Quality control for fetal brain MRI

Thomas Sanchez, Meritxell Bach Cuadra
CIBM SP CHUV-UNIL

CONTEXT

The multi-FACT study in a few words

Goal. Characterize fetal abnormal brain trajectory using MRI in a large scale, multi-centric retrospective study

Challenge. Privacy concerns, cannot share data between centers

Solution.
1. Data standardisation
2. Privacy preserving ML

The project just started!

RECONSTRUCTION

From low-resolution (LR) series (thick slices in various orientations) to high resolution (HR) volumes:

- Preprocessing
- Slice to volume registration
- Super-resolution reconstruction
- Data curation, standardization and reconstruction

Imaging descriptors for characterizing brain development

- Brain segmentation
- Mesh computing
- Central folding analysis

Patient stratification

Clinical hypothesis evaluation

A EUROPEAN COLLABORATION

Assessing the quality of LR fetal brain series requires specialized metrics.

Examples include:
- Brain mask centroid across slices
- Low-rank representation of the brain
- Normalized Cross-Correlation across a series
- Mutual information across a series
- Pretrained NN for slice-wise quality assessment

Preliminary results

(N=50 scans)

Feature-based prediction reaches 60% accuracy
Fair inter-agreement rater (0.459)

Preliminary Conclusion

1. Need a larger scale evaluation
2. Need a rating protocol to increase rater agreement
3. Need additional quality metrics

QUALITY CONTROL

Issue

Bad quality input ⇨ Bad quality output
Quality can vary drastically between stacks.

Proposed Solution

1. Fetal QC. Collect quality ratings on LR series
2. Quality control model. Learn to predict quality ratings

Fetal QC

A easily-shareable tool to facilitate quality annotations and standardise QC for fetal brain MRI, based on MRIQC [1].

Quality control model

1. Extract features from images (image quality metrics - IQMs)
2. Predict quality ratings (regression model)

Focus on image quality metrics

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REFERENCES