Automatic localization of the mid-sagittal plane in human brain imaging

The human brain is anatomically organized into two approximately mirrored halves, meaning that there is a coarse level of bilateral or reflection symmetry. In automated processing of images of the human brain, this property is frequently exploited (e.g. Leung et al. 2010, Eskildsen et al. 2011), but generally in an implicit fashion. Methods for explicitly identifying the mirror plane located between the right and the left half exist, but depend on other preprocessing steps (brain extraction and/or spatial normalization, Prima et al. 2002) or manual interaction. Furthermore, these methods come without extensive validation. In the following, the anatomical mirror plane will be referred to as the midsagittal plane (MSP).

In this project, we propose to develop an automatic technique for estimating the MSP on three-dimensional T1-weighted magnetic resonance images of the human brain. The proposed technique will be based on flipping the three-dimensional image along the left-right axis, aligning the flipped image with the original using nonrigid image registration (Rueckert et al. 1998), and locating the sagittal plane in the original image that is most similar to the transformed flipped image. (This plane may or may not be parallel with the sagittal plane of the scanner). The plane thus identified may be a good approximation of the MSP.

The procedure dispenses with all other preprocessing and may therefore be helpful in achieving greater accuracy in procedures such as spatial normalization, intracranial volume measurement, brain extraction/skull stripping and anatomical segmentation. The possibility of iterative processing between these procedures and MSP estimation will be explored.

The accuracy of the procedure will be assessed by comparison with manual MSP positioning on a limited number of images. Further means of assessing MSP quality assessment will be developed, for example by qualitative comparison of brain extractions aided and unaided by MSP estimation.

The project can be extended. This could include applying the method to images of other modalities (PET, CT) and other species (macaques, rats). The combination of automatic MSP determination and quantitative anatomical segmentation (MAPER; Heckemann RA et al. 2010) also allows, in principle, the fully automatic determination of image orientation including right-left orientation, by exploiting known minor cerebral asymmetries.

References


URL http://dx.doi.org/10.1016/j.neuroimage.2010.12.067


URL http://dx.doi.org/10.1016/j.neuroimage.2011.09.012

URL http://dx.doi.org/10.1109/42.993131

**Environnement**

Ce stage convient à un étudiant de master 1, master recherche, master professionnel, 2ème ou 3ème année d'école d'ingénieur.

L'étudiant sera encadré par Rolf Heckemann (MD, PhD), chercheur dans l'équipe de neuroimagerie fonctionnelle de la Fondation Neurodis dirigée par Alexander Hammers (MD, PhD, HDR, http://www.fondation-neurodis.org/La-Chaire-d-Excellence-en-Neur.80.0.html).


Le sujet de ce stage est prévu pour un travail de 2-3 mois. Il pourra être complété par un deuxième thème complémentaire pour un stage d'une durée de 5-6 mois.

La convention de stage prévoit une indemnité d'un montant égal à 1/3 du SMIC brut.

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