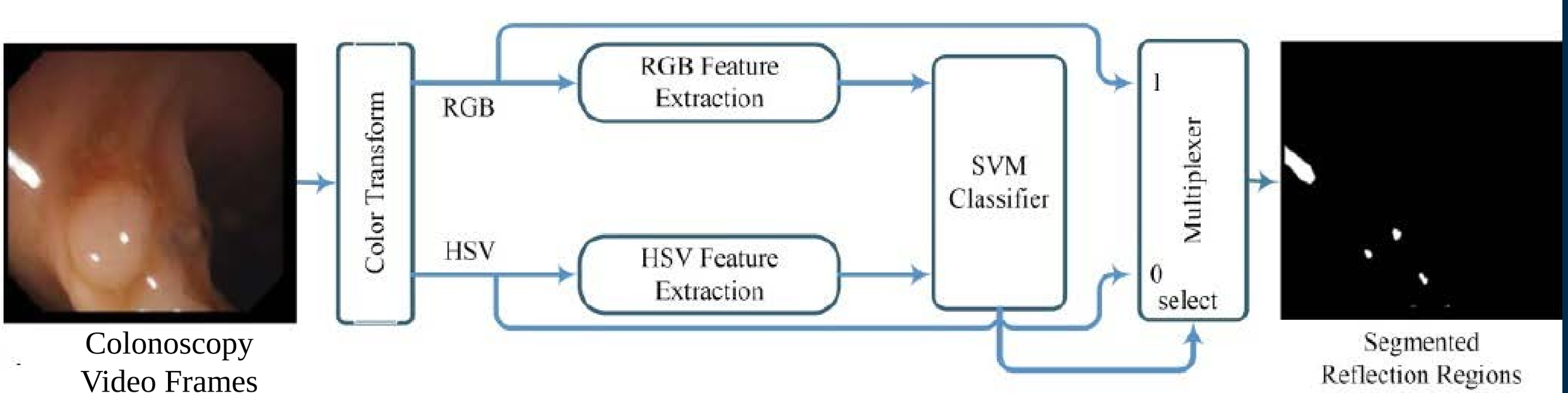
Introduction

- Importance of Polyp Detection
- Specular reflection results in detection challenges
- Using different color spaces for detection of reflection

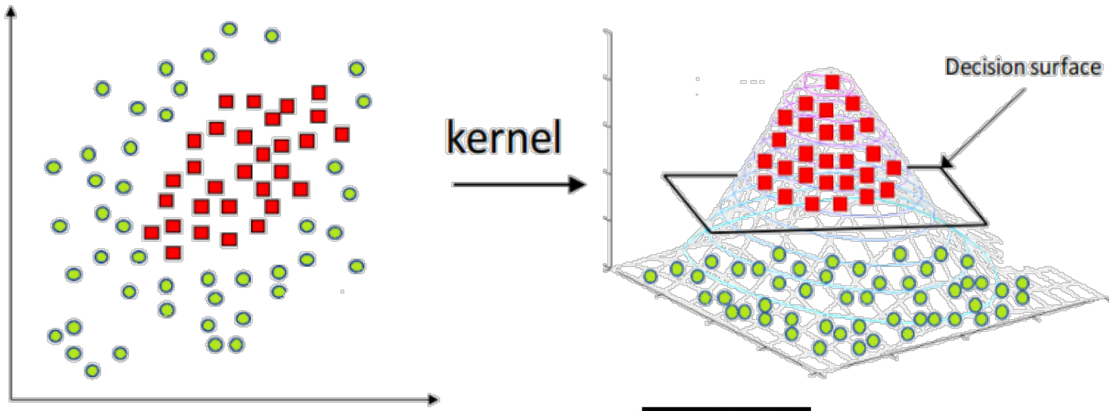
Proposed Detection Method

- Main Steps of Proposed Detection Method
  - RGB Color Space Method
  - HSV Color Space Method
  - SVM Classifier

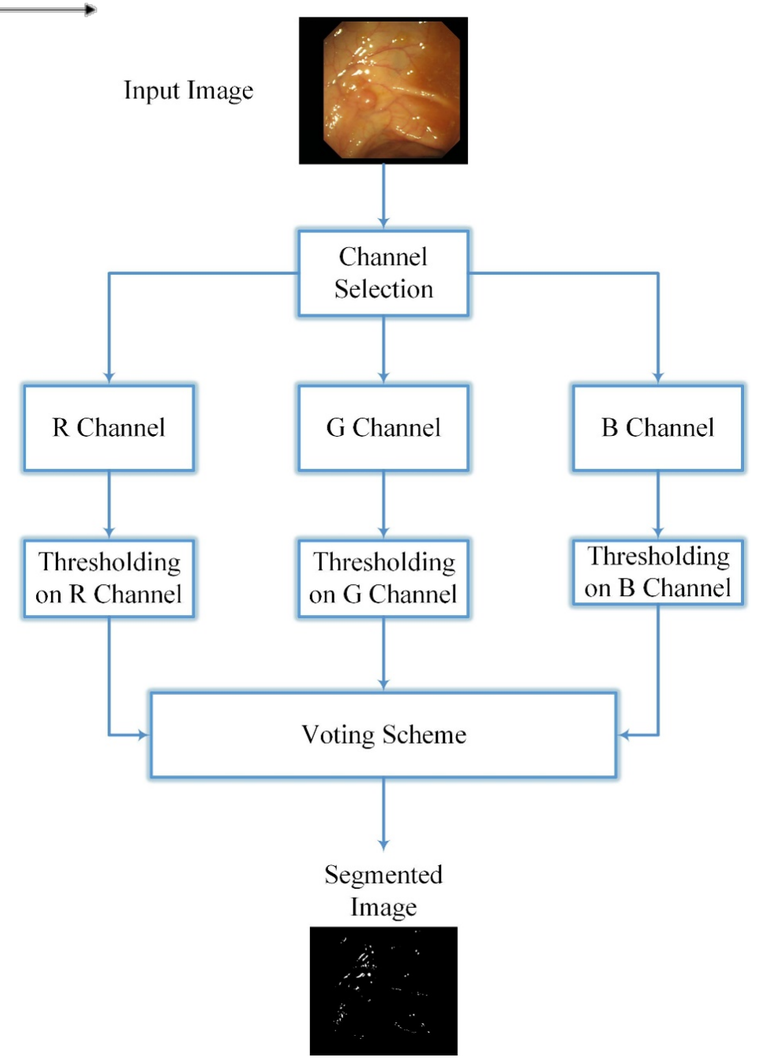


Color Space Selection and RGB Detection Method

- Non-linear SVM Classifier
  - 12 Features Including Statistical Measures of Each Channel
  - Normalization of Features
  - 80% of Data for Training and 20% for Testing
  - Classification Based on Dice Score

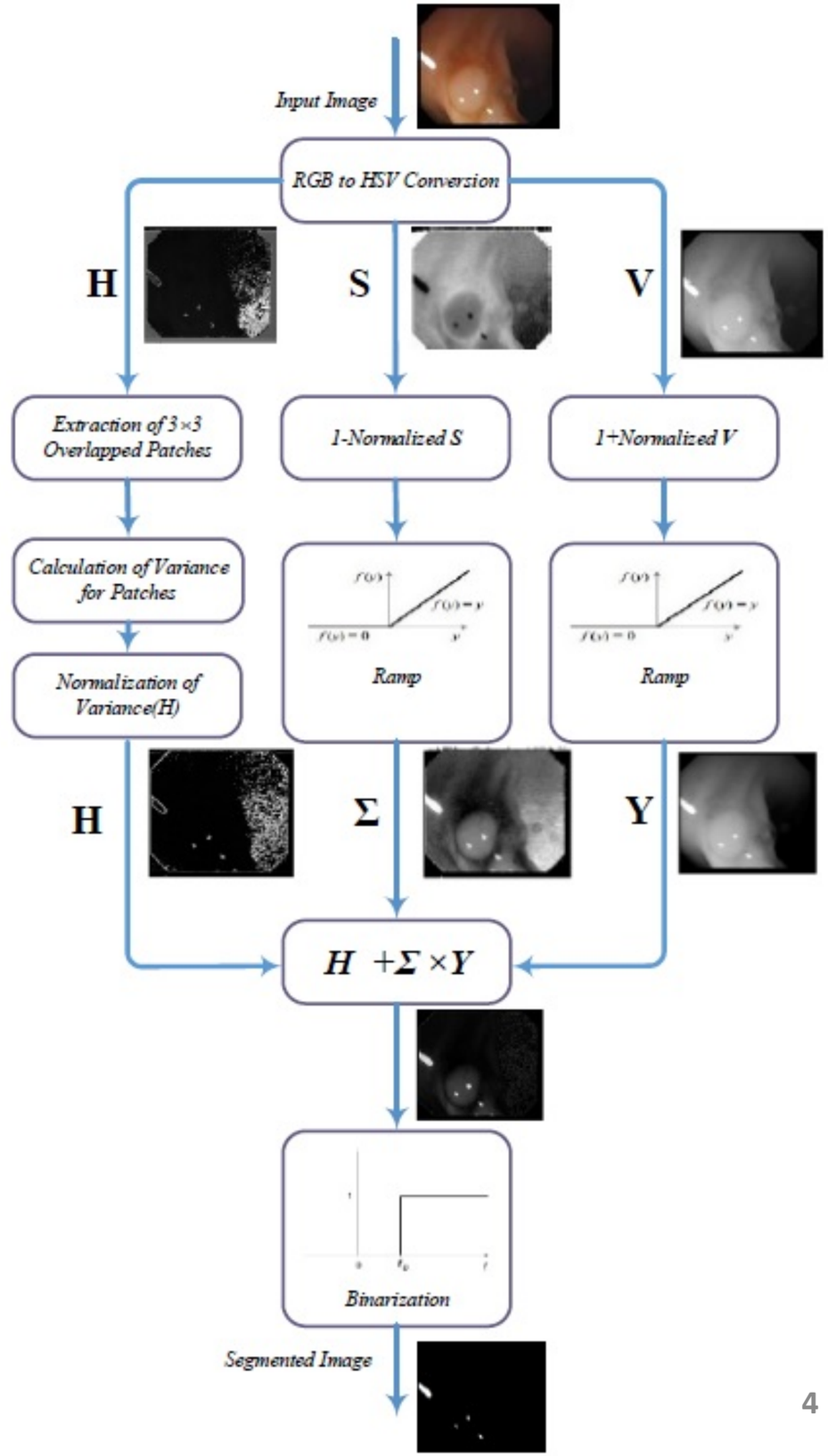


- RGB Detection Method
  - Thresholding on Intensities of Each Channel
  - Voting Scheme Based on Decision Result of Channels



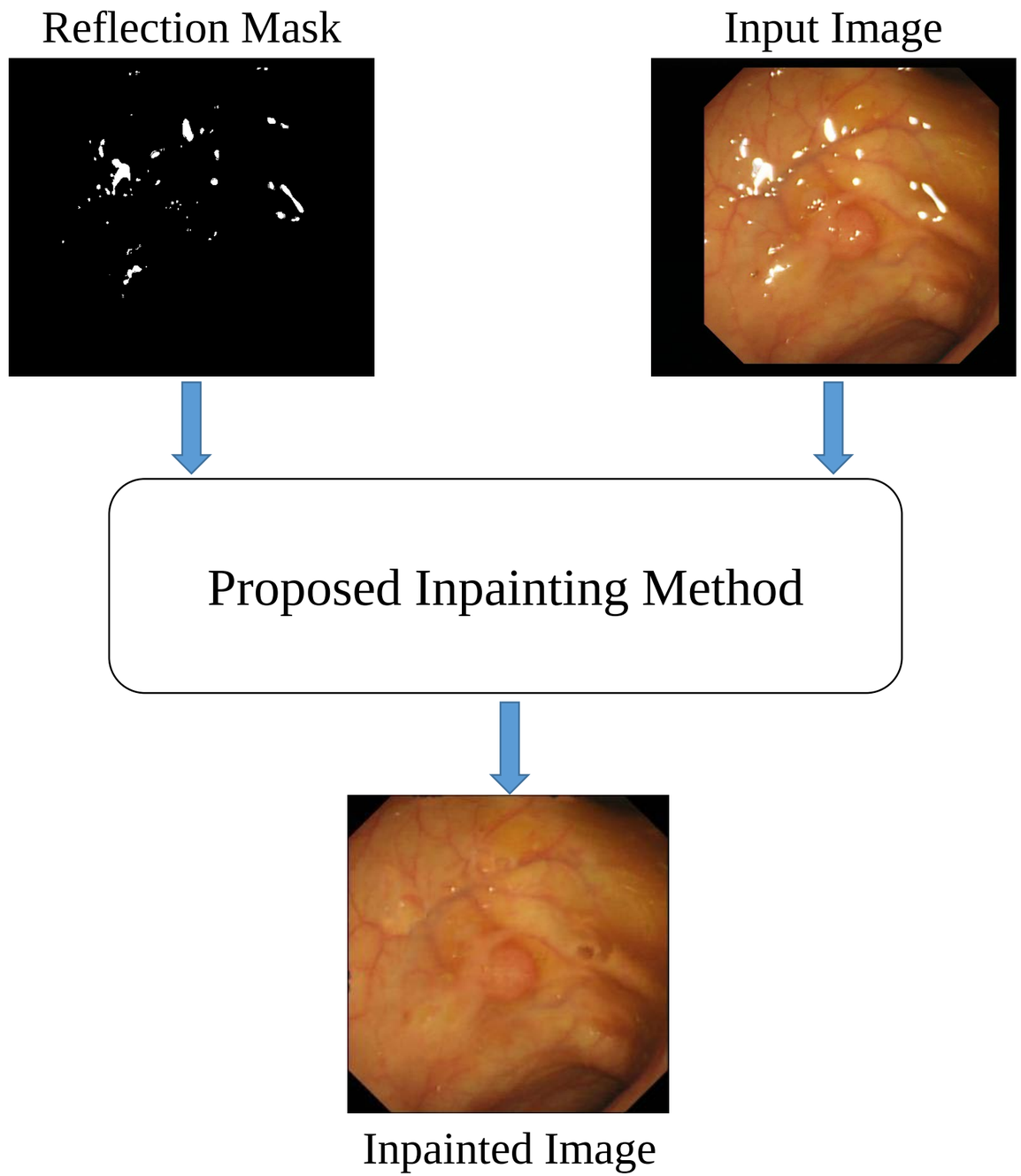
HSV Detection Method

- H Channel
  - Extraction of 3×3 Overlapped Patches from Each Image
  - Variance Calculation and Normalization of Each Variance Matrix
- S and V Channels
  - Normalization and using Ramp Function to Remove Uninformative Data
- Aggregating all Features of Three Channels
- Adaptive Thresholding for Binary Segmentation

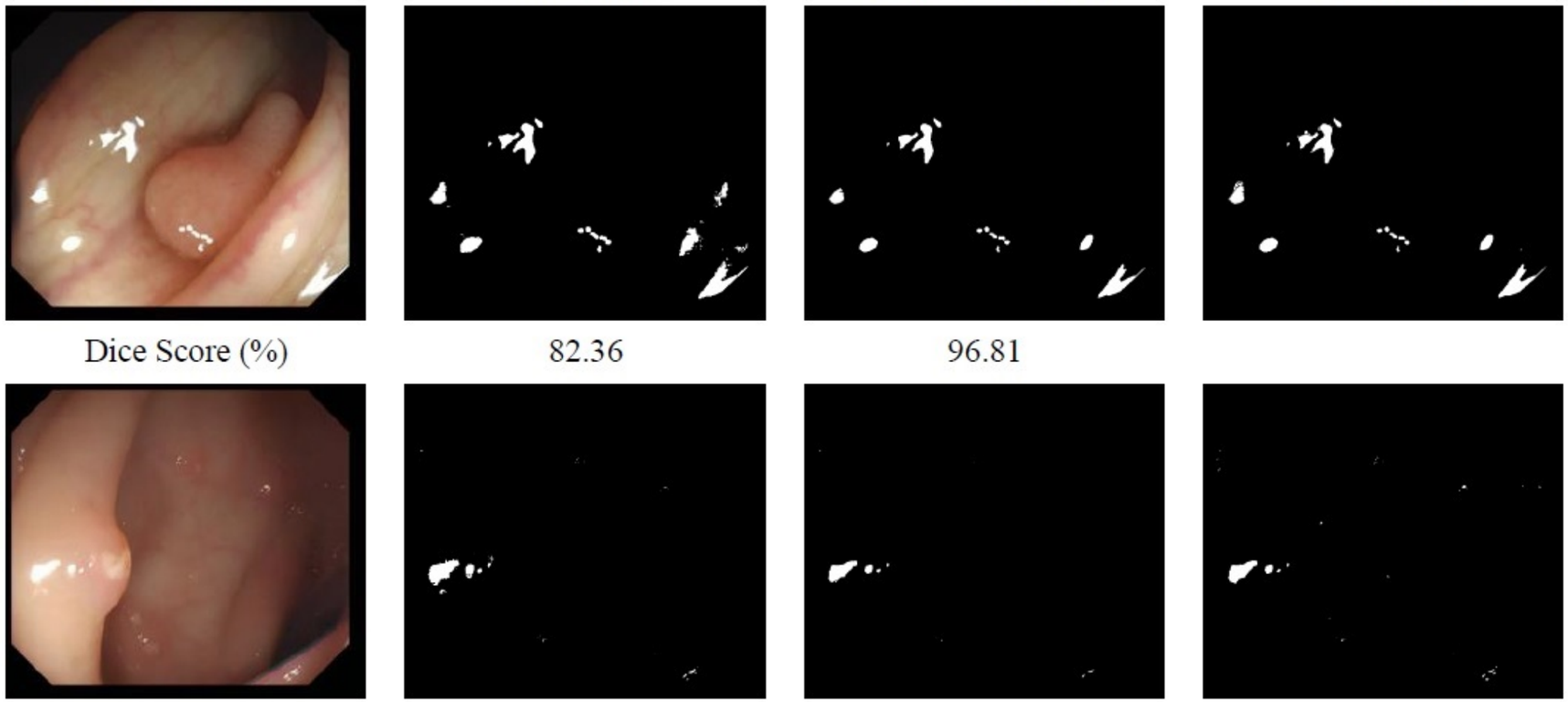


Proposed Inpainting Method

- Removing Image Frame
- Finding Equivalent Patch
  - Finding Four Candidates in Four Main Directions
  - Using Proposed Cost Function to Select Best Candidate:
    $Cost = \Delta_\mu \times \Delta_\sigma \times d \times (1 - NC)$
  - Replacing Degraded Patch with Selected Patch
- Enhancing Inpainted Image Quality by Applying Proposed Smoothing Method on Edges



Results and Comparison



Method	*Dice (%)*	*Accuracy (%)*	*Specificity (%)*	*Precision (%)*
RGB	*60.26*	*99.62*	***99.96***	***87.52***
HSV	*67.34*	*99.58*	*99.78*	*66.44*
Proposed	***71.79***	***99.68***	*99.92*	*82.78*
Ganz et al	*61.76*	*99.34*	*99.43*	*48.67*

M. Ganz, X. Yang, and G. Slabaugh, “Automatic Segmentation of Polyps in Colonoscopic Narrow-Band Imaging Data,” *IEEE Trans. Biomed. Eng.*, vol. 59, no. 8, pp. 2144–2151, 2012.