Optimization of Electroencephalography Reference Layer

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Simultaneous Electroencephalography & Functional Magnetic Resonance Imaging, (EEG-fMRI), is a brain imaging technique that combines the high spatial resolution of fMRI with the high temporal resolution of EEG. However, the usage of magnets in fMRI induces electrical currents which are also picked up by the EEG scalp electrodes, this is an effect of Faraday's Law which creates electrical noise. Inside the magnetic field the cardiovascular system of the human skull also creates artifacts known as Ballistocardiogram (BCG) noise and this reduces the clarity of EEG data. Researchers try to remove these artifacts by designing and producing reference layers which consist of insulating and conductive pieces of fabric that collect BCG noise, allowing for the reduction of artifacts in post-hoc analysis. These Reference Layers tend to be crudely made to fit researchers' specific needs. In the Lewis Lab, we've created a standardized design for a double-sided Reference Cap, consisting of a single fabric that has holes cut out for EEG Scalp Electrodes. This fabric has an insulating spandex side that makes contact with the scalp and a nylon fabric side that makes contact with EEG Reference Electrodes. This nylon fabric is coated in poly(3,4-ethylenedioxythiophene) polystyrene sulfonate (PEDOT:PSS), an electrically conductive polymer that is safe for usage in MRI machines. With this design, we are able to provide a design that is easy to replicate and assemble in any lab. This design functions well as a reference layer, allowing researchers to attenuate noise found during EEG-fMRI imaging.