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Microengineered Force Sensors and Haptic Feedback System for Catheter Contact Force

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Host: Dr Deepak Choudhury

Seminar Abstract

Minimally Invasive Surgery (MIS) reduce the complicated process of the traditional surgery with fast postprocedural recovery and less hospital expenditure cost. Though it looks promising, it requires specific surgical tools (such as catheters and fine instruments) and techniques to perform the surgery. Catheters that can measure several physiological parameters, including tissue contact force during MIS procedures, require microsensors. Especially in ablation procedures, the required force is between 0.2 N and 0.3 N for an efficient lesion formation.

Micro-electro-mechanical-system (MEMS) technology offers advantages of miniaturization and high sensitivity within the dimensional constraints provided by the catheters. Given the challenges in the MIS procedures, integration of MEMS sensor within the catheter, along with a vibrotactile platform for force feedback, offers a promising solution. This approach would result in a reliable smart catheter technology which can provide real-time haptic feedback to the operators. In this presentation a catheter integrated with a MEMS-based force sensor and vibro-haptic force feedback to perform a manual MIS procedure will be shown. Towards this, the sensors that are designed and fabricated will be presented and experimental studies performed to integrate the better sensitive force sensor with the catheter will be discussed. This presentation also discusses on facile 3D-integrated sensor packaging (using plastic, PCB, and spring-loaded pins) to realize electrical interconnections between the fabricated force sensor and measurement system, which can also be adapted for various applications.

About the Speaker

I did my Ph.D. from the Department of Electronic Systems Engineering, Indian Institute of Science, Bangalore in 2022. My research work was focused on developing a manual biomedical catheter prototype that integrates MEMS force sensor and signal conditioning devices to provide haptic feedback to the electrophysiologists during minimally invasive surgery. I joined Biomanufacturing Devices Group (BMD) in BTI to contribute my expertise in research with translational and industrial value.

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