Exploring Brain microMR for Neurosurgery Planning

Collaboration opportunities for the Neuroimage Analysis Center (NAC, P41EB015902 Kikinis, Westin) and the Center for In Vivo Microscopy (CIVM, P41 EB015897 Johnson)

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The NAC and CIVM P41 Centers, which have been collaborating actively through sharing of data, software, and dissemination activities for over a decade, have identified a avenue of collaboration through the application of microMR scanning technologies with enormous promise to better inform and plan neurosurgical procedures. CIVM has recently developed new techniques to acquire high resolution scans of macro-scale human specimens of and demonstrated their potential for deep brain stimulation (DBS) surgery.[1] NAC investigators are interested in pursuing several applications including (1) supporting the ongoing use of 3D Slicer at CIVM to disseminate huge atlas datasets through remote rendering, (2) exploring translation of CIVM's DBS results into the 3D Slicer-based clinical research PyDBS platform,[2] and (3) studying neurosurgical anatomy existing CIVM human specimens and working together to identify new preparations to address surgically significant open questions about neuroanatomy. The unique abilities of the open source 3D Slicer technology, created and maintained as part of NAC Slicer Core and Outreach activities provide a platform for multimodal visualization, analysis of structural and diffusion scans, registration of microMR to clinical scans, and interoperability with clinical neuronavigation systems make it an ideal platform for this collaborative research.

[1] Calabrese, Evan, et al. "Postmortem diffusion MRI of the human brainstem and thalamus for deep brain stimulator electrode localization." *Human brain mapping* 36.8 (2015): 3167-3178.
[2] D'Albis, Tiziano, et al. "Pydbs: an automated image processing workflow for deep brain stimulation surgery." International journal of computer assisted radiology and surgery 10.2 (2014): 117-128.

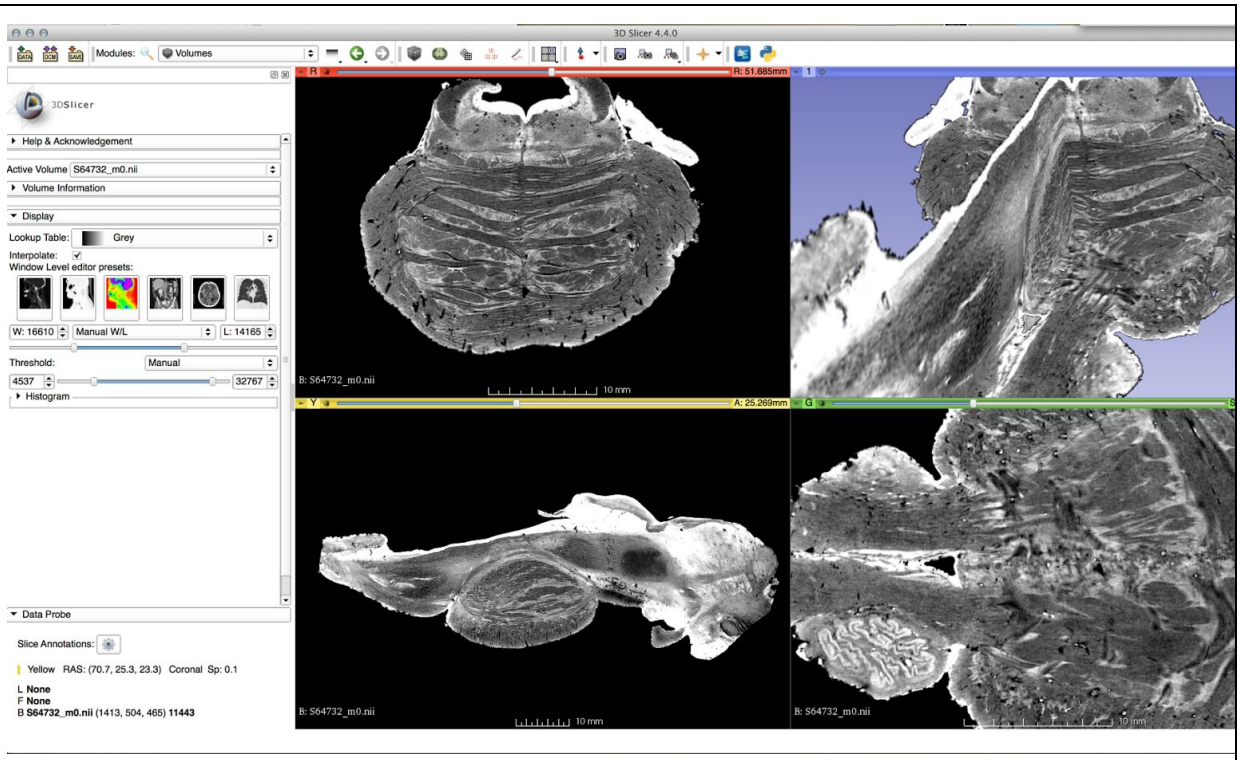

Figure 1: CIVM structural microMR scan of human brainstem at 50 micron isotropic voxels.

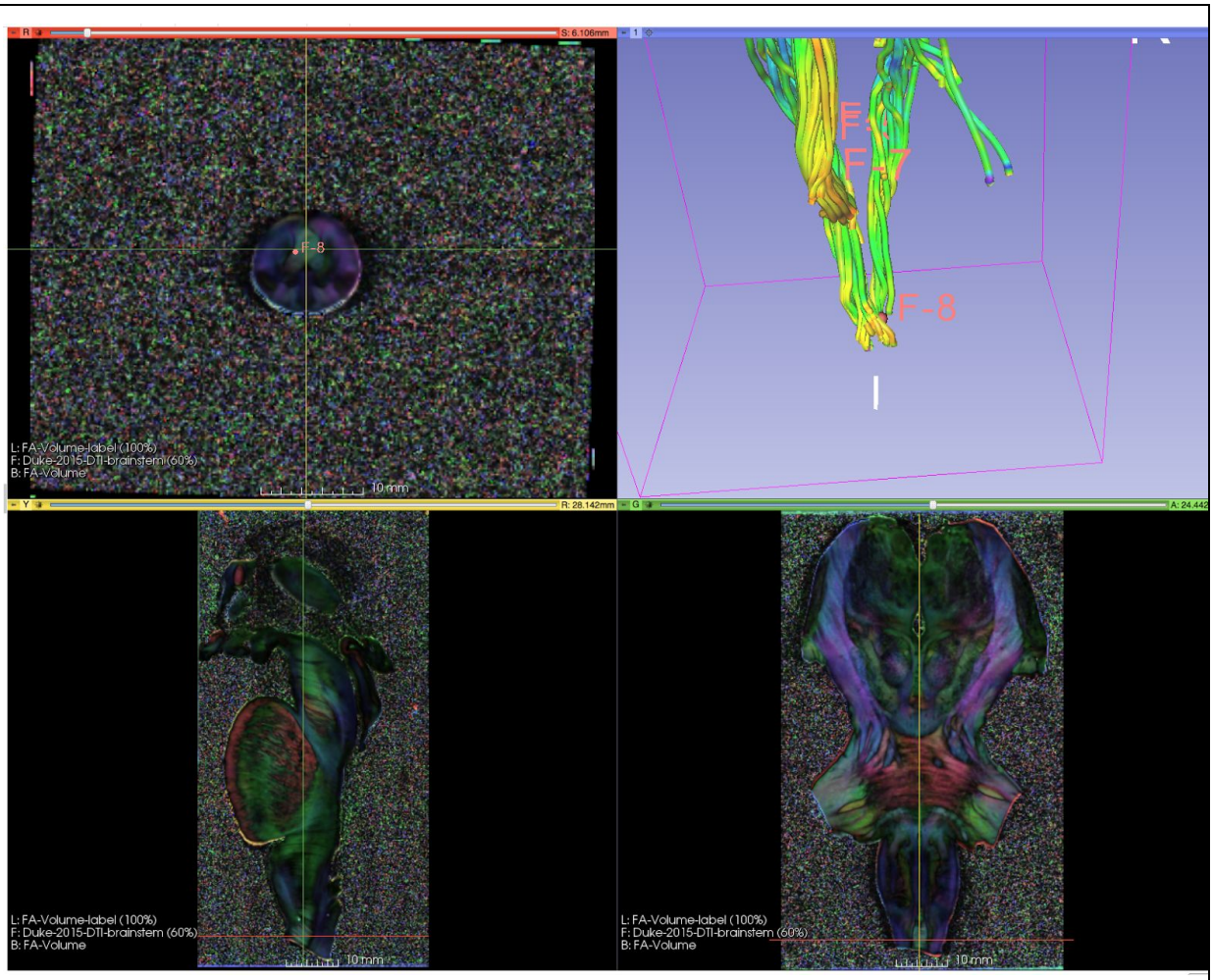

Figure 2: Tractography of CIVM diffusion microMR scan with 200 micron isotropic voxels. Tractography result illustrate decussation of the medullary pyramids, a structure not currently visible in macro scale MR.