PATTERN RECOGNITION ANALYSIS FOR PROGNOSIS OF INFLAMMATORY BOWEL DISEASE

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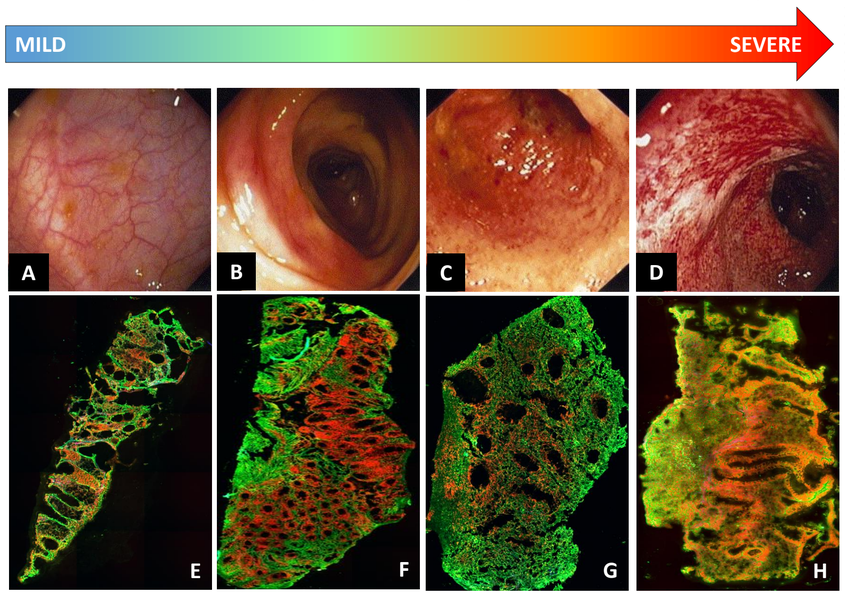
Abstract – Non-linear multimodal imaging, the combination of coherent anti-Stokes Raman scattering (CARS), two-photon excited auto fluorescence (TPEF) and second-harmonic generation (SHG), can provide a real-time diagnosis of Inflammatory Bowel Disease (IBD) activity. Morphological changes like the crypt architecture can be used as a marker for characterizing the IBD activity. Manually annotating cryptal regions is a time-consuming task. Therefore, we present an ***automatic segmentation of multimodal image into cryptal and mucosal regions.***

Background – Inflammatory bowel diseases (IBD) are chronic inflammations of the gastrointestinal tract and the quantification of inflammatory patterns in IBD patients can be useful for predicting the disease relapse.



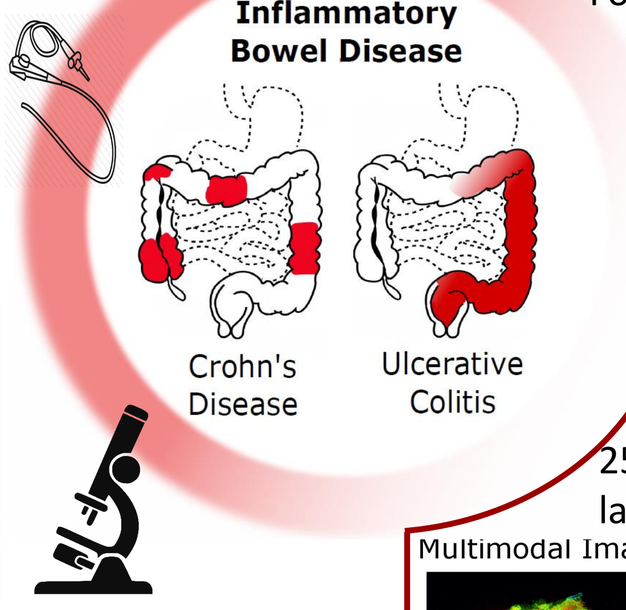


Figure 1. (A), (B), (C), (D) are colonoscopy images. (A) Mayo Score 0: Inactive disease (B) Mayo Score 1: Mild Disease (C) Mayo Score 2: Moderate disease, (D) Mayo Score 3: Severe disease, spontaneous bleeding (E), (F), (G), (H) Multimodal Image of Mayo score 0, 1, 2, 3 respectively.

Dataset – The dataset comprised of twenty multimodal images that were acquired with the combination of CARS @ 2850 cm^{-1}, TPEF @ 458 nm and SHG @ 415 nm. For data augmentation, the train and validation images were resized by a factor of 0.2, 0.25, 0.5, 0.7, 0.9.

Dataset	Number of images	Number of patches
Train	12	4246
Validation	4	1352
Test	4	660

Table 1. Overview of the dataset

Methods – 1. *Patch filtering:* Patches (size 256×256 with 50% overlap) exhibiting all four labels were retained.

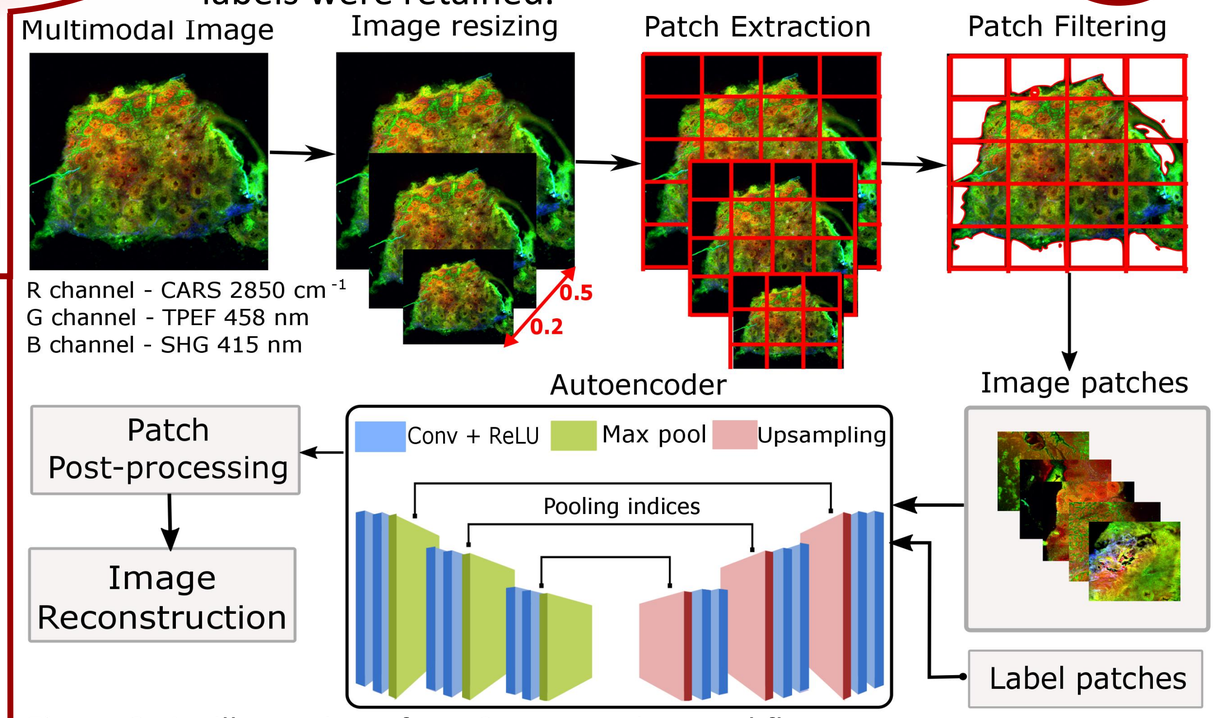
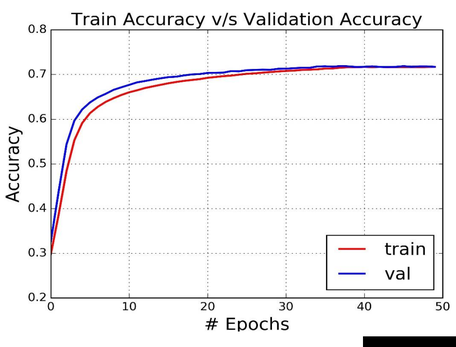


Figure 2. An illustration of our Segmentation workflow

2. Patch training protocol: We used a SegNet model [2] to classify the pixels of the multimodal images into four classes namely - crypts, mucosa without crypts, non-mucosa tissue region and background. The weights of the encoder layers were initialized using the ImageNet trained VGG16 model with Batch size = 5 and Initial learning rate = 10^{-4}.

3. Patch refinement and Image reconstruction: The model was tested using patches of the resized test images. The predicted test patches were combined into a whole image and refined using region morphological operations.



RECONSTRUCTED IMAGE

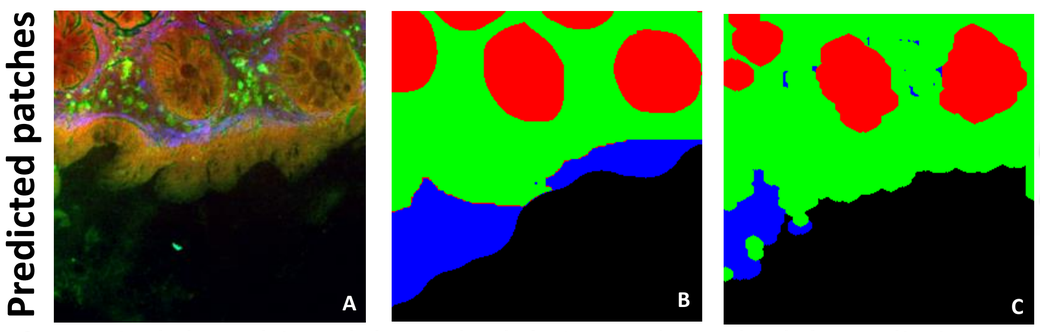


Figure 3. (A) Multimodal patch; (B) Ground Truth; (C) Prediction. Colour code – Background, Non-mucosa, Mucosa without crypt, Crypt.

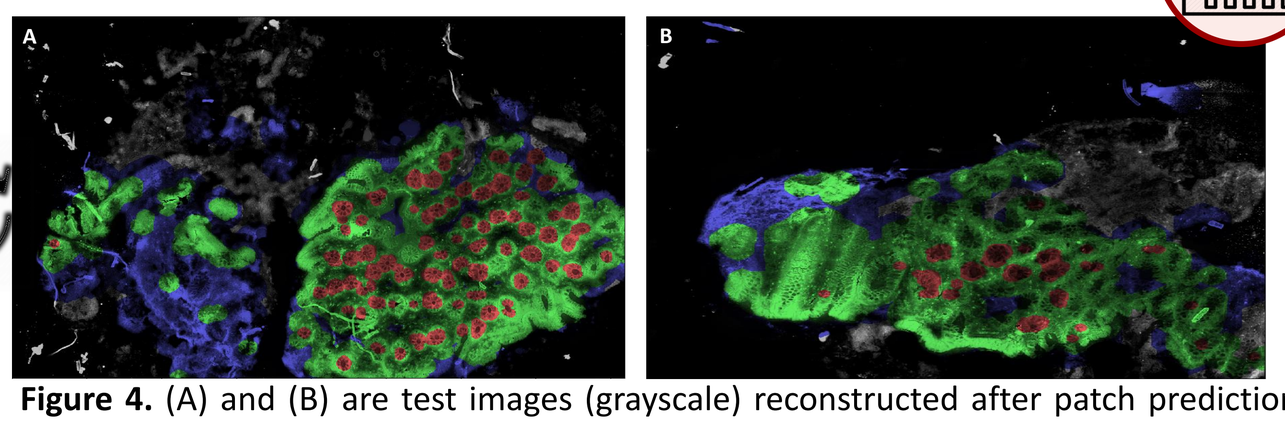


Figure 4. (A) and (B) are test images (grayscale) reconstructed after patch prediction. Crypt and mucosa regions are highlighted in red and green colour respectively.

REFERENCES

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ACKNOWLEDGEMENT

The funding of the DFG for the project BO 4700/1-1, PO 563/30-1 and STA 295/11-1 and the Prochance scholarship of the University Jena for PP are highly acknowledged.