A Novel Approach for Detection of Bleeding in Wireless Capsule Endoscopy Images

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Abstract

Bleeding in gastrointestinal (GI) tract is a symptom of a disease rather than a disease itself. It can occur as the result of a number of different conditions, such as angiodysplasia, small bowel tumors, inflammatory bowel disease, diverticulosis, peptic ulcer disease, and so on. Thus locating the bleeding in GI tract is very important. Wireless capsule endoscopy (WCE) is a new imaging technique that allows clinicians to visualize the entire GI tract, especially the small intestine, where conventional endoscopies, such as gastroscopy and colonoscopy fail to reach. It was invented by *Given Imaging Ltd.* in 2000 [3], and the first devise got approval from FDA (U.S. Food and Drug Administration) in 2001. Since then it has been widely used in hospitals, and has shown great importance in evaluating GI bleeding and other abnormalities of GI tract.

Although clinical findings of this pioneering technique are promising, some improvements are still needed. One major issue with this new technology is that it generates approximately $50,000$ images per examination for one patient, whose analysis is left to naked eyes of clinicians, which is very tedious and time consuming. Furthermore, some images containing bleeding regions or abnormalities may be missed by clinicians because of visual fatigue, or because of the size or distribution of bleeding regions or abnormalities. This opens a door for computer-aided decision support systems, to assist the clinicians in the analysis of the WCE images, by reducing the time required to reach the diagnosis and thus the cost of the procedure, making it a more efficient and affordable technique.

Recent years have witnessed some development on computer-aided approaches for detection of abnormalities in WCE images, see [1, 2, 3, 4, 5, 6, 7] and the references therein. This work is concerned with a novel approach for detection of bleeding in WCE images.

Starting with a suitable color channel we employ some enhancement techniques, involving an adaptive anisotropic diffusion (alike Perona Malik diffusion), and an appropriate segmentation for confining our computations to mucosa part. We then employ analysis of eigenvalues of the image Hessian matrix and multiscale image analysis approach that provides us ingredients for designing discriminators of bleeding and normal image frames. The efficiency of the proposed approach is tested on several medical datasets. For evaluating the performance of our approach we have considered standard measures: sensitivity, specificity, and accuracy. We also do the ROC (receiver operator characteristics) curve analysis for our approach. The results show that this technique is promising in distinguishing bleeding and normal image frames.

Keywords: anisotropic diffusion, segmentation, bleeding detection, wireless capsule endoscopy, ROC curve, gastrointestinal tract

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