

Photometric Stereo Endoscopy

Technology #15991

Applications

This technology utilizes photometric stereo imaging to improve endoscopy strategies through the generation of topographical tissue maps and three-dimensional endoscopic images, thereby improving detection of gastrointestinal lesions, including colorectal cancer.

Problem Addressed

Colorectal cancer is the second leading cause of cancer-related death in the United States. Colonoscopy is critical to early detection of cancerous colorectal lesions. Current colonoscopy methods predict tissue morphology based on two-dimensional images obtained from a conventional colonoscope, which cannot be used to extract significant topographic information. Furthermore, illumination of the whole tissue from multiple light sources at once produces images with subtle contrast, hindering detection of lesions. It is estimated that 30% of clinically significant lesions are missed during this routine screening, partly due to limitations in current endoscopy imaging technologies. This invention enables three-dimensional surface image construction and topographical mapping of the tissue of interest to improve detection of colorectal lesions using photometric stereo technology.

Technology

Photometric stereo imaging is an established computer vision technique that acquires a series of images illuminating the same sample from each of a number of different light sources sequentially. This series is used to synthesize a map of the spatial orientation of the object surface for each pixel in an image. Usually, photometric stereo imaging is limited by proximity of light sources and cannot be used in confined spaces. This invention relies on the same principle as photometric stereo imaging, but, importantly, can measure topographic information within a compact system for application in endoscopy.

Photometric stereo endoscopy utilizes one camera to acquire a series of tissue images utilizing multiple light sources, which are already incorporated into most commercial endoscopes. In contrast to traditional endoscopy analysis, a processor is used to analyze each surface image obtained under various illumination directions to determine tissue topography and construct a three-dimensional surface image. This image can be evaluated by endoscopists, and topographic information can be used as input for a computer-aided detection algorithm to improve detection of colorectal cancer lesions.

Advantages

- Maintains compact endoscope size with more sensitive detection of colorectal lesions
- Simplicity and low cost of implementation - in some cases, only requires a software update to existing endoscopes
- Generates topographic surface tissue information that can be used for computer-aided

diagnosis

Categories For This Invention:

Medical Devices
Diagnostic
Surgical
Life Sciences
Clinical Applications
Gastroenterology & Urology
Oncology
Diagnostics
Imaging

Intellectual Property:

Photometric stereo endoscopy
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Publications:

Photometric Stereo Endoscopy
Journal of Biomedical Optics
July 17, 2013, 18(7) 076017
System for Clinical Photometric Stereo Endoscopy
Advanced Biomedical and Clinical Diagnostic Systems XII
February 27, 2014, vol. 8935, p. 89351F

External Links:

Madrid-MIT M+ Vision Consortium, Team Colo
<http://mvisionconsortium.org/portfolio-item/team-colo/>

Image Gallery:

