Non-invasive Device for Image Acquisition through Super Thin Multimode Fibers

An optical fiber is a glass or plastic fiber that carries light along its length. Optical fibers have been widely used in several imaging devices, such as endoscopes and borescopes, which are utilized in medical and industrial applications in order to capture images from spaces closed to direct vision. In the current multi-fiber endoscope, an image is formed at the input end of the fiber by an optical system, and is transmitted to the output end in the form of individual pixels by a bundle of fibers, one resolvable pixel per fiber. In other words, the relatively large total thickness of an endoscope is due to the large number of optically isolated fibers. The resolution of the optical system forming the image at the input end of the fiber bundle puts a sufficiently large transverse size requirement on the opening, through which the endoscope is to be inserted into the closed space. Such technology results in an invasive technique for penetration when used for medical purposes (e.g., to examine bones or tissues), as well as for industrial purposes (e.g., going through the walls of containers with hazardous materials). Another disadvantage of the traditional methods of the multi-fiber endoscopy is that almost any movement made by the live object will produce continuous phase shift and “breathing” of the scattered complex field, resulting in inaccurate and irresolvable images. There is a need therefore, for much thinner endoscopes and borescopes, which are able to sustain the number of resolvable pixels being characteristic to existing multimode endoscopes.

Technical Details

The present invention developed by UCF engineers, provides a non-invasive device for image acquisition by integrating thinner multimode fibers that will allow safer penetration into the most intricate parts of the human body, or of a complicated mechanical or electronic device. Unlike prior art, the new multimode fibers can support propagation of more than one confined mode without considerable attenuation or phase shifting. These thinner multimode fibers can transmit accurate resolvable images and larger numbers of information bearing pixels by proper encoding and decoding of the transmitted information, and by stabilization of that encoding against the deformation of the guide. Such a novel technology has important commercial applicability on the medical and industrial fields, where it can significantly improve current endoscopes and borescopes.

Benefits

- Flexible and non-invasive device for image acquisition that is five times thinner than anything on the market, providing safe penetration into the human body or into a complicated mechanical or electronic device
- Due to its flexibility, it is possible to maintain the stability of the intensity of the transmitted information against the perturbations introduced by the twists and bends of the cable

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• Able to eliminate noise, phase shifting and attenuation, resulting in an accurate image acquisition

Applications

• Flexible endoscope
• Borescope for mechanical, electrical or hazardous container inspection

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