An Average Image of Myeloarchitecture in Common Marmoset Monkeys (*Callithrix jacchus*)

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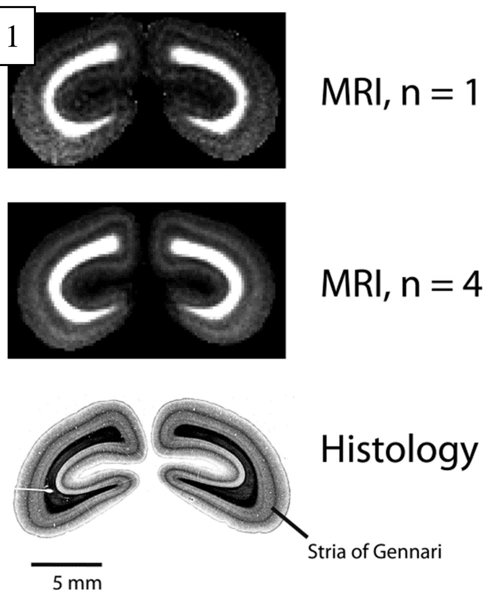
Many cortical regions in the common marmoset monkey are uniquely described by their myeloarchitecture; thus it would be useful to have a 3D or surface-based digital atlas of myeloarchitecture to localize functional signals to specific regions, or for surgical planning. To create an atlas of myeloarchitecture, however, requires MR images with a very high resolution and contrast-to-noise ratio (CNR) to visualize the subtle layer-specific details in the myeloarchitecture similar to what can be identified with histology (**Figure 1, Bottom**). This would allow the borders of many regions to be sharply defined.

We have previously optimized a 3D T_1-weighted pulse sequence with 160 µm isotropic resolution[1] for imaging myeloarchitecture in marmosets. But even in images made for several hours in anesthetized monkeys to increase CNR (**Figure 1, Top**), it is difficult to follow myeloarchitectural features through imaging planes for accurate 3D atlas creation. To solve this problem, we are now creating an average image comprised of images made in different monkeys to increase CNR. The space of the average image is based on an individual monkey, rather than being probabilistic, to preserve fine details in the myeloarchitecture.

In a beginning study, we imaged four female marmosets (aged 1 to 8) with our sequence, then masked the cerebrum in each monkey's image. We used one monkey's image as a template, and registered the other monkey cerebrums to this using an affine registration (FLIRT in FSL[2]). We then nonlinearly registered the monkey cerebrums (FNIRT in FSL[2]) to the template to remove fine morphological variations and summed the individual images to make an average image. Features of the myeloarchitecture are much better visualized in this average image than in individual images. For instance, the Stria of Gennari identifying the primary visual cortex (V1) is clearly identified throughout the occipital cortex (**Figure 1, Middle**) and several other strongly enhancing myelinated regions are readily delineated from the surrounding cortex (**Figure 2**).

Already in our atlas with n =4, the borders of heavily myelinated regions such as V1, MT, A1, and S1 are more distinct than in individual images (as seen in maps of MRI signal intensity sampled at a middle depth in the cortex in **Figure 3**). We will continue to add monkeys to the average image to improve CNR and thereby delineate lightly myelinated regions including the primary motor region (M1) and secondary somatosensory region (S2). Finally, we will create a digital atlas of myeloarchitecture in the marmoset for distribution to complement existing 3D anatomical digital atlases.

1



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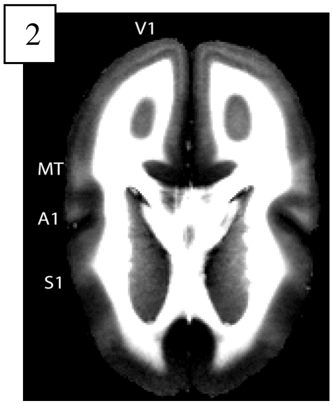

Cortical anatomy key: V1 = primary visual, MT = middle temporal, A1 = primary auditory, S1 = primary somatosensory

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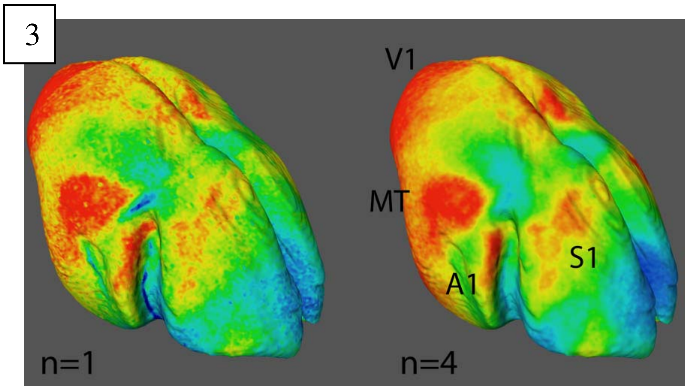

References:

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