Infrared Endovascular Navigation for Enhanced Sensing and Treatment

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We present recent results toward development of an endovascular navigation system comprised of a programmable surgical wire with infrared (IR) emitters and detectors on the tip. This system is intended for enhanced sensing and medical treatment, particularly for remote treatment sites, including telemedicine. Successful demonstration of this system has the potential to enhance urgent care provided by field surgeons and medics, as well as to open opportunities for remote practitioners minimally to observe and provide expertise and maximally to operate or assist in the field by expertly guiding the wire. The proposed device has great potential (1) to enable imaging and sensing deeper in the head and body, (2) to increase the sensitivity of infrared measurements of biomarkers, (3) to result in more efficient and safer navigation of catheters and surgical instruments for treatment of aneurysms and other endovascular procedures, especially in remote settings, and (4) to reduce exposure of patient and surgeon to harmful radiation by employing ultrasound or infrared imaging techniques. This endovascular device uses wire made of a shape-memory alloy, such as Nitinol, to navigate arteries for treatment. Nitinol has prior FDA approval and a long record of biocompatibility, especially when an oxide and/or another passivating layer is applied. The wire is programmed to bend at temperatures above core body temperature and navigate arterial branches using current control. Blind navigation of wires by physical pushing can result in rupture of vessel walls with lethal consequences. Stents have been used to deploy deep brain stimulation devices, but no deep system for *in vivo* near-infrared spectroscopy exists. The ability to effectively insert and guide an infrared emitter to the brain for neurological monitoring and treatment would be of significant benefit in the operating room, particularly during cardiothoracic surgery or neurosurgery.

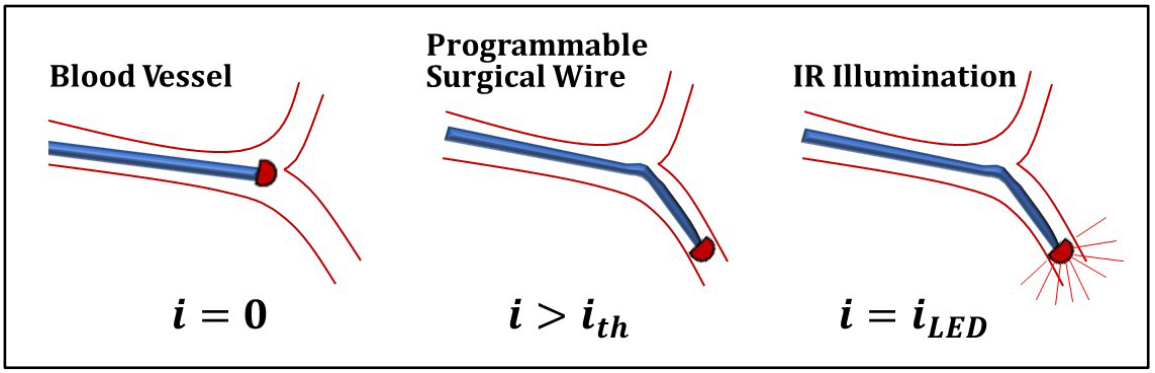

Figure 1 Current-controlled endovascular navigation and IR sensing using a programmable surgical wire comprised of a shape-memory alloy.

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