

Current sensing for navigated electrosurgery

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Introduction: Tracked power-tools are routinely used in computer-assisted intervention and surgical systems. In order to properly perform temporal and spatial monitoring of the tracked tool with the navigation system, it is important to know when the tool, such as an electrosurgical cauterizer, is being activated during surgery. The objective of this work is to implement a general purpose current sensor that can be augmented to tracked surgical devices in order to inform the surgeon and the navigation system when the tool is activated.

Methods: Since clinically applied power tools are approved by FDA and/or Canada Health, an isolated sensing and feedback system is required that does not interfere with the tool in any manner. The current sensing system must be compatible with electromagnetic tracking and electrically isolated from the surgical device. A Hall Effect current sensor (Allegro ACS712) is integrated with the electrosurgical device in an isolated manner (Figure 1). The sensor measures the magnetic field produced by the cable that supplies the current to the electrosurgical device. The output voltage produced by the sensor is fed into an analog input pin of the microcontroller (Arduino Uno). The microcontroller is programmed to turn on a LED when a specific voltage is received. This LED provides visual confirmation for the surgeons that current is flowing into the electrosurgical device. We integrate the sensor with the SlicerIGT open source (www.SlicerIGT.org) surgical navigation system, in which tool tracking functions are implemented using the PLUS toolkit (www.plustoolkit.org) [1]. The microcontroller communicates the voltage information through a serial USB connection via the PLUS toolkit to SlicerIGT. The current sensor is first being applied in EM-navigated breast-conserving surgery [2] to sense the current of the electrosurgery cauterizer. The systems schematic is shown in Figure 2. The sensor and microcontroller are placed far (approximately 2 m) away from the patient in order to prevent a galvanic connection to the patient, as well as to minimize the effect of the EM tracking on the sensor.

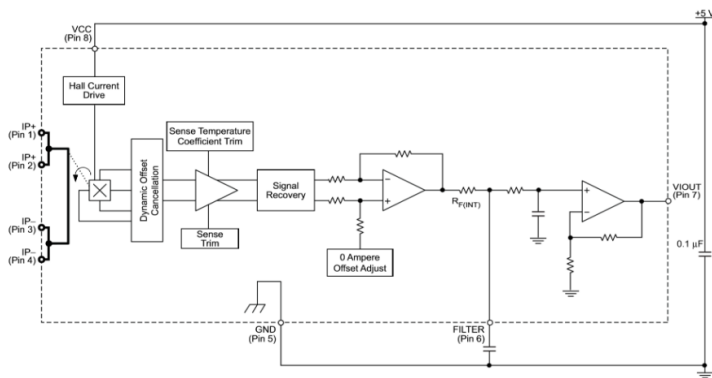


Figure 1: Functional block diagram of Allegro ACS712 Hall Effect current sensor

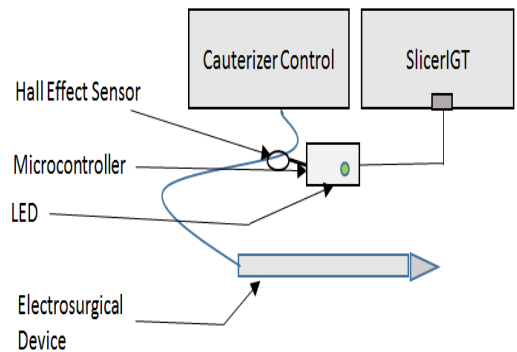


Figure 2: Schematics of the current sensing feedback system

Conclusions: The current sensing device has been designed and is currently being implemented and tested within the context of EM-navigated breast-conserving surgery. The device represents no risk to the patient and thus it can be promptly translated for clinical evaluation within our ongoing patient trial.

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