Fetal functional MRI brain masking using open data.

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Editorial

The use of fetal Resting-State Functional Magnetic Resonance Imaging (rs-fMRI) to characterise brain development before birth has emerged as a key new technique. Despite the fast and broad use of this method, we still lack neuroimaging processing pipelines capable of addressing the particular problems associated with this data source. Resting-State Functional Magnetic Resonance imaging (rs-fMRI) has emerged as a useful technique for investigating the evolution of the brain's network architecture. In recent years, this approach has been applied to the human brain in prenatal, providing access to a hitherto inaccessible functional development phase. Fetal fMRI research offers the potential to shed light on the type and manner in which the brain's network architecture is first constructed, providing important new insights into neurodevelopmental beginnings. Despite this promise, development has been sluggish, in part due to a lack of image analysis tools designed specifically for prenatal imaging data. Though there are several tools and software packages available for fMRI analysis, these techniques were built with adult and child data in mind and meet unique challenges when used to prenatal functional data. Image capture and image post-processing are two areas where advancements in foetal MRI technique have been realised. Image acquisition has improved largely in foetal structural MRI, namely in anatomical (mostly T2 HASTE; Half-Fourier Acquisition Single-shot Turbo spin Echo imaging) and Diffusion Tensor Imaging (DTI).

The most time-consuming phase in foetal fMRI preprocessing is distinguishing the foetal brain from the surrounding maternal compartment at each acquisition time point. The creation of an example mask that designates all in-brain voxels achieves differentiation. This mask is required for the whole preprocessing workflow, as well as later activation or connection studies. Instead of the dark backdrop seen in adult brain pictures, there is surrounding maternal tissue in foetal scans. The embryonic brain is not in a normal orientation, and shape assumptions do not hold, rendering adult brain segmentation techniques' atlas-based extraction priors inapplicable. As a result, prior investigations depended on the creation of brain masks by hand. Offering an automated solution to the challenge of fetal brain segmentation from surrounding tissue in this paper. By trained a Convolutional Neural Network (CNN) to replace this time-consuming pre-processing step using a large corpus of manually traced human fetal fMRI masks. CNNs are a useful technique for finding complicated, non-linear patterns in spatially organised high-dimensional data. When compared to structural data, functional data usually has a lower resolution and, owing to mobility, necessitates a greater number of individual segmentations. The vast majority of available foetal MRI datasets used for deep learning brain segmentation were acquired in clinical settings where the primary goal is to examine foetal brain anatomy. The data from a scientific research programme is used in this work to characterise the development of functioning brain systems beginning in utero. The scanning methodology used in this investigation prioritised functional MRI data gathering, and most functional scanning sessions did not include an anatomical scan. As a result, existing structural brain segmentation models are inadequate for the foetal functional MRI data employed in this study. This study offers an early step toward a completely comprehensive, open-source approach for fetal functional MRI data preparation, with publicly shared code and data.

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