White Matter Segmentation of Brain MRI during Infancy

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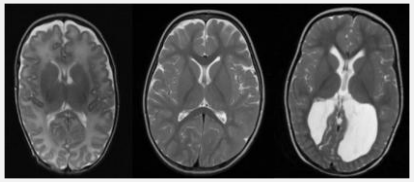
Introduction: Cerebral palsy is a neurodevelopment impairment which can be detected by analysing the inconsistencies in the white matter.

Aim: This study describes a novel automatic white matter segmentation approach for premature infant data.

Challenges:

- Infants brain are at an early state of development
- Intensity values inconsistences throughout the volume
- Shape and brain structure differ from one patient to another
- No clear boundaries between grey matter and white matter
- Each dataset has to be manually segmented for numerical evaluation



Brain Extraction: is a pre-processing step of Magnetic Resonance Imaging (MRI) brain segmentation. This procedure involves the removal of all non-brain tissue such as skull, fluid, fat and body parts.

Bias Field Correction: Bias field is a low-frequency multiplicative field arising from an inhomogeneity in the magnetic field during the MR acquisition and is causing a slow varying shading affect in the MRI within the same tissue. This method removes the intensity inhomogeneities.

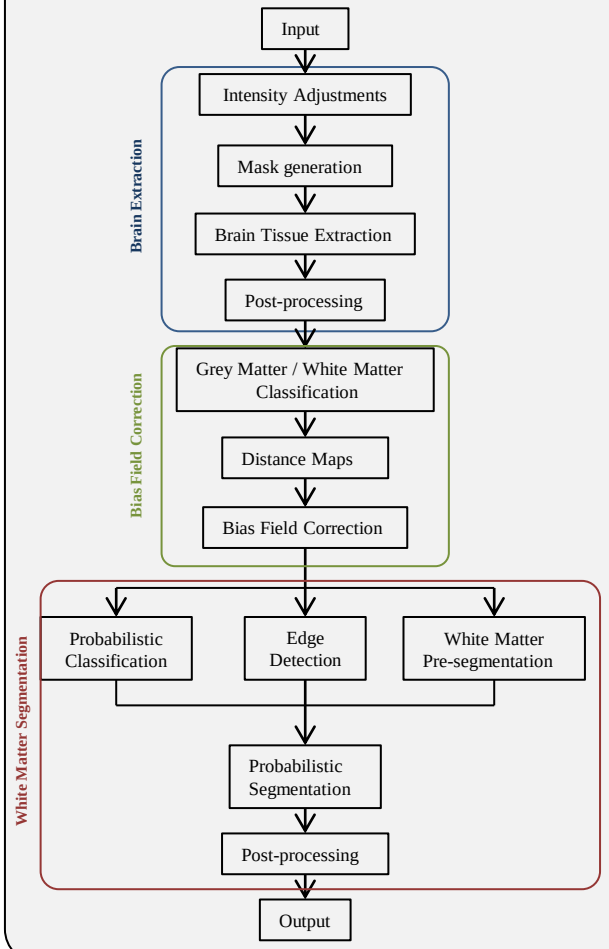
White Matter Segmentation: segments and measures the white matter tissue volume in the infant brain. The measurements will then be analysed by our clinical experts which aim to use the results as an indicator for an early diagnosis of neurodevelopment impairment

MRI data acquisition:

The database consists of T2 brain volume MRI (TR: 2660; TE: 142.7; FOV: 16x16 cm) of premature infants which have been imaged at full term equivalent in Children's University Hospital. Each slice has a thickness of 1mm and a dimension of 512x512 pixels.

The 15 datasets were manually marked in conjunction with a clinical expert from Children's University Hospital, Dublin, Ireland.

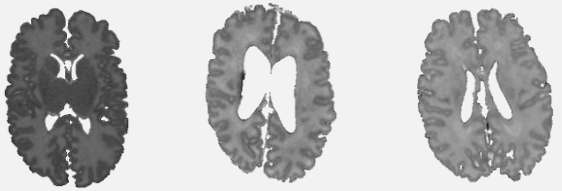
Proposed approach:



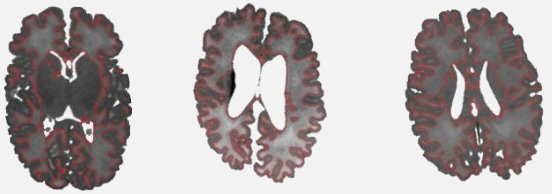
Results:

Brain Extraction results

Bias Field Correction results



White Matter Segmentation results



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Conclusion: In this study, a novel, fully automatic white matter segmentation algorithm for infant brain MRI is proposed. The designed method is composed of three main computational components and shows positive experimental results.