Grounding the Untouchable: Physicalization of Cortical fMRI Data

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1 Introduction

Data physicalization encodes data in the geometry or other material properties of physical objects, giving the data a physical shape (Djavaherpour, 2021; Jansen, 2015). In comparison to digital renditions, physicalization also employs non-visual senses, resulting in multimodal affordances and a cohesive, multisensory experience of abstract data. By engaging various senses and providing an opportunity for active exploration, data physicalizations support embodied understanding and later information retrieval, holding benefits for formal and informal educational settings.

In our project, our aim is to create an open access data physicalization pipeline, using Python scripting. We are analyzing cortical fMRI surface data and developing a meaningful physical model with 3D printing. By encoding the structural and functional data in a multimodal brain model, we provide visual and tactile exploration affordances.

2 Methods

We are using an open somatotopic mapping dataset (Ma, 2022) to explore the physicalization opportunities of fMRI data. Employing Python scripting, our aim is to develop an easy-to-understand data visualization and physical data rendering pipeline. Our model is built using the pial native surfaces (mesh extracted from the volumetric MRI data, defining the pia meninges as the boundary of the cerebrum) and the results of the GLM task analysis. Our decision to visualize the brain activation of the trials involving finger movements alludes to the activation patterns of an individual's brain while exploring the model tactilely.

We are developing meshes of the structural surface and activation, combined in the virtual model which is then converted to be 3D printed by a multimaterial printer using different infill (density) values and colors to separate activated and non-activated cortical areas.

3 Results

Our project bears two distinct results. Firstly, we are developing a meaningful virtual and a 3D printed physical model to aid data interactions (e.g. virtual/physical rotation, tactile exploration). Secondly, we are providing open access to the user-friendly data visualization and physicalization pipeline, including scripts and instructions.

4 Discussion

The physicalization of neuroimaging data is a yet underresearched field, yielding possibilities to explore effective science communication and make neuroscientific data more accessible.

Throughout our project, we are outlining the opportunities of multimodal neuroimaging data visualization and physicalization, developing an efficient pipeline. We are exploring the challenges of the physical rendering of complex medical data. Our results can be employed in educational and artistic settings, connecting neuroscientific data with the general public.

References

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