Fabrication and Test of a Tube-Shaped Artificial Skin Sensor Array for Colonoscope Usages

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Thin-film stretchable sensors are believed to have great applications on devices with curved surfaces. As one type of these sensors, electronic skins (e-skins) for pressure measurement have the potential to provide protection to the human body by feeding back the contact pressure. One of the applications is to monitor the contact pressure from a colonoscope to the colonic wall during a colonoscopy to prevent perforation and hemorrhaging. In this work, a new technique to make ultra-thin, highly stretchable electrodes on thin films has been developed. Then a three-layer tube-shaped tactile sensor with high conformability and stretchability has been successfully built. The pressure generated by various bending curvatures on a colonoscope was then investigated. Finally, a real-time pressure measurement with the whole sensing system on a fake colonoscope in a colon-simulator has been performed. The measured pressure was obtained and visualized on a computer screen. These experiments validated the applicability of the designed sensor and revealed the actual stress distribution on a tube-shaped e-skin sensor array in a colon-simulator. This research could be the starting point of the effort to upgrade the strategies of colonoscopy for safer operations and could provide new routines to optimize tactile sensor design for other medical applications.

Biography

Dr. Debao Zhou is a tenured professor in the Department of Mechanical and Industrial Engineering (MIE), and a Distinguished Visiting Professor in Tianjin Polytechnic University. He joined UMD as a tenure-track assistant professor in 2009. Dr. Zhou teaches in the areas of signal processing, kinematics, control, robotics, machine vision and artificial intelligence. He received 2013 SCSE Young Teacher Award. Dr. Zhou's research interests include conformable artificial skin sensor and smart materials, vision system, modeling and simulation of surgical processes, robotics, and system dynamics and control. Dr. Zhou has received various funding as principal investigator (PI) or co-PI that are related to his teaching and research. His research has led to principal author and co-authoring of near 90 peer reviewed journal and conference publications, such as IEEE Sensors Journal, Smart Materials and Structures, Sensors and Actuators A: Physical, and IEEE Transactions on Nanotechnology. Dr. Zhou has been on several proposal review panels including National Science Foundation. He severed on several International Associations including the IEEE Robotics & Automation Society Technical Committee on Manufacturing Automation and the ASME Energy Harvesting Technical Committee, etc.

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