Development of a Simulated Platform That Replicates the Visual System Using Large Scale Neural Modeling and Performs Deep Brain Stimulation Using the Virtual Brain to Produce Synthetic Sight for the Visually Impaired

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In past work, invasive implants that implement a process called deep brain stimulation (DBS) in order to regenerate sight for the visually impaired have been investigated. DBS is a surgical procedure that involves the implantation of electrodes in specific regions of the brain, which are later utilized to transmit electrical impulses to alleviate symptoms and regenerate vision. Visual cortex stimulation as a treatment for visual impairments has had successful results but is still under investigation through clinical trials in order to evaluate the safety and efficacy of this procedure and is expensive, causing it to not be widely adopted. Therefore, the goal of this project was to develop an accessible platform/software for surgeons and researchers to simulate this operation based on individualized patient data in order to predict complications that may occur and to determine whether the operation would be suitable for the specific patient. This was accomplished by developing software to simulate the visual system and the transmission of visual stimulus using large scale neural modeling. The Virtual Brain libraries were then used to perform DBS, to administer current to the visual cortex. A machine learning algorithm (GAN) was used to obtain the generated fMRI/EEG and decode it into visual activity. The results were analyzed through the comparison of the input stimuli and output visual image through the development of an inception network that presented an accuracy of 0.76 and an accuracy of 2.024. In conclusion, a proof of concept was developed and this software takes a step towards improving DBS surgical procedures in the realm of visual impairment by providing surgeons with tools that aren't currently available to perform/test this process virtually.