Design of an Endoscope Shape Tracker to Guide Navigation in Colonoscopy

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Colonoscopy, the gold-standard for screening colorectal cancer and inflammatory bowel disease, is performed using a flexible endoscope. Flexible endoscopes lack functionality in that only the frontal view from the distal tip is available to aid navigation, creating a tunnel vision effect that often results in disorientation. Our objective is to design a new fiber-based technology that can track the 3D shape of the scope in real-time. This will allow us to create a navigational aid display to guide the clinician in colonoscopy. In the design of our endoscope shape tracker, laser light is sent through a single optical fiber that has been marked with differentiable fluorescent dyes. The shape tracker is designed to be inserted into the biopsy channel of current endoscopes, providing an easy but drastic upgrade. As the fiber bends, laser light leaks out and irradiates the dyes, whose fluorescence is measured by a spectrometer to establish a relationship between the intensity of fluorescence and curvature. Initial findings indicate that there is as much as a ~40% increase in fluorescence intensity when the fiber's bend radius decreased from 58 mm to 11 mm. While our initial results are restricted to one degree of bending at one point along the fiber, we have the basis for building a fully capable multi-axis shape tracker using a single optical fiber. Future work involves optimization of the manufacturing process and sensor resolution.

