**Developing an Open-Source Hardware and Software Platform for High Current Electrical Impedance Tomography Measurement**

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ABSTRACT

Electrical impedance tomography (EIT) is a nondestructive technique in which the local impedance within a structure is reconstructed based on measurements of voltage drop across pairs of electrodes placed on the outside of that structure while current is being injected across other pairs of electrodes. This technique is used within the medical world for noninvasive imaging of the body. Also within the medical world, there have been several efforts for advancing the technique by making it widely available and accessible to researchers by lowering barriers to entry with open-source hardware and software [1-3].

However, in the medical context, the “part under inspection” is the human body, which has significantly higher electrical resistivity than the types of materials that are of interest in the typical nondestructive evaluation (NDE) context. Even for inspections in composite materials, which have significantly lower conductivities than materials like metals, the conductivity is still several orders of magnitude higher than many tissues found in the human body. Though, it is important to note that conductivity in composites is often highly anisotropic and can vary across several orders of magnitude depending on orientation and layup. Regardless, significantly higher levels of current are required to perform EIT on conventional materials as compared to medical imaging. As a result, there are limitations to what current open-source hardware designs can handle, as many rely on injected current passing directly through a multiplexer, which typically significantly limits the maximum current, especially in chips designed for large numbers of channels.

In this effort, an open-source hardware platform is being developed for high current EIT applications. An initial hardware implementation provides 32 channels utilizing a low-cost off-the-shelf data acquisition system, an Arduino and multiplexers for control of the injection path, and Metal-Oxide-Semiconductor Field-Effect-Transistors (MOSFETs) to provide switching between positive current injection input, negative current injection input, and a not connected state for all electrodes. The current injection path can be cycled arbitrarily between any combination of electrodes via Python script from a computer. Components are mounted on custom-designed printed circuit boards. Initial test results will be shown. Integration with a Python-based open-source data acquisition package Dataguzzler [4] enables rapid measurements. Initial testing results will be presented, along with plans for future development.

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