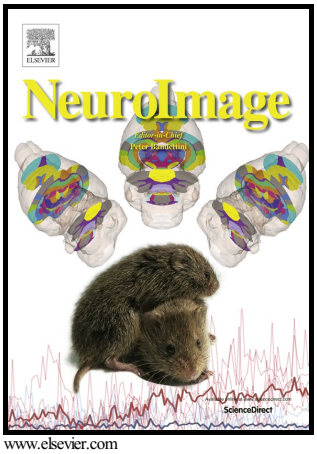

A population MRI brain template and analysis tools for the macaque

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A population MRI brain template and analysis tools for the macaque

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Abstract

The use of standard anatomical templates is common in human neuroimaging, as it facilitates data analysis and comparison across subjects and studies. For non-human primates, previous *in vivo* templates have lacked sufficient contrast to reliably validate known anatomical brain regions and have not provided tools for automated single-subject processing. Here we present the "*National Institute of Mental Health Macaque Template"*, or NMT for short. The NMT is a high-resolution *in vivo* MRI template of the average macaque brain generated from 31 subjects, as well as a neuroimaging tool for improved data analysis and visualization. From the NMT volume, we generated maps of tissue segmentation and cortical thickness. Surface reconstructions and transformations to previously published digital brain atlases are also provided. We further provide an analysis pipeline using the NMT that automates and standardizes the time-consuming processes of brain extraction, tissue segmentation, and morphometric feature estimation for anatomical scans of individual subjects. The NMT and associated tools thus provide a common platform for precise single-subject data analysis and for characterizations of neuroimaging results across subjects and studies.

Keywords: MRI, macaque, template, atlas, segmentation, vasculature

Introduction

Investigations into the structure and function of the non-human primate brain significantly contribute to our overall understanding of the nervous system. The macaque monkey is a well-studied model system that has provided tangible translational benefits, owing to its phylogenetic proximity to humans (Zhang et al., 1993) and the ability to test hypotheses using invasive techniques (e.g., electrophysiology, histology, and lesions). The application of non-invasive brain imaging techniques, such as structural and functional magnetic resonance imaging (MRI), in both humans and monkeys has helped contextualize findings from human research and demonstrate the translational relevance of the macaque as a model system. However, to reap the most translational benefit from non-human primate neuroimaging, it is essential that the analytic tools used in monkey imaging keep parity with the tools used in human imaging and that these tools be made widely

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