Quantitative morphometry analysis of the fetal brain using clinical MRI imaging

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Motivation: In vivo fetal magnetic resonance imaging provides a unique approach for the study of early human brain development [1]. In utero cerebral morphometry could potentially be used as a marker of the cerebral maturation and help to distinguish between normal and abnormal development in ambiguous situations. However, this quantitative approach is a major challenge because of the movement of the fetus inside the amniotic cavity, the poor spatial resolution provided by very fast MRI sequences and the partial volume effect. Extensive efforts are made to deal with the reconstruction of high-resolution 3D fetal volumes based on several acquisitions with lower resolution [2,3,4]. Frameworks were developed for the segmentation of specific regions of the fetal brain such as posterior fossa, brainstem or germinal matrix [5,6], or for the entire brain tissue [7,8], applying the Expectation-Maximization Markov Random Field (EM-MRF) framework. However, many of these previous works focused on the young fetus (i.e. before 24 weeks) and use anatomical atlas priors to segment the different tissue or regions. As most of the gyral development takes place after the 24th week, a comprehensive and clinically meaningful study of the fetal brain should not dismiss the third trimester of gestation. To cope with the rapidly changing appearance of the developing brain, some authors proposed a dynamic atlas [8]. To our opinion, this framework's pipeline do not use any prior, our method can potentially answer clinically relevant question such as the true developmental age of the fetus without being biased by its biological age.


![Image 1](https://example.com/image1)
![Image 2](https://example.com/image2)

**Fig. 1. Tissue classification**

**Fig. 2. Surface extraction**