MRI CHILDREN ATLAS BASED ON A ROBUST ESTIMATOR

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Introduction

Brain normalization for fMRI and VBM, usually is done using adult templates [1]. This reliance on adult data poses problems when pediatric brain studies are analyzed [2], one solution to this problem is to produce a pediatric template. At present time there are some templates adjusted to different the ages, which can describe some structures [1,2]. To develop an MRI group atlas or template requires different linear preprocesses acted on the 3D data sets, the first step is the realignment of all the brain MR volumes acquired for the template. In this work we compare three different processes of realignment and two MR acquisition planes, combined with the use of robust estimation [3], to obtain a one child MR template.

Methods

After the parental informed consent was obtained, one healthy eight years old child, with normal development and periodic pediatric visits, participated in three different imaging sessions to acquire twenty independent 3D MRI series with a Philips Intera 1.0T scanner (Best, The Netherlands). Using a whole-brain, T1-weighted Fast Feel Echo (FFE) sequence in axial plane for ten series and coronal plane for the other ten series (TR = 25 ms, TE = 6.90 ms, Matrix = 256 x 256 x 140, FOV = 230, RFOV = 80 %, resolution = 0.82 x 0.82 x 1 mm, flip angle = 30^0 and 140 slices) in a total scan time of 6.38 min. All images were exported to a off line workstation for analysis transferring all data with DICOM format. Statistical Parametric Mapping (SPM5) [3], Automated Image Registration (AIR) [4], and a manual process in MEDx [5] were used to realign all the image volumes using the T1 (ICMB305) template on SPM5, for the first two automatic processes, the manual process was executed with eight reference points (anterior and posterior commissures, and the borders of the temporal, parietal and occipital lobes). Three volumes template were estimates using a robust local estimator –the mode- centered in each voxel, for the ten acquisitions, least median of squares “LMS”, was calculated as the statistical error to evaluate the “goodness of the estimator” to generate a variance map to compare the three different realignment processes.

Results

A one child with robust estimators –mode- atlas was build, and the statistical variability map was estimated for the manual and computational aligned (SPM5, AIR) templates (Figure 1). The mode atlas that presented the better localized and lower statistical variability is the based on the manual realignment. The AIR aligned sets presented good resolution of cortical an sub-cortical structures, which suggest a better realignment process, nevertheless the variability map for the SPM5 process present smaller variance.

Conclusion

The manual aligned images generated the template with the lower statistical variation map and better cortical and sub-cortical structural characteristics. For the automatic computerized alignment processes the AIR based template presented a better cortical and sub-cortical structural detail when compared with the SPM realign process. Axial plane acquisition was the easier to handle in the image analysis programs without any substantial statistical variability difference compared to the coronal plane volumes. This one child template can be used as seed for the registration for an multi-subject children atlas for children of this age, and the use of a robust estimator will provide a better estimation for the case of a limited number of subjects.

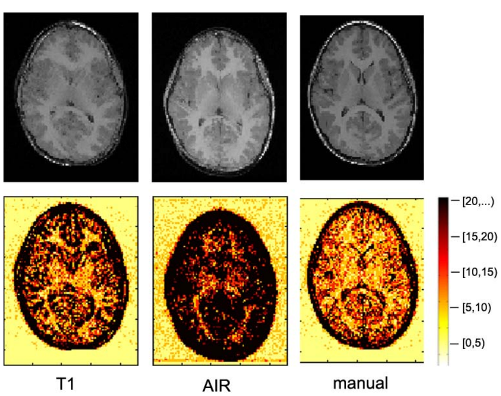

Figure 1. Upper; Mode template images for the three different alignment processes. Lower; Satistical variability maps for each realignment process.

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