

FACILITIES & OTHER RESOURCES

Functional MRI Laboratory Facilities and Resources

The Functional MRI Laboratory at the University of Michigan is organized under the University of Michigan's Medical School and is located in the biomedical quadrant of the University of Michigan's North Campus in the Bonisteel Interdisciplinary Research Building. It is a research facility for imaging researchers and a fee-for-service facility, providing research MRI scanning and other peripheral services to the broader University community. The Laboratory is dedicated to supporting research on the structures and functions of the brain that underlie cognitive and affective processes in normal and patient populations, and research on functional MRI and associated research tools. Its mission is to maintain an environment that will enhance the excellence of research using functional MRI and associated technologies by providing a well-equipped physical facility and appropriate intellectual support services for investigators.

The fMRI Laboratory is Co-Directed by Douglas C. Noll, Professor of Biomedical Engineering and Radiology and John Jonides, Professor of Psychology. Scott Peltier, Ph.D. is the Technical Director. Other facility faculty include Luis Hernandez, Ph.D. and Jon-Fredrick Nielsen, Ph.D. Staff includes four MR technologists, IT Specialist, Research Computer Specialist, Neuroimaging Analysis Specialist and two Administrative Support staff.

During its operation, the laboratory has provided a common forum for research groups ranging from psychiatry, psychology and neuroscience, to less traditional neuroimaging areas, such as kinesiology, biostatistics, electrical engineering, biomedical engineering, and the business school. In addition, the laboratory hosts a yearly Symposium where new advances in the field of brain research and MRI use are presented. Monthly seminars are also given by invited speakers from around the country in the field of MRI brain research and are broadly attended by investigators from the Great Lakes region. The Laboratory also holds an intensive two-week course in FMRI every summer supported by NIH R25 MH071279-11, and an advanced neuroimaging seminar in order to facilitate training of new investigators and disseminate the latest findings in the literature among the local neuroimaging community.

In the following paragraphs we provide a description of the relevant available fMRI facilities and resources. The fMRI Laboratory website also contains descriptions of resources (<http://fmri.research.umich.edu/>).

Office space

The Functional MRI Laboratory contains office space for all research faculty and graduate students in close proximity to the MRI scanners, ensuring good communication between researchers and easy access for carrying out experimental studies. Standard office equipment including color printers, scanners and photocopiers are available in the office area.

The facility has two scanner rooms and control rooms, four dedicated subject preparation and training areas, a workshop for coil and phantom construction, as well as office space for faculty,

students and post-docs. The fMRI Lab has four dedicated parking spots for research subjects, and is connected by high-speed networks to laboratories on the campuses of the University.

Computing

The Functional MRI Laboratory provides preliminary preprocessing for fMRI data including image reconstruction with correction for susceptibility distortions, slice-timing correction, and movement correction. Two large scale Linux servers with dedicated backup are available for reconstruction, processing and archival storage (Server 1: 128 core/503G RAM/55T storage; Server 2: 64 core/251G/55T). Multiple Linux workstations are available for use for processing fMRI data for pilot and other small projects. Software packages available for data collection and analysis include EPrime, Presentation, MATLAB, Psychtoolbox, SPM, FSL, AFNI, C++ and a variety of custom packages.

The Laboratory also holds an NIH-funded intensive two-week course in fMRI every summer to facilitate training of new investigators, both locally and internationally.

EQUIPMENT

Functional MRI Laboratory Equipment

The Functional MRI Laboratory houses two state-of-the-art, research-dedicated MRI scanners: a 3.0T GE Ultra High Performance (UHP) system (release RX28R4) and a 3.0 T GE Discovery MR750 MRI scanner (release DV29.1). They both have high performance gradient systems (750: peak 50 mT/m, slew rate 200 T/m/s, UHP: peak 100 mT/m, slew rate 225 mT/m/ms.). Both have a full set of functional imaging capabilities, including single-shot imaging (spiral and EPI), multiband imaging, automated shimming, real-time image reconstruction and processing. The scanners also come equipped with standard MR spectroscopy (MRS) pulse sequences, as well as sequences to detect GABA. The Functional MRI Laboratory has two 32-channel receive arrays from Nova Medical for greater image acquisition speed-up factors and improved SNR, and implementation of cutting-edge multi-band acquisitions. The scanners are also equipped with the standard volumetric quadrature bird-cage head coil and whole body coil. In addition, the UHP system has a 48 channel coil for larger head sizes, and AIR flexible coils for adaptable configurations. The fMRI Lab has access to pulse sequence source code and GE's pulse sequence compiler, and has built in-house an extensive library of rapid acquisition pulse sequences designed for functional brain imaging including spiral acquisition, arterial spin labeling, SSFP, multi-band imaging, etc.

Several fMRI participant stimulation devices are available to investigators at the fMRI laboratory. These include fiber-optic button response systems from Brain Logics (Pittsburgh, PA); two 40 inch MR compatible, HD resolution LED monitors, and fiber-optic display goggles from Nordic Neurolabs (Bergen, Norway); MR compatible eye-tracking (Avotec, Stuart, FL; SR Research, Ottawa, Canada); and MR compatible headphones (Sensimetrics, Malden, MA; MR Confon, Germany). The Lab also has an MR-compatible microphone with active noise cancellation (FOMRI-III, OptoAcoustics, Israel).

Electronics Shop

The electronics shop at the Laboratory is equipped with machining tools, soldering stations, and electronic instrumentation. The electronics shop at the Laboratory is outfitted with basic electronic measurement tools including two network analyzers (HP 8751A), oscilloscope (Tektronix TDS2022B), waveform generator (HP 33120A) and voltage supply (HP E3630A 0 to 20 V) and current sources (Lambda). A computer-based data output and acquisition system with A/D and D/A hardware are available (National Instruments), which can be controlled by a PC running LabView or Matlab. A soldering station, drill press and band saw, as well as other miscellaneous items are also available.

Transcranial Magnetic Stimulation

The Functional MRI Laboratory houses a Magstim Model 220 Biphasic TMS stimulator and a MacIntosh computer equipped with Rogue research's Brainsight positioning system interfaced with a Polaris frameless infrared stereotaxic system dedicated for TMS and MR image coregistration and targeting in real-time. We also have at our disposal a new prototype TMS driver constructed in-house. This prototype is able to generate >1 kA currents in a TMS probe in the 3 -15 kHz frequency range.