



# Updated labelling and description of the gross anatomy of the sheep cortex derived from surface reconstruction of the brain.

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## Title

Updated labelling and description of the gross anatomy of the sheep cortex derived from surface reconstruction of the brain.

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## Introduction

The sheep model is a compelling yet underused model for understanding structure and function of the cortex. In general neuroanatomical labeling facilitates the generalizability and comparability of experimental results across studies and laboratories. While brain-labeling atlases have largely focused on subcortical regions in sheep, very little information is available about the cortical parcellation. The current work proposes an updated nomenclature of the major sulci and gyri of the sheep cortex, the first complete (gyri and sulci), detailed description of the the sheep cortex and an accompanying digital surface-based atlas.

## Methods

### *Cortical surface reconstruction*

The FreeSurfer software suite (<http://freesurfer.net>) was used for the cortical surface reconstruction of T1-weighted MRI images of the sheep brain. Freesurfer contains an automatic surface reconstruction pipeline for *human* MRI data that also labels each vertex of the surface anatomically (Dale et al 1999; Destrieux et al 2010). It was not possible to use this entire pipeline for sheep MRI data but certain individual stages could be used to produce cortical surface reconstructions for the sheep brain, which were then manually labelled.

### *Parcellation scheme*

The first step of this project was to produce a database containing the names of each cortical region, the aspect of the brain where the region is situated, its limits to neighbouring regions and its alternative names used in the literature. Conflicts in nomenclature across different works were resolved by giving priority to the terms of the Nomina Anatomica Veterinaria (5th Edition - Revised 2012). The limits of sulcal regions largely followed those already well described by Landacre (1930); however, no comprehensive description of gyral limits was available. Gyral limits were defined based on the gross neuroanatomical structure of the sheep cortex and previous neuroanatomical and functional neuroscientific work of the sheep brain in particular but also of the cat, dog, donkey, goat and pig brains. Differentiation of sulci from gyri was achieved automatically using local mean curvature values output during the surface reconstruction process: positive and negative curvature values defined sulci and gyri, respectively. The entire cortex was then manually delineated into the sulcal and gyral regions described in the name database. The limits of each region were drawn by hand on the inflated surface then each vertex within these limits was associated to the label from the name database.

## Results & Discussion

Thanks to our mainly Freesurfer based image processing pipeline we have produced accurate surface reconstructions and anatomical parcellations for the cortex of 21 sheep. This process allowed us to describe in detail the gross anatomy of the major sulci and gyri of the sheep cortex. We also propose to update the currently used nomenclature of the sheep cortex to resolve conflicts in the label used to describe some brain regions and also to adhere to the recommendations of the Nomina Anatomica Veterinaria (5th Edition - Revised 2012). We are currently working on using these parcellated brains to create a *probabilistic* surface-based atlas and accompanying image processing pipeline that can reliably, accurately and automatically parcellate the cortical surface of any MRI image of the sheep brain. The three major contributions of this work (anatomy database, image processing pipeline and digital atlas) will all be made openly available. We hope that these resources will facilitate neuroimaging investigations of this large-animal model.

## References

- Dale, A. M., Fischl, B. & Sereno, M. I. Cortical surface-based analysis. I. Segmentation and surface reconstruction. *Neuroimage* **9**, 179–94 (1999).
- Destrieux, C., Fischl, B., Dale, A. M. & Halgren, E. Automatic parcellation of human cortical gyri and sulci using standard anatomical nomenclature. *Neuroimage* **53**, 1–15 (2010).
- Landacre, F.L. The Major and Minor Sulci of the Brain of the Sheep. *Ohio J. Sci.* **30**, (1930).