Wireless Monitoring of Intraluminal Prostheses

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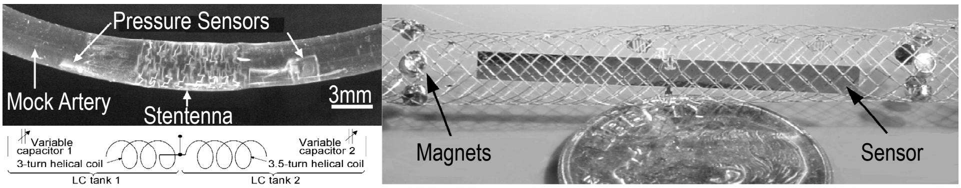

Left – A dual-inductor stentenna with two pressure sensors and its equivalent circuit, Right – A magnetoelastic sensor mounted in a photochemical-machined stent, with integrated magnets biasing the sensor for optimal performance.

This project investigates stents that exploit planar microfabrication technologies and their applications to wireless sensing of blood pressure, flow rate, and tissue accumulation (restenosis). A stent typically has mesh-like walls in a tubular shape, and—once positioned by a catheter—is either expanded radially by the inflation of an angioplasty balloon or is self-expanding upon retraction of a delivery sheath. The vast majority of commercialized stents are made by either laser machining of metal tubes, or by braiding metal filaments into a tubular shape. However, laser-machining limits throughput, and braiding limits the incorporation of features that allow for convenient integration with sensors. High-throughput patterning of metal microstructures can be achieved utilizing batch-compatible micro-electro-discharge machining (μEDM), which has been applied to manufactured stents that demonstrate better mechanical performance than some commercial stents. Stents with features that facilitate sensor integration can also be fabricated in a batch process using photochemical machining (PCM). This effort has been further extended to develop an inductive antenna stent, or stentenna, and to integrate it with micromachined pressure sensors and electromagnetic flow sensors for wireless flow rate sensing in coronary applications. Additionally, the incorporation of resonant magnetoelastic sensors allowing for wireless sensing of viscosity and tissue accumulation in biliary applications is being explored. This project is supported in part by a National Science Foundation Graduate Fellowship, by the Engineering Research Centers Program of the National Science Foundation under award number EEC-9986866, and by the University of Michigan.