

Translational & Molecular Imaging Institute

November, 2014
Issue 5

tmii.mssm.edu

Message from the Director

This is an exciting time of the year with the Fall season upon us and all the energy that the NYC Marathon brings to NYC. We feature in this Newsletter some exciting work that was presented by our TMII faculty at the 1st Annual Brain Imaging Center (BIC) Symposium. I congratulate Rita Goldstein (BIC Director) and her team for a wonderful meeting. We also present a Spotlight on one of the recent joint TMII/BIC faculty recruit (Dr. Prantik Kundu). We also highlight some recent work by Dr. Willem Mulder and congratulate him and his team

on his new NIH R01 focused on the treatment of atherosclerosis with nanoparticles (A little bird has told me that we will need to celebrate also his other new NIH R01 very soon! More on this next time...) I also like to congratulate Dr. Gordon Xu for his recent grants awards for his work on spinal cord injury and his other work in adolescent depression. Finally, as you will read we at TMII and Mount Sinai continue to introduce the best state of the art imaging technology for our research community. I am thrilled about the upcoming Siemens Force

CT scanner which is the third generation of dual-source CT technology. In collaboration with Siemens we intend to explore the use of color CT to better characterize disease this new scanner. I wish all of you a good read of the TMII Newsletter and a great last quarter of 2014.



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WHAT'S NEW?

TMII News & Updates

New Funding:

Dr. Junqian Gordon Xu and his team recently received two new awards. First, "Longitudinal Multicenter Cervical Spinal Tract Diffusion MRI for Progressive MS" awarded by the

International Progressive MS Alliance. This award will allow Dr. Xu's team, in collaboration with Dr. Matilde Ingelese (Neurology), to develop the infrastructure needed to facilitate clinical trials that track cervical spinal cord MRI

measurements as a way of measuring the impact of potential therapies on MS damage and progression. These methods are crucial for clinical trials that set out to determine the effectiveness of strategies at stopping or reversing this progression.

The second award is a Brain and Behavior Research Foundation NARSAD Young Investigator Award for "Neuroimmunology of Anhedonia in Adult Major Depressive Disorder". For this study Dr. Xu and his team will study the neuroimmunology of anhedonia, the inability to experience pleasure, in adults with major depressive disorder. This research project will build upon findings in his mentor Dr. Vilma Gabbay's lab (Psychiatry) that in adolescents with depression, activation of the immune system, inflammation and accompanying neurometabolic alterations are specifically linked to severity of anhedonia.

Abstract Deadline:

23rd Annual ISMRM Meeting; May 30 - June 5, 2015 - Toronto, Canada: [Abstract deadline - November 12, 2014](#)



Icahn
School of
Medicine at
Mount
Sinai

Translational and
Molecular Imaging
Institute

5th Annual TMII Symposium

July 24th, 2015

Keynote Speaker:

Roderic I. Pettigrew, PhD, MD
Director, National Institute of
Biomedical Imaging and Bioengineering
National Institutes of Health

Location:
Davis Auditorium
Hess Center for Science and
Medicine
Icahn School of Medicine
at Mount Sinai

Neuroimaging

Susumu Mori, PhD
Professor, Radiology
Johns Hopkins University School of Medicine

Cardiovascular Imaging

Matthias Stuber, PhD
Professor, Center for Biomedical Imaging (CIBM)
University Hospital of Lausanne (CHUV)

Nanomedicine

Chrit Moonen, PhD
Professor, Radiotherapy
University Medical Center Utrecht

Cancer & Body Imaging

Richard L. Ehman, MD
Professor, Radiology
Mayo Clinic

UPCOMING EVENTS

- TMII Seminar Series

Friday, November 14th @ 2:30pm - CSM room 9-101: Valentina Giannini, PhD - Candiolo Cancer Institute: "A fully automatic Computer Aided Diagnosis (CAD) system based on multiparametric MR imaging for prostate cancer diagnosis and staging"

- Small Animal Imaging Core - Seminar Series

Wednesday December 17 @ 2pm - Davis Auditorium - Youssef Ziam Wadghiri, PhD - NYU Langone Medical Center

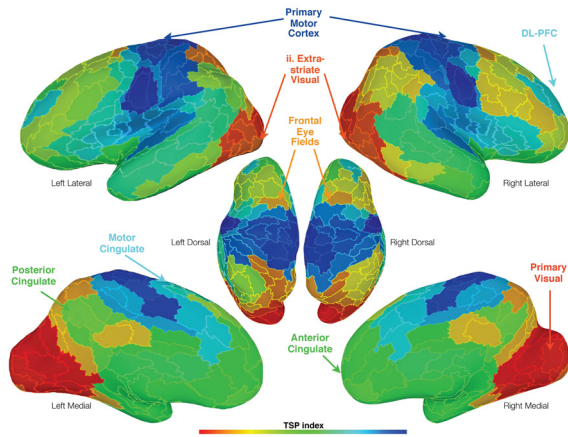
- 5th Annual TMII Symposium - July 24, 2015. 8 am - 5 pm Davis Auditorium Hess Center for Science and Medicine

For more information on these and other events go to: <http://tmii.mssm.edu/events/>

Leading the Way in Advanced Image Processing

Prantik Kundu, PhD

As the Chief of the Section on Advanced Functional NeuroImaging and the ANALYZE Core of the Brain Imaging Center (BIC) at Mt.



Sinai, Dr. Kundu focuses on developing novel MRI analysis techniques towards understanding brain organization, connectivity, and temporal dynamics. A key element of his approach is utilization of advanced statistical techniques to maximize the fidelity of functional MRI, which is known to be prone to high levels of noise and artifact. His pioneering work has led to substantial improvements in signal-to-noise ratio for many fMRI experiments, including task and resting state fMRI, and anesthetized animal functional imaging. Ongoing work includes implementation

of highly reliable fMRI at high spatial and temporal resolution, and at high field (7T). In collaboration with other faculty at TMII, the Friedman Brain Institute, and the Department of Psychiatry, Dr. Kundu also works towards developing key infrastructure to newly enable critical fMRI experiments as well as meta-analyses, with the aim of helping BIC become a world-class center for translational brain imaging of neuropsychiatric disorders.



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SCIENCE SPOTLIGHT

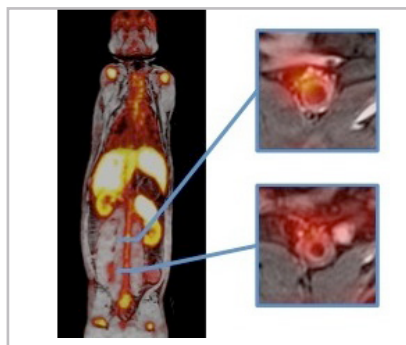
New Grant to Study Treatment of Atherosclerosis with Nanoparticles, Awarded

Willem Mulder, PhD

This summer, Dr. Mulder was awarded a 4 year, \$2.3 million R-01 grant from the National Heart, Lung, and Blood Institute. The grant will fund Dr. Mulder's research on the use of nanoparticles as a treatment for Atherosclerosis.

Atherosclerosis and its major clinical manifestation, coronary artery disease (CAD), is the leading cause of death in the western world. Preventive strategies currently focus on controlling risk factors and lipid levels. Substantial residual risk remains high, even when treatment goals are fully met. In humans, monocytes that infiltrate the plaque differentiate into inflammatory macrophages produce proteolytic enzymes that digest extracellular matrix causing plaque rupture. Plaque inflammation is therefore pursued as a therapeutic target to lower the recurrent rates of atherothrombotic events. Statins have known pleiotropic anti-inflammatory effects, but to exploit and amplify these effects, novel formulations that effectively target plaques and accumulate the drug at high concentration in target tissue need to be developed. Similarly to statins, cannabinoids, a class of hydrophobic compounds that can activate either the cannabinoid receptor 1 (CB1) or CB2 receptor, have shown potent anti-

inflammatory properties as well. To better exploit both drug classes in the context of atherosclerotic disease, nanoparticle formulations offer significant advantages, including the reduction of systemic or psychotropic effects, while simultaneously increasing the efficacy and bioavailability through local atherosclerotic plaque drug delivery. In this context, lipoprotein nanoparticles may be



excellently suited as they can carry payloads of lipophilic drugs and naturally target atherosclerotic plaque macrophages. The aforementioned nanoparticle platforms will be produced using microfluidics. Full in vitro targeting and efficacy studies will be performed. In vivo, biodistribution and imaging-assisted therapeutic studies will be performed on a traditional mouse model of atherosclerosis as well as an myocardial infarction aggravated mouse model of atherosclerosis.

Extensive immunofluorescent, histological, and molecular biological techniques will be applied to evaluate the in vivo findings and to unravel the mechanism of action. The specific aims are to create a library of drug-loaded lipoprotein nanoparticles using microfluidics; to study the biodistribution and plaque targeting of these lipoprotein nanoparticles in atherosclerotic ApoE-KO mice via imaging; to conduct a HDL nanotherapy study in atherosclerotic ApoE-KO mice and to conduct a HDL therapy study in mice with MI-aggravated atherosclerosis.

Translation to the clinic is facilitated by the fact that the individual components of all the proposed nanoparticle formulations are FDA approved. Finally, the paradigm shift, i.e. using nanoparticle formulations to alter the pharmacological effects of two well-known drug classes could have a broad and profound impacts on the management of different human diseases.



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TMII at BIC Day

TMII faculty present at the 1st Annual BIC Symposium

The Icahn School of Medicine at Mount Sinai (ISMM) has built a new relational bridge between the Translational and Molecular Imaging Institute (TMII) and The Friedman Brain Institute (FBI) to accelerate use of cutting-edge imaging tools to further research into the workings of the brain. Known as the Brain Imaging Center (BIC), BIC is designed to enhance research efforts within and outside the institution by providing investigators with high-level expertise in the collection and analysis of precise structural and functional images of living brains.

- Dr. Gordon Xu detailed the new Sinai BIC Common Imaging Protocol (Figure 1)

	HCP lifespan (32ch)	Sinai (32ch)	Sinai (16ch)
Resolution	2 mm iso	2.1 mm iso	2.3 mm iso
Slices	72	70	60
TE (ms)	33.1	35.0	31.4
TR (ms)	720	1000	1000
PE direction	LR/RL	LR/RL (AP/PA)	LR/RL (AP/PA)
Multiband / R _{PE}	8 / 0	7 / 0	5 / 0
Partial Fourier	NA	NA	NA
Echo-spacing (ms)	0.58	0.68	0.65
ETL (ms)	52.2	57.1	50.7
rs-fMRI (eyes open)	4 x 5 min	2 x 5 min LR/RL	2 x 5 min LR/RL

Figure 1: Comparison between the EPI (BOLD) studies for the Human Connectome Project and the Common BIC Protocol

- Dr. Priti Balchandani gave a talk titled "Exploring new ways to visualize the brain through 7T MRI" (Figure 2)

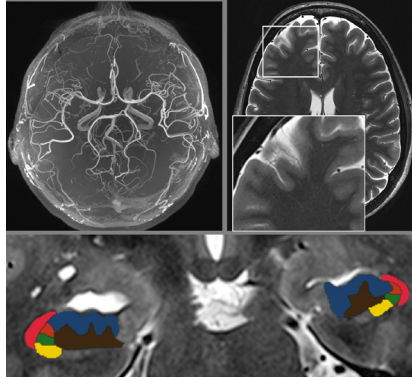


Figure 2: Ultrahigh resolution vascular and structural images obtained at 7 Tesla

- Dr. Rafael O'Halloran's talk was titled "Freeze that Patient! Motion in (d)MRI and What We Are Doing About It." (Figure 3)

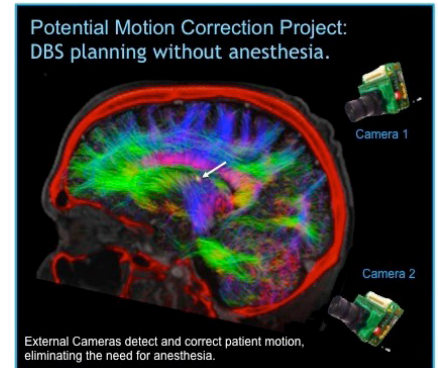


Figure 3: Image and optical guided motion correction

- Dr. Prantik Kundu discuss his work in a talk titled "Studying Resting State Connectivity Using Multi-echo fMRI" (Figure 4)

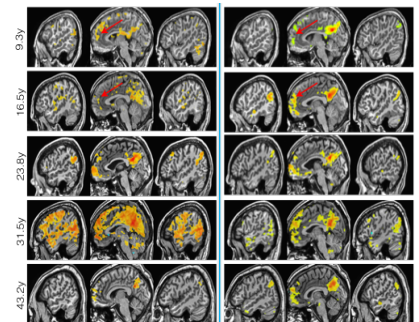


Figure 4: Seed-based functional connectivity at the subject-level using multi-echo fMRI

CORE SPOTLIGHT

New State-of-the-Art CT

Siemens - SOMATOM Force

The Force is the third iteration of Siemens' dual-source CT design and the new flagship product in the Siemens product line. The system will be online at the end of 2014. It features two sets of x-ray tubes and enhanced detectors for imaging of all patients, young and old, including children, patients with renal insufficiency, and those who cannot hold their breath.



Due to its low-kV imaging technique, Force broadens CT's application for patients with renal insufficiency and offers an acquisition speed of 737 mm/sec, so an entire adult chest, abdomen, and pelvis study can be done in one second with no breath-holds.

In cardiac imaging, Force can obtain an entire study within one-quarter of a heart beat at a temporal resolution of 66 msec, which is the speed required to freeze the fastest-moving anatomy, such as the right coronary artery.

BIC CORNER

The First Annual BIC Symposium was well attended throughout the day at the Davis Auditorium on October 28. Wonderful presentations from many TMII scientists were very well appreciated- by the Symposium organizers, as well as by those attending. Thank You all!

The BIC website (<https://bic.mssm.edu>) is being updated- be sure to check back after the symposium for highlights of the day.

BIC has corroboratively produced a thorough and detailed technical document to support grant writers and investigators in preparing protocols that would benefit from neuroimaging components. To obtain a copy, please email anita.kalaj@mssm.edu.

The BIC Common Protocol has been updated. The protocol can now be found on the scanner with the label BIC_v1 in the folder 'Research-Dev/GCO-13-8882D-BIC'. This update contains 3 important modifications- 1) a new "brain" shim mode to provide a more uniform magnetic field, particularly in frontal regions, 2) a more robust DWI post-processing sequence with a lower b-value, matched diffusion directions and a TR delay to mitigate eddy current related artifacts, and 3) shorter localizer protocols, and more robust Autoalign. Specific details have been distributed in the weekly BIC Tech minutes. Please work with the MR technologists Kamil and Dewey to make the needed changes to your protocols

BIC users are encouraged to obtain project

allocations on the ISMMS Scientific Computing group's Minerva supercomputer. Much of the computational heavy lifting required for the extensive pre-processing of neuroimaging data is now automated using XNAT pipelines developed at BIC. The flow of imaging data from MR acquisition into the XNAT data management repository now continues to BIC's allocation on Minerva for high-speed processing. BIC users will need Minerva project allocations to position their pre-processed image sets for downloading. <http://icahn.mssm.edu/research/resources/scientific-computing> contains descriptions and procedures for working with Minerva. In addition, BIC server space for temporary large volume assemblies is increasing, through purchases of storage for the SOMA and PYRAMID high performance analysis servers.

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