The MR Research Facility maintains a website to disseminate information to current users and to provide information about the facility to new investigators. The website contains information about our facility, equipment, current research projects, contact information and more. The homepage of our site is updated frequently with new information about projects and equipment that is available to researchers.

The website is also utilized for online scheduling, billing, and new proposal submissions. Here, researchers can access an up-to-date, interactive web calendar to reserve research time on our scanners. Requesters are sent automated confirmation emails whenever a timeslot is reserved or modified and have the ability to change or delete a reservation.

The proposal submission site allows researchers to submit new project proposals to the MR Research Advisory committee electronically and confidentially.

MR Research Facility Equipment

The newest and most utilized piece of research equipment at the MR Research Facility is the research dedicated Siemens 3T TIM Trio scanner, located in the Medical Education and Research Facility in suite L169. Since its installation in July of 2007, the Trio has steadily become the primary workhorse of the MR Research Facility and has proven to be an invaluable asset to researchers and collaborators. At the present time, fMRI studies and pilot fMRI projects are performed almost exclusively on the Trio. We recently upgraded the Trio’s imaging capabilities to include 18 receiver channels and multi-nuclear imaging capabilities. This will allow researchers to image faster and to acquire images from alternative nuclei, including $^3$He, $^{23}$NA, and $^{31}$P.

Currently, the Avanto is primarily utilized for cardiac imaging, hyperpolarized gas analysis and a number of longitudinal studies of anatomical brain changes associated with psychiatric and neurological disorders. The Avanto is a valuable addition to the facility due to its placement within the hospital, which allows us to utilize potential in-patient subjects and participate in studies that administer contrast agents. Possessing a 1.5 Tesla scanner has also enabled departments within the University to participate in multi-center studies requiring the more common 1.5T field strength.

The third scanner the facility manages is the Shared 3T TIM Trio scanner located within the hospital. This scanner is available for research 50 percent of the time, and is otherwise used as a clinical scanner. Most research protocols have been moved from the Shared 3T to the research dedicated 3T in MERF; however, a small number of studies that originally began on the Shared 3T still utilize it. In addition, this scanner facilitates translational research into clinical populations by allowing inpatients to be imaged as part of research protocols.
MRS

Magnetic Resonance Spectroscopy (MRS) has been around since the early development of MR imaging. This technique allows investigators to evaluate metabolite concentrations within the brain in mmol concentrations. The separation of metabolites linearly increases with field strength. We have begun to apply this technique to study delirium, Huntington’s Disease, and traumatic brain injury. One limitation of this technique is the large voxel size of the acquired images (~1cm³) while MRI images are acquired with a resolution of 1mm³. Since CSF does not contain metabolites, the measured metabolite concentrations must be corrected for the volume of CSF within the voxel of interest. We are developing tools in-house to allow us to readily perform these corrections. This tool, along with the MRS analysis LCModel, has been made available to users of the facility.

With the recent addition of the multi-nuclear capabilities on the scanner, spectrum from other nuclei can also be obtained. 31P spectroscopy can be used to study high energy phosphate and phospholipid metabolism. In addition, 23Na has the potential to be used to study cartilage health.

MR Research Advisory Committee

The MR Research Advisory Committee consists of ten research and clinical faculty and one external collaborator from Siemens Medical Solutions:

- Vincent Magnotta, PhD
- Daniel Thedens, PhD
- Alan Stolpen, MD, PhD
- Brad Bolster, PhD (Siemens)
- Peggy Nopoulos, MD
- David Rudrauf, PhD
- Wendy Smoker, MD
- Laurie Ponto, PhD
- Sergio Paradiso, MD, PhD
- Jinsuh Kim, MD
- Jinhu Xiong, PhD

The committee meets every other Wednesday for one hour. During the committee review process, projects are reviewed for innovation, feasibility of the proposal, funding status, likelihood of funding (for pilot studies), development required, and availability of personnel & equipment. Two members of the committee provide written feedback and present their review at the meeting. After discussion, each committee member assigns a priority score between 0 (low) and 10 (high). If a proposal is deemed of poor quality (scores of 5 and below), the Chair of the committee will contact the primary investigator of the project to discuss the deficiencies and propose solutions that will make it a viable project. Once a proposal is approved, the project is assigned a project code to the protocol. The project code is then utilized by the scheduling system to assign a billing account for the study.

The Research Center supports a limited number of pilot projects each year to facilitate investigative data collection for inclusion in researcher grant submissions, and caps pilot scan time to ten one-hour sessions per study. Approved pilot studies are not billed for scans, but are still obligated to comply with the Research Center’s project guidelines.

External Advisory Board

In March 2008, the MRI Research Center was reviewed by an external advisory board consisting of leaders in the field of MRI imaging. External members include:

- Bill Bradley, MD, PhD
- Ravi Reddy, PhD
- Jia-Hong Gao, PhD

http://mri.radiology.uiowa.edu
Pilot Projects

Supporting Research

From its inception, the MR Research Facility has supported pilot studies. These studies are currently funded by the MR Research Facility. Investigators must put together a short proposal describing the project and how the pilot data will be used. Projects are reviewed by the MR Research Committee and typically are supported for the acquisition of 5-10 subjects, or a number deemed sufficient for pilot data for a grant application. To date the following 15 projects have successfully received funding after acquiring pilot data in this manner.

- Susan Schultz, R01/NIH
- Grazyna Kochanska, R01/NIH
- John Widness, P01/NIH
- Peg Nopoulos, R01/NIH
- Antonio Damasio, P01/NIH
- James Tomblin, R01/NIH
- Nicole Grosland, R01/NIH
- Nicole Grosland, R21/NIH
- Beng Choon Ho, NARSAD
- Annunziato Amendola, American Orthopaedic Society for Sports Medicine
- Joseph Buckwalter, P50/NIH/NIAMS
- Thomas D. Brown, R01/NIH/NIAMS
- Ergun Uc, VA Merit Review
- John Wemmie, McKnight Foundation
- Sergio Paradiso, DANA

Research Highlights

T1rho Imaging

T1rho imaging has been one of the novel imaging techniques that has been used extensively by research center users. Investigators are currently applying this to study both proteoglycan changes in cartilage as well as pH in the brain. We are also continuing to study brain pH changes by imaging phantoms, animals and humans. CO2 challenges are being utilized to change brain pH. Measurable changes in the T1rho signal have been obtained in mice. We are waiting for IRB approval to perform similar studies in humans, but have collected baseline T1rho images and obtained similar values to those collected in mice.

Magnetic Source MRI (msMRI)

Magnetic source magnetic resonance imaging (msMRI) is a novel technique based on detecting MRI signal changes in response to changes in magnetic fields concomitant with neuronal firing. Unlike current functional MRI techniques, which rely on measuring regional cerebral hemodynamics to infer information about neuronal activity, msMRI assesses neuronal function directly. It offers improved spatial localization and temporal resolution and has great potential impacts on the neuronimaging community. This technique, however, is still at its early stage of developments. We are one of a few laboratories in the leading position of studying mechanisms of signal contrast in msMRI and developing msMRI procedures for mapping human brain functions.

http://mri.radiology.uiowa.edu
Updates to the MR Research Facility

The MR Research Facility strives to keep our equipment state-of-the-art and provide tools to investigators that will facilitate their research projects. We have listed several upgrades that we have added to the facility over the past year.

• **18-Channel Multi-Nuclear Upgrade Option**
  The Research Dedicated 3T scanner was upgraded from 8 to 18 channels. This will facilitate shorter imaging times and will allow new multi-channels to be utilized for imaging the brain and extremities. The multi-nuclear imaging option allows nuclei other than 1H to be imaged. Several potential projects requesting 31P, 23Na and 11C have been proposed by investigators within the College of Medicine.

• **BIOPAC O2 and CO2 Gas Analysis Hardware**
  The BIOPAC O2 and CO2 modules can be used to perform real-time oxygen and carbon dioxide concentration monitoring in humans and small animals.

• **fMRI MediGoggles**
  MediGoggles permit subjects who require prescription glasses to see visual stimuli from within the scanner without introducing any safety risks to the subject or artifact in the images. The goggles can be customized from –6 to +6 dioptre in 0.5 dioptre increments and are easy to set up and use.

• **FOMRI II Fiber Optic fMRI Microphone**
  We recently purchased the FOMRI II Dual Channel MRI Microphone System from MAGMEDICS. The FOMRI II system uses fiber-optic technology and an advanced set of noise-canceling algorithms to reproduce high quality speech from recordings within the magnet and is available for general research usage.

• **Animal Anesthesia Machine**
  The VT-110-MRI 3T-MRI Compatible Small Animal Anesthesia Machine was recently purchased from JD Medical to support sedation of animals while being studied in 3T whole body scanners. This will initially be used by investigators within Neurosurgery and Internal Medicine to image rats.

• **Metrasens FerroGuard Freestanding Metal Detector**
  The Metrasens FerroGuard metal detector is available at the research suite at L169 MERF and is used to screen every research subject for potential hazardous metallic material. The system is movable and can be adjusted to meet the sensitivity requirements of the location.

Computing Resources

Within the MERF Imaging Facility, research workstations are available for investigators to utilize while imaging and post processing data after it is collected. Both Microsoft Windows and Linux-based workstations are available. Several image processing tools are available on these systems including: BRAINS, Slicer, FSL, and AFNI.

We have worked with the Iowa Institute of Biomedical Imaging to provide administration of the computing resources. They provide system upgrades, on-site technical support and backup all machines on a regular basis.

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