DETECTION OF INTRAVENTRICULAR AND INTRA-PERITONEAL BLEEDING

Intraventricular hemorrhage is a common cause of death in premature human infants. As preventative measures and treatments become available, a method for monitoring and detection is required. Electrical impedance tomography (EIT) is a viable monitoring method compared to modalities such as ultrasound, MRI or CT because of its low cost and contrast sensitivity to blood. We have developed a novel electrode layout based on the neonate anatomy to image, locate and quantify bleeding in the head’s center.

We are also pilot-testing an application of Electrical Impedance Tomography to detection and quantification of bleeding following blunt trauma. We are able to detect peritoneal infusions of conductive fluid at rates within about 30 ml/minute using a device placed on the anterior abdomen.

TRANSCRANIAL DIRECT CURRENT STIMULATION

Transcranial Direct Current Stimulation (tDCS) involves the application of relatively weak direct current to the brain through the scalp with the aim of modulating underlying cerebral function. Little is known of the neuroanatomic specificity of transcranial direct current stimulation (tDCS) in humans. We are simulating current density distributions in a realistic human head model and patient-specific models. We have found that existing electrode topologies do not concentrate current as assumed. Therefore, our main aim at present is to optimize delivery of current to targeted structures while avoiding of sensitive regions.

MAGNETIC RESONANCE ELECTRICAL IMPEDANCE TOMOGRAPHY

Magnetic resonance electrical impedance tomography (MREIT) was developed to improve electrical image resolution. Because injected electrical currents produces a magnetic as well as electric field inside an object, we measure the induced internal magnetic flux density data using an MRI scanner and use these data to produce conductivity images with similar resolution to conventional MRI. We initiated the area of high-field MREIT using scanners at the Advanced Magnetic Resonance Imaging and Spectroscopy (AMRIS) facility at the McKnight Brain Institute, and are currently developing MREIT for single-cell imaging.