3T MR Research Program

Center for MR Research

University of Illinois at

TECH 2000 3T MRI RESEARCH FACILITY

WINTER 2015 ISSUE

3T Research News

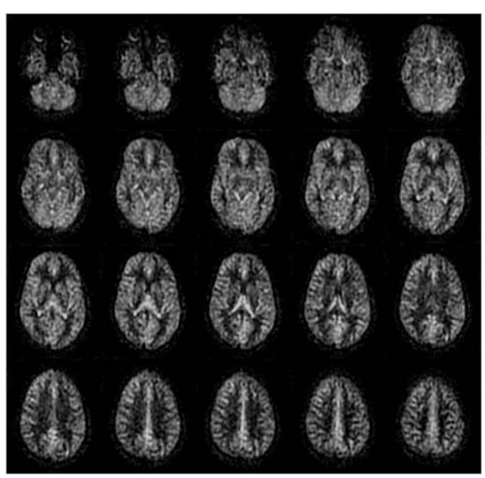
By Mike Flannery

The 3T MR Research Program would like to send a friendly reminder to everyone that after **March 31, 2015**, we will no longer be maintaining or supporting the MRIx front projection system. Investigators may continue to use the front projection system as long as it is functioning; however, we cannot guarantee normal operation.

In preparation for this transition, we have been actively pursuing technical improvements and additional training. Currently, we are in the process of evaluating the integration of the eye camera with the SensaVue fMRI stimulus system. We will be testing a new IR source for the eye monitoring system that we hope will minimize the visual distractions of the LED array with the current setup. Additionally, a new minimally obtrusive hot mirror is also being evaluated. We will keep the user groups informed of our progress.

GE MR750 Advanced Application: 3D ASL

3D Arterial Spin Labeling (3D ASL) is a non-invasive advanced application that allows for the visualization of tissue perfusion and provides a quantitative assessment of cerebral blood flow. This scan technique allows for excellent “non-contrast” enhanced perfusion imaging of patients in whom contrast is contraindicated. 3D ASL produces hires 3D whole brain coverage with instantaneous, automated post processing.

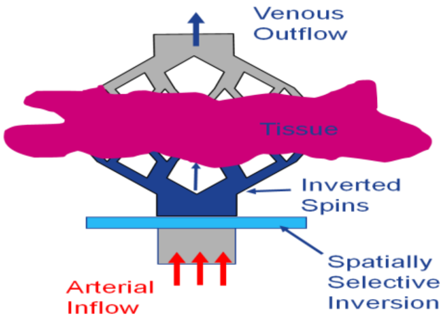


3D ASL is used to rule out a multitude of focal or global perfusion defects. The following are some clinically relevant uses for 3D ASL:

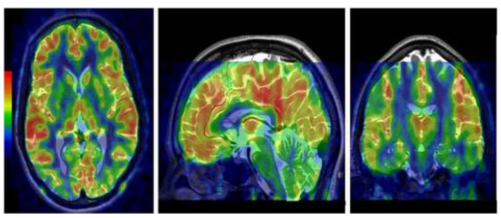
- Evaluation, grading, and therapy monitoring of certain tumors.
- Evaluation of stroke, TIA, stenoses and other CV disease processes.
- Assessment of neurodegenerative diseases.
- Imaging of structural vasculature problems.

How does 3D ASL work?

A spatially selective continuous inversion pulse is applied to the inflowing arterial blood to the brain. This, in effect, “labels” the protons in the arterial blood flowing into the brain. This inverted blood decreases the signal on a PD image within the brain tissue being imaged.



During acquisition, the targeted tissues are imaged twice - one with the spatially selective inversion pulse and one without the spatially selective inversion pulse. The control (static) image is then subtracted from the labeled image, which removes signal from the static background resulting in images that are proportional to cerebral blood flow. Multiple datasets are acquired to make a CBF image.



Images courtesy of GE Healthcare

Research spotlight

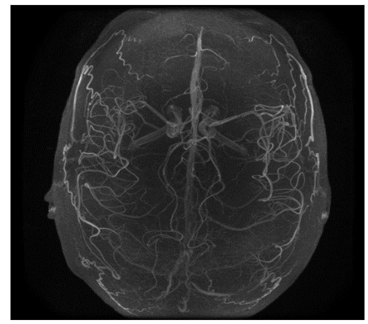
Medical Image Processing for Automatic Construction of Subject Specific Full Brain Computational Mesh

Prof. Andreas Linninger, PhD

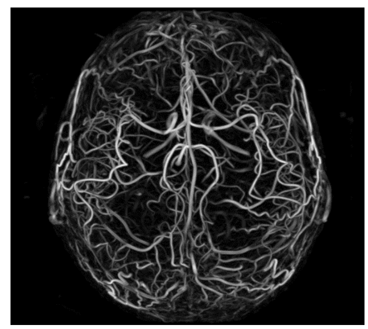
Dr.Linnininger is a professor in the Departments of Bioengineering and Neurosurgery. His research focus consists of the following:

- Cerebral hemodynamics. Predicting organ-wide blood flow patterns in normal conditions and in diseases including ischemic stroke, arteriovenous malformations and aneurysms.
- Control of cerebral blood flow and metabolism. Investigate molecular mechanisms of neurovascular coupling using micro-imaging and computational methods. Measure blood flow in major cerebral blood vessels with in-vivo imaging modalities.
- Virtual reality diagnostic and training for neurosurgeons. Developing novel fully immersed virtual reality applications for providing neurosurgeons and medical students with better diagnostic, planning and training options for neurovascular interventions.

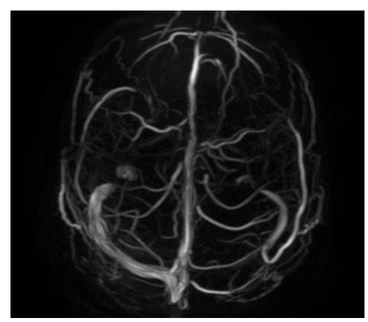
By collaborating with Dr. X. Joe Zhou, PhD and Mike Flannery from the 3T MR Research Program, high resolution images were acquired along with in vivo measurements with Quantitative MRA with phase contrast and Inhance techniques. The state-or-the-art imaging pulse sequences with the 32 channel phased array coil provided high resolution images for segmentation of the cerebral soft tissues to include the grey/white matter, CSF space, and cerebral vasculature. An automatic image processing pipeline was developed to segment the soft tissues and construct computational meshes for 3D immersive visualization and cerebral hemodynamic simulations. To ensure that the anatomical relationships between the soft tissues, an automatic rigid image registration algorithm with morphological operations and level set evolution was utilized to account for partial volume effects. Moreover, an image filter was designed to enhance vessel signals while suppressing noise and other tissues for clear delineation and more accurate identification of the vessels. Professor Linninger and his graduate student Chih-Yang Hsu plan to use code optimization and GPU programming to accelerate the pipeline for real-time application of the full brain mesh to assist clinical diagnosis and research for cerebral hemodynamics.



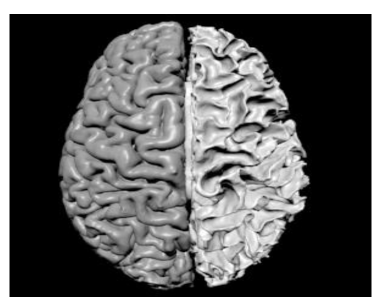
3D TOF MRA



Filtered MRA



2D Inhance MRV



Segmented Grey and White Matter