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RESEARCH ARTICLE

An Identification of Efficient Vessel Feature for Endoscopic Analysis

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ABSTRACT:
An indispensable chore in computer–aided Minimally Invasive Surgery (MIS) is the typical feature detection. In some of the distinctive conditions in MIS imaging such as texture homogeneous areas specular reflections uses general feature point detectors for drawing out the feature points which are less distinct and repeatable in MIS images. We examine that a new set of image feature can be taken out from the copious blood vessels which are obtainable from the tissue surfaces. Two types of blood vessel feature are put forward for endoscopic image analysis in this proposed paper: branching segments and branching points. Ridgeness Based Circle Test (RBCT) and Ridgeness Based Branching Segment Detection (RBSD) are the two new proposed methods used to obtain the branching points and branching segments from the blood vessels. To estimate the working effectiveness of the proposed method extensive in vivo experiments are carried out and the state-of-the-art method is used to evaluate them. In MIS images, the blood vessels from the tissue surfaces can yield enormous large number of points, which is proved from the numerical results. The points produced by the blood vessels are more robust and repeatable when compared with other types of feature points. This type of feature detection can be used as a new tool for the analysis of MIS images in endoscopy. Thus, the proposed method for detecting feature point is very efficient and robust in nature.

KEYWORDS: MIS, RBSD, RBCT.

INTRODUCTION:
Image processing is also used in medical field. Medical imaging is the technique and process of creating visual representations of the interior of a body for clinical analysis and medical intervention, as well as visual representation of the function of some organs or tissues (physiology).

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Medical imaging seeks to reveal internal structures hidden by the skin and bones, as well as to diagnose and treat disease. Medical imaging also establishes a database of normal anatomy and physiology to make it possible to identify abnormalities. In the field of medical imaging endoscopy plays a vital role. It is the examination and inspection of the interior of body organs [1]. It is used to diagnose various conditions by close examination of internal organs, body structures and blood vessels clearly. Endoscope is a device that uses fiber optics and powerful lens system to provide lighting and visualization of the interior of the joint.

The objective of this experiment is to evaluate, in MIS images, how distinctive vessel features detected by

RBCT and RBSD are compared with general feature points (corners and blobs). RBCT is a part of RBSD. They are treated as a unit and are compared with the others in all the experiments. Branching points, branching segments, corners, and blobs are different types of features and they have different densities in the images. The minimum distances of branching points, branching segments, and general feature points were defined as 11 pixels, 0 pixel, and 1 pixel, respectively. To have a consistent comparison, we applied non maximum suppression with 11-pixel radius for all the methods, including branching segments so that the minimum distance between any two feature points was at least 11 pixels.

To apply non maximum suppression, scores indicating the significance of feature points, such as cornerness for points from determinant of Gaussian (DoG), to run the non-maximum suppression, all points were considered to be equally important by assigning the same cornerness score. One important property of a feature point detector is that the same scene point can be detected repeatedly from different viewpoints. Our feature points have minimal distance of 11 pixels, which are larger than 6 pixels. Therefore, the obtained homography mappings are accurate enough.

It is useful to see how many human-recognizable branching points can be detected by the proposed branching point detector. The sets of manually selected branching points and automatically detected ones are denoted as $S1$ and $S2$, respectively. The coverage is defined as the percentage of ground-truth branching points that is automatically detected: $|S1 \cap S2|/|S1|$, where ∩ represents intersection of two point sets.

The complexities of RBCT and RBSD are both linear to the number of pixels in the given image and they can achieve real-time speed with the proper implementation. The average coverage for RBCT is 75%, which means, in average, 75% out of human-recognizable branching points is automatically detected. Compared with the previous methods, the methods proposed in this paper have the advantage that they do not rely on any image segmentation techniques. Therefore, the proposed method does not need to solve optimization problems required by many image segmentation methods [2].

SYSTEM DESIGN:

The Existing system is the detection of blood vessel features is considered as a serious impact in the area of medical imaging. Distinctive image feature extraction one of the fundamental task in MIS. The extracted features can be used for tissue tracking, deformation recovery, 3D construction, etc. For extracting vessel features branching points and branching segments are used. For detecting this vessel features RBCT and RBSD are used. These vessel features can produce a large number of points. The objective is to produce an enhanced view of blood vessels with good resolution and provides more accurate vessel localizations. Based on the ridgeness [3] representations more robust methods of vessel feature detection are presented.

Compared with feature points, branching segments are more powerful and distinctive visual cues whose locations, tangential directions and curvatures can all be exploited. The methods proposed in this paper to detect branching points and branching segments are named as Vesselness Based Circle Test (VBCT) and Vesselness Based Branching Segment Detection (VBSD) respectively [4].

For detecting branch point, VBCT is used and detecting branch segments VBSD is used. Input is obtained from the endoscope and preprocessing is done for the removal for the specular reflections, vesselness and ridgeness images are computed by using hessian matrix which is calculated for each pixel. Branching points and branching segments are detected by using circle test and vessel tracking techniques. By calculating the Eigen value using hessian matrix, the vessel features are detected from the tissue surfaces.

The diseases caused by the blood vessel damage are examined with the help of endoscopy. The feature points are used to detect the vessels. They are: corners, ridges, blobs. The previously introduced methods were mainly designed for general purposes and it uses some of the feature detectors to detect the damages in the vessel.

In the proposed method, vesselness is detected based on the ridge feature detector which is more robust and repeatable in nature. Jacobian matrix is developed to detect the features of blood vessels in MIS images [10]. Canny edge detector is used to detect the edges of the blood vessels and tissue surfaces. In order to improve the resolution of the final image, Histogram (image equalization) is used. Accuracy of the features is increased. Error in automatic localization of branching points is reduced. Two types of blood vessel features are defined in this paper:

- Branching points and
- Branching segments.

Bifurcations and crossing points are defined as branching points. Blood vessel segment that has branching points at both ends are considered as a branching segment. A blood vessel segment that has only one branching point is called a half branching segment. Branching segments are essentially curve segments and a pair of branch segment correspondence can generate tens of pairs of point correspondences. This study proposes a new way of blood vessel enhancement, based on a new ridgeness measure which provides more accurate vessel localizations. Based on the ridgeness representation, more robust methods of vessel feature detection are presented.

Meanwhile, this study provides an in-depth analysis and thorough evaluation of the proposed methods. For detecting branch point, RBCT is used and detecting branch segments RBSD is used [5]. Input is obtained from the endoscope and preprocessing is done for the removal for the specular reflections, vesselness and ridgeness images are computed by using hessian matrix which is calculated for each pixel. Branching points and branching segments are detected by using circle test and vessel tracking techniques. By calculating the Eigen value using hessian matrix, the vessel features are detected from the tissue surfaces. Where the Proposed System Flowchart is shown in Fig.1.

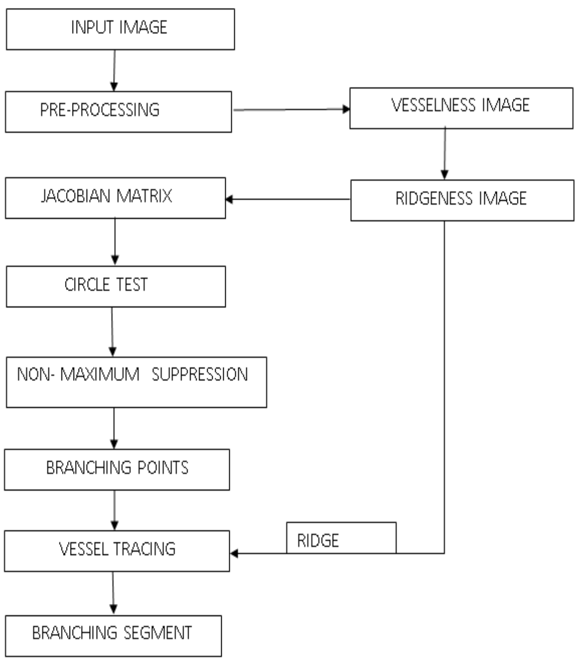

Fig.1Flowchart of Proposed System

The goal of the proposed method is to design efficient algorithms that can detect robust and repeatable MIS image features across different viewpoints and different lighting conditions. It is desirable to develop a feature detector that will turn the drawbacks of the in vivo environment to advantages. The blood vessels are abundant within the intra-abdominal environment, such as on the abdominal wall and on the surface of tissue organs [6]. The explicit extraction of blood vessels provides a large number of new types of features for MIS image analysis.

Feature Detection:
It is a low level image processing operation [9]. That is, it is usually performed as the first operation on an image, and examines every pixel to see if there is a feature present at that pixel. If this is a part of larger algorithm, then the algorithm will typically only examine the image in the region of the feature detection, the input image is usually smoothed by Gaussian kernel in scale space representation and one or several feature images are computed, often expressed in terms of local image derivatives operation.

System Design:
A novel branching point detector, ridgeness-based circle test(RBCT), and a novel branching segment detector, ridgeness based branching segment detection (RBSD) is used [8].

Steps to detect the vessel branching points are:
Step 1: First, image preprocessing, such as specular reflection removal, applied on the input image.
Step 2: Then, Hessian matrix is calculated for each pixel, based on which Frangivesselness and ridgeness are computed.
Step 3: Circle tests are performed to detect branching points.
Step 4: Vessel tracing technique is introduced to detect branching segments.

RESULTS AND DISCUSSION:
Where the Output Image of RBCT image is shown in Fig.2.

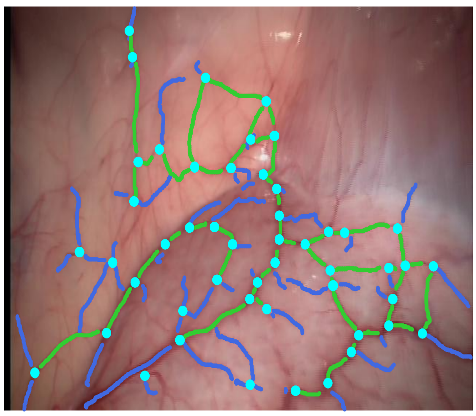

Fig.2 RBCT image

Vessel feature detection by RBSD: branching segments (green), half branching segments (blue), and branching points (cyan dots). In the computation of RBSD there involves three main components. They are

- Ridgeness
- Circle test
- Vessel tracing

Hessian matrix and the calculation of Eigen values in the 2×2 Hessian matrix for each pixel is done. These calculations have been used and analyzed to achieve the real-time speed.

Second, circle tests are performed on each candidate branching point and it is less than 1% of the total number of pixels. Typically, one circle test scans 64 pixels along the circle (11-pixel radius) and less than six computer instructions are executed to scan one pixel.

Third, the RBSD algorithm visits each ridge point at least one time to detect all branching segments and half branching segments. The test data contains images with resolution 640 * 480 from an in vivo MIS dataset. This gives the clear view of segments by without having any background noise.

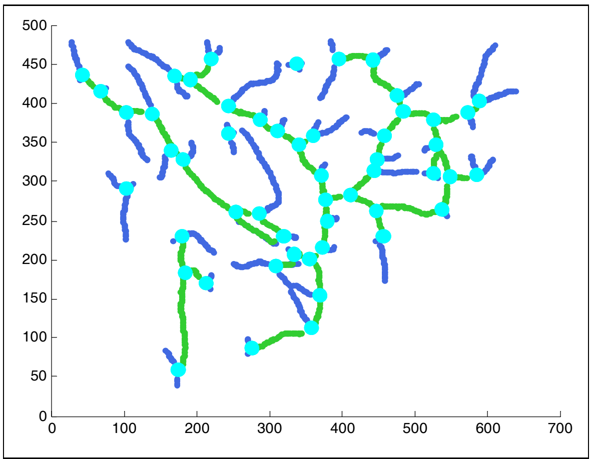

Fig.3 Graphical representation of ridgeness image

The Graphical representation of ridgeness image (Fig.3) shows that it is a plot between ridgeness values and pixel order along the circle obtained from RBSD. It is similar to VBCT, multiple tests are employed at each pixel p on the circle:

1) p(pixel) is bright on the ridgeness image (R(p)>Rpeak)
2) p(pixel) has similar intensity with the center pixel (|I(p)−I(center)|<I similar)

Bifurcations should have three peaks and crossing points have four peaks. If one test is failed, the algorithm will exit early to save computation because vessels have different widths, to detect as many branching points as possible; multiple circle tests with different radii are employed in RBCT.

By using RBSD and RBCT,

- The intensities of the vessels is increased.
- Pixel width is reduced.
- Background noise is reduced.
- Clear view of the image is obtained.

CONCLUSION:

It is well known that feature extraction in MIS images is difficult due to the special imaging environment. The existence of abundant blood vessels in intra-abdominal MIS images provides a solution to overcome this problem. This paper proposes to extract branching segments as features and has quantitatively verified their distinctiveness. Moreover, the vessel features can be combined with general feature points since they extract different structures in the images. Therefore, RBCT and RBSD offer researchers new types of distinctive features for endoscopic image analysis.

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