System for Clinical Photometric Stereo Endoscopy

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250 word Abstract

In many endoscopic applications, tissue topology is a critically important factor in accurately assessing lesions. However, conventional endoscopy captures only color and intensity contrast of the field of view, and consequently, tissue topology can only be inferred through indirect cues. To capture more information about the object shape, our laboratory has recently introduced Photometric Stereo Endoscopy (PSE): a technique that obtains information about the high-spatial-frequency topology of the field of view simultaneously with the conventional color image. In this work, we describe the principles of PSE, progress on our development of a PSE system for human clinical testing, and various solutions to visualize contrast obtained with PSE.

Using a benchtop PSE prototype, we demonstrate PSE imaging of adenomas in *ex vivo* human gastrointestinal tissue. Our clinical PSE system consists of a commercial gastroscope, a set of four optical fibers, and an alignment cap. The custom pieces are biocompatible and can be sterilized before assembly in the endoscopy suite. The resulting endoscope has the same outer diameter as a conventional colonoscope (14 mm), plugs in to a commercial video processor, captures PSE images at 15 Hz, and displays a conventional color movie to the gastroenterologist. We show that this system can capture topological contrast of 1 mm tall

bumps at working distances that are typical of colonoscopy screening. This system will enable PSE to be clinically evaluated as a tool for providing topological contrast in endoscopy.

100 word Abstract

Photometric Stereo Endoscopy (PSE) is a novel technique that obtains information about the high-spatial-frequency topology of the field of view simultaneously with the conventional color image. In this work, we describe the principles of PSE, progress on our development of a PSE system for human clinical testing, and solutions to visualize PSE contrast. Our clinical PSE endoscope has the same outer diameter as a conventional colonoscope, plugs in to a commercial video processor, captures PSE images at 15 Hz, and displays a conventional color movie to the gastroenterologist. Using this system, we show topographical reconstructions of ex-vivo human colon tissue.

Durr Bio

Dr. Durr completed his Ph.D. in Biomedical Engineering at the University of Texas at Austin in 2010. He then worked for a year as a postdoctoral fellow in the Frangioni Lab at Harvard Medical School. In 2011, he joined the Madrid-MIT M+Vision Consortium in the inaugural class of Research Fellows.