Capitol Graduate Research Summit

Non-Invasive Detection of Intracranial Fluid Volume Shifts Using Wearable Headband

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Pathological increases in cerebral blood or cerebrospinal fluid volume have been linked to neurological complications and even death in patients who have had hemorrhagic strokes, traumatic brain injury, or have undergone neurosurgical or neurological treatments. The development of non-invasive techniques to measure and monitor shifts in intracranial volume have included the use of ultrasound, magnetic resonance imaging (MRI), and computed tomography (CT). However, these methods require expensive, specialized equipment and personnel that may not be available in many rural communities across rural Kansas. This study's focus was to develop a point-of-care, wearable headband capable of non-invasively detecting shifts in intracranial fluid volume in limited resource settings. The sensor consists of a single baseline component configured into a rectangular planar spiral with a self-resonant frequency response when impinged upon by external radio frequency sweeps. Preliminary human tests, approved by the Institutional Review Board (IRB) of Wichita State University, were performed to determine the feasibility of detecting fluid volume shifts. Participants were placed in a 15° head down tilt for approximately 30 minutes to induce an increase in intracranial fluid volume. During this induced bio-fluid shift, the sensor was applied to the forehead and data was collected. Validation of the increase in intracranial fluid volume was performed through non-invasive ultrasound measurements of the optic nerve. This study establishes the foundation for future work to optimize the sensor capabilities to monitor shifts in fluid volume and assist with medical scenarios including stroke, cerebral hemorrhage, or traumatic brain injury in limited resource environments.