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CERTIFICATE OF PRESENTATION

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A New fMRI Simulator with Stimulation Capability of Anatomical Brain Regions

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Introduction

Every fMRI image is obtained by processing a temporal sequence of MR images recorded through BOLD-contrast imaging. Since BOLD imaging is time-consuming and expensive, simulated fMRI data can be used as an alternative ground truth for evaluating fMRI analysis methods (Drobnjak et-al., 2006; Allen et-al. 2012; Türkay, 2009; Hilla et-al., 2017). In most fMRI simulators, the anatomical position of the activation stimulus was not precisely determined. In this paper, we propose a new method to overcome this shortcoming.

Methods

As shown in Fig. 1, the proposed fMRI simulator takes advantage of a resting-state (RS) T2-weithed MR dataset and its corresponding T1-weighted MR image. First, the T1-weighted MR image is registered with the ICBM152 atlas (Fonov et-al., 2011) by using rigid (Saadatmand-Tarzjan et-al., 2016) and non-rigid (Sarani&Saadatmand-Tarzjan, 2013) transformations. Then, the MR image is segmented by using the TPM atlas (Ashburner and Friston, 2011). Next, the

gray-matter of the brain is further separated into different anatomical regions given by the labeled MICCAI2012 atlas (http://Neuromorphometrics.com/). All the above atlases are illustrated in Fig. 2. Then, the stimulation signal is obtained by convolving the hemodynamic response function (HRF) with the boxcar function of stimulus pattern of simulated task. Finally, the simulated fMRI data is obtained by adding the stimulation signal to voxels of the brain region of interest previously determined by the labeled atlas.

Results

We computed a simulated fMRI data by using a temporal sequence of RS-MR images with 36-s duration (http://www.fil.ion.ucl.ac.uk/spm/data/spDCM/). The simulated task consisted of three 12-s periods; each with 6-s off and 6-s on conditions. As shown in Fig 3, all stimulation regions of the simulated fMRI data were successfully detected by using the general linear model of the SPM toolbox (http://www.fil.ion.ucl.ac.uk/spm/software/spm12/).

Conclusion

In this paper, we proposed a new fMRI simulator to induce stimulation pattern in every anatomical region of interest.

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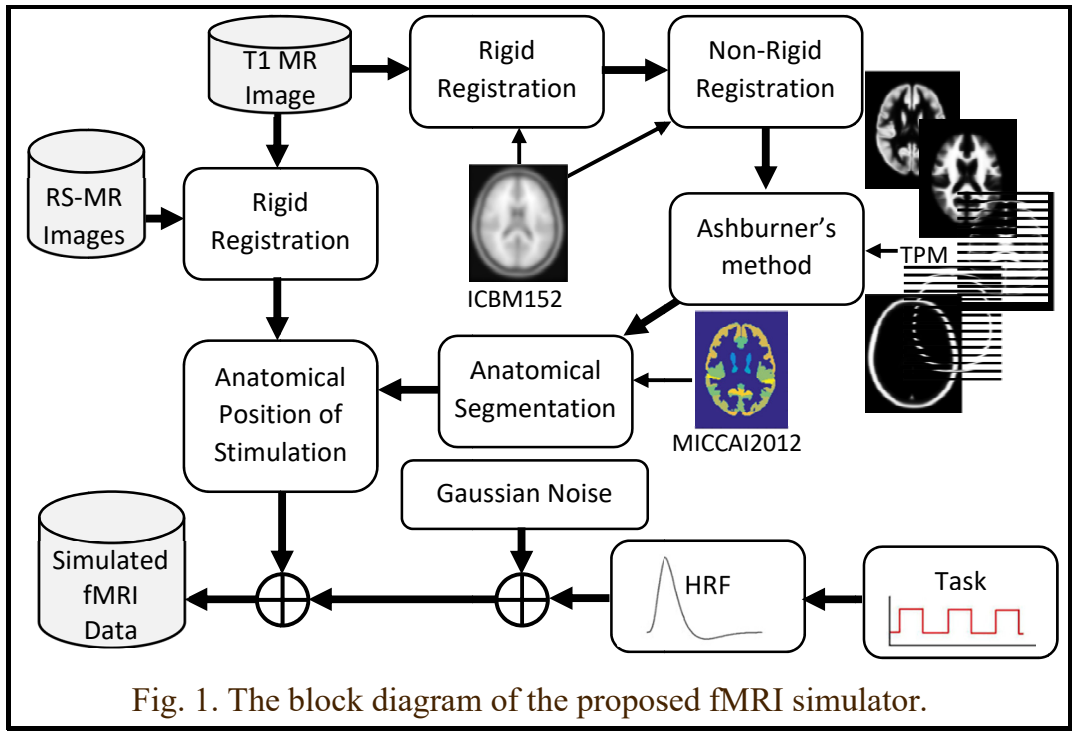

Fig. 1. The block diagram of the proposed fMRI simulator.

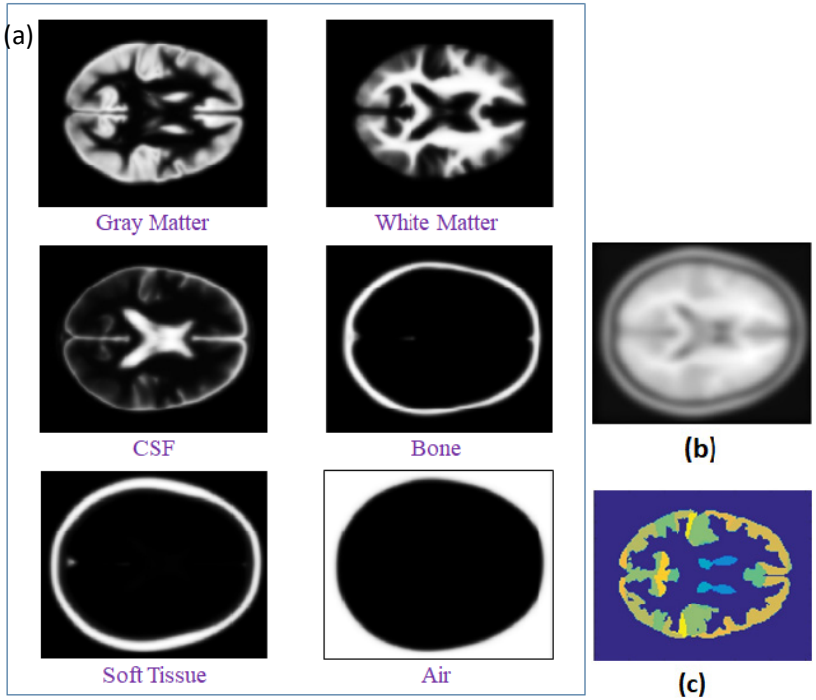

Fig. 2. All digital atlases used in the proposed algorithm including (a) TPM, (b) ICBM152, and (c) MICCAI2012.

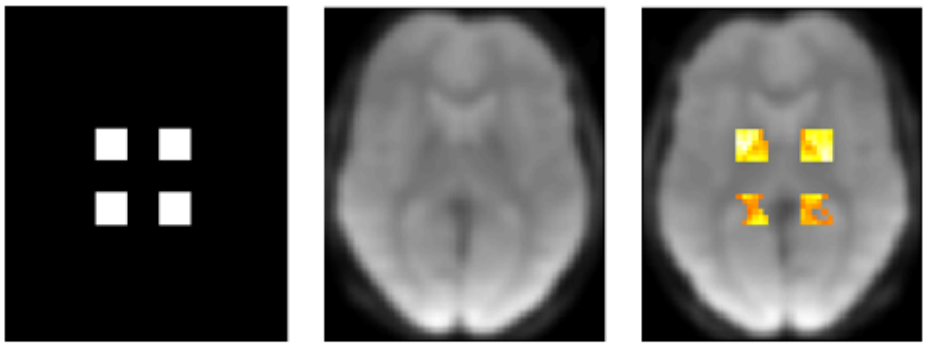

Fig. 3. (a) The regions of interest used to induce the stimulus pattern, (b) one slice of the simulated fMRI data, and (c) all stimulation regions detected by processing the simulated data through the SPM toolbox.