Icahn School of Medicine at Mount Sinai

Translational & Molecular Imaging Institute

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Message from the Director

The Translational and Molecular Imaging Institute (TMII) is a comprehensive, multi-disciplinary, and integrated imaging research institute, which focuses on the use of multimodality imaging for brain, heart, and cancer research, along with research in nanomedicine for precision imaging and drug delivery. TMII is composed of research groups in all aspects of imaging research, including engineering, physics, chemistry, analysis, basic science, and medicine. Our mission is centered around development, validation, translation and education of innovative technology in biomedical imaging to address both basic and clinical research problems and therefore improve human health. Since 2013, the Translational and Molecular Imaging Institute occupies approximately 20,000 square feet at The Mount Sinai Medical Center. Please find, below, the lastest news and information on TMII.

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WHAT'S NEW?

TMII News & Updates

Good News for NIH Funding

From the Academy of Radiologic Research: "... the House unveiled a comprehensive spending package known as an Omnibus* spending bill. The bill surprisingly includes the controversial Health and Human Services division, and calls for a much-welcome $1 billion increase over last year's post-sequester amount. For the National Institute of Biomedical Imaging and Bioengineering, this will be a $10 million increase ($329 million) over the 2013 level, a year in which funding was cut by an unprecedented $19 million from 2012."

For more information: http://www.acadrad.org

Premier Journal Focuses on Reproducibility

Editorial in the current issue of *Science*: "Science advances on a foundation of trusted discoveries. Reproducing an experiment is one important approach that scientists use to gain confidence in their conclusions. Recently, the scientific community was shaken by reports that a troubling proportion of peer-reviewed preclinical studies are not reproducible. Because confidence in results is of paramount importance to the broad scientific community, we are announcing new initiatives to increase confidence in the studies published in Science. For preclinical studies (one of the targets of recent concern), we will be adopting recommendations of the U.S. National Institute of Neurological Disorders and Stroke (NINDS) for increasing transparency.* Authors will indicate whether there was a pre-experimental plan for data handling (such as how to deal with outliers), whether they conducted a sample size estimation to ensure a sufficient signal-to-noise ratio, whether samples were treated randomly, and whether the experimenter was blind to the conduct of the experiment. These criteria will be included in our author guidelines"

For the complete editorial go to- http://www.sciencemag.org/content/343/6168/229.full

New Faculty & Staff

The new year has brought two new additions to the TMII team. Dr. Rafael O'halloran is our newest faculty member and will be chief of the Image Acquisition Core. Dr. O'Halloran comes to us by way of Stanford University where he was a research associate working on DTI methods. In 2009 Dr. O'Halloran received his PhD in Medical Physics from University of Wisconsin, Madison. He's joined by his wife Erin Girard and 16-month-old son Rafael.

Also joining the team, as the head of operations for TMII, is Christopher Cannistraci. Christopher previously worked in the neuroimaging core and as operational manager for Dr. John Gore, first at a Yale University then, at the Vanderbilt University Institute of Imaging Science. He is joined by his wife Beth, 5 year old son Gabriel and 3 year old daughter Sofia.

Welcome to TMII!

Brain Imaging Core - Corner

- Weekly tech meeting:
  Mondays 12pm CSM 10fl, rm 101
- Bi-weekly users meeting:
  Tuesdays 3pm CSM 2fl, rm B
- BIC Protocol - nearing completion:
  SOP for structural, DTI, fMRI, fcMRI, & RNA/DNA banking
- BIC Day - coming soon:
  Profiling imaging facilities and invited speakers

For more info: anita.kalaj@mssm.edu

FACULTY SPOTLIGHT

New Frontiers in Diffusion-Weighted MRI

Rafael O'Halloran, PhD

As Chief of the Image Acquisition Core, Dr. O'Halloran's work is focused on bringing innovative new imaging techniques to bear on problems in basic and clinical research. His primary area of focus is on diffusion weighted imaging (DWI), in particular on high-resolution DWI. At high spatial resolution, DWI allows visualization of the white matter pathways that connect functional areas of the brain. One application of this technique that Dr. O'Halloran is focused on is in the planning of deep brain stimulation surgery to treat conditions such as Parkinson's disease, dystonia, and depression. Dr. O'Halloran's other interests include image reconstruction and motion correction. Patient motion continues to be a major problem in MRI, causing failed or prolonged exams which ultimately results in increased heath care costs. Solutions to patient motion can be implemented on both the acquisition and image reconstruction side, and can potentially benefit a wide range of MR imaging techniques. Dr. O'hallroan hopes his expertise in MRI will foster collaborative research in areas of clinical practice and neuroscience.

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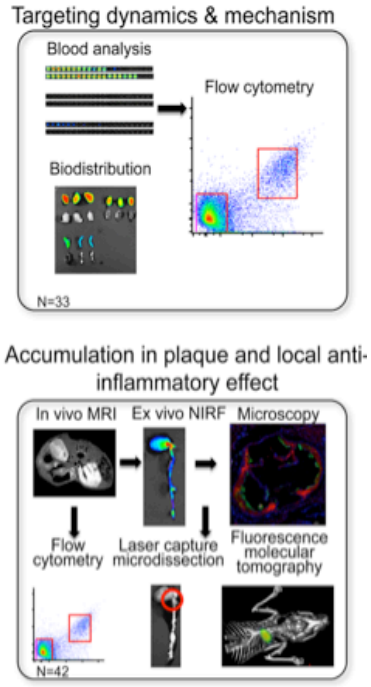
SCIENCE SPOTLIGHT

Nanomedicine Laboratory

Willem Mulder, PhD

Dr. Willem Mulder is an Associate Professor of Radiology at the Icahn School of Medicine at Mount Sinai (MSSM) in New York and Professor of Cardiovascular Nanomedicine at the Academic Medical Center in Amsterdam. Dr. Mulder, a chemist by training, received his PhD in Biomedical Engineering from the Eindhoven University of Technology in The Netherlands in 2006. Thereafter he moved to MSSM to found the Nanomedicine Laboratory within the Translational and Molecular Imaging Institute (TMII).



Currently, Dr. Mulder directs TMII's Nanomedicine Laboratory (Nano-TMII) and his research is focused on the development, preclinical testing and translation of nanoparticle imaging agents and nanoparticle therapies for cancer and cardiovascular disease. Because the Nanomedicine Laboratory resides within an imaging institute the research has a strong emphasis on in vivo imaging, which allows the visualization of nanoparticle biodistribution and targeting as well as nanotherapeutic efficacy.

His team consists of 6 postdocs, 4 Ph.D. students, 2 technicians and on average 2-4 (visiting) undergraduate students. The nanomedicine research projects at Nano-TMII are diverse, highly multidisciplinary and imaging oriented. They range from the basic development of nanoparticle platforms with 'smart' coatings or as 'smart' reporters, to full-blown preclinical mouse nanotherapy studies (figure), all the way to translational studies with rabbit models.

To facilitate the translation of nanotherapy for atherosclerosis patients Dr. Mulder also holds a strategic appointment at the Academic Medical Center (AMC) in Amsterdam. At the AMC he collaborates with a team of clinical trialists, led by Dr. Erik Stroes, with whom he has initiated the first clinical trials in cardiovascular disease patients.

The research at Nano-TMII is supported by several NIH grants, including an R01 through the National Cancer Institute and the Program of Excellence in Nanotechnology through the National Heart Lung and Blood Institute. For the latter program Dr. Mulder serves as a co-PI on a project that revolves around theranostic cardiovascular nanomedicine. He was recently awarded a prestigious vidi grant by the Dutch Science Foundation (NWO).

Dr. Mulder has authored more than 90 papers and 7 book chapters, has trained over 30 young scientists, and is a regular invited speaker at international conferences. His work has been highlighted in an article entitled "From the Lab, a New Weapon Against Cholesterol" in The New York Times in 2009 and, more recently, in The Daily News at the 2011 AHA meeting in Orlando. The recent crowdfund project HighonNano.com resulted in a lot of publicity from the Dutch mainstream media. Most recently, a paper published in Nature Communications (figure) received a lot of US media coverage: http://www.mountsinai.org/about-us/newsroom/press-releases/novel-nanotherapy-breakthrough-may-help-reduce-recurrent-heart-attacks-and-stroke

Figure. Study design of a recent study by Nano-TMII members Raphael Duivenvoorden and Jun Tang (http://www.nature.com/ncomms/2014/140120/ncomms4065/full/ncomms4065.html)
(top) The biodistribution, targeting dynamics, targeting mechanism and anti-inflammatory action of stati nanotherapy ([S]-rHDL) in apoE-KO mice were investigated. (bottom) Magnetic resonance imaging, NIRF, fluorescence microscopy and flow cytometry were used to validate the plaque macrophage-targeting efficiency of [S]-rHDL. The effect of [S]-rHDL on the mRNA levels of inflammatory genes of plaque macrophages was determined in macrophages isolated with laser capture microdissection. Fluorescence molecular tomography and computed tomography were used to assess the effect of [S]-rHDL on inflammatory protease activity in aortic root plaques.

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IMAGING SPOTLIGHT

New Models for Cancer Imaging

Taouli Lab - Cancer & Body Imaging

DCE-MRI can be used to quantify liver tumor perfusion parameters with the use of pharmacokinetic (PK) models, such as the Tofts Model (TM). However, the TM assumes infinitely fast equilibrium inter-compartmental water exchange kinetics, which might not hold true when there is significant contrast agent (CA) extravasation during CA bolus passage through the tissue of interest. The Shutter-Speed model (SSM) takes into consideration the finite water exchange kinetics and the two-compartment SSM version introduces a parameter in addition to the K^{trans} and v_e parameters, the mean intracellular water molecule lifetime, τ_i, to account for the transcytolemmal exchange. In this study, the TM and the SSM are applied to estimate perfusion parameters of liver parenchyma and hepatocellular carcinoma (HCC).

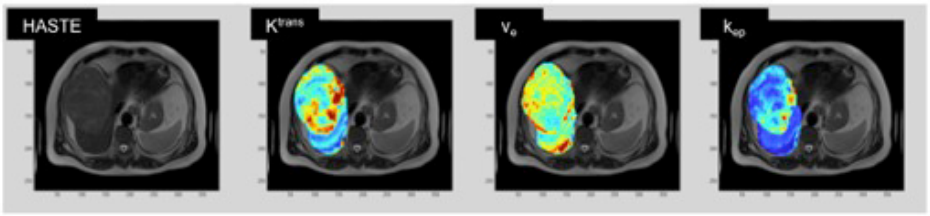

Figure: Reference T2 HASTE, and parametric maps of Tofts K^{trans}, v_e and k_{ep} in a 66 year old patient with a 14 cm HCC.

Initial data shows different perfusion metrics when computed with the TM and the SSM, with differences observed for K_{SSM}^{trans} and τ_i, but not for v_e^{TM} and k_{ep}^{TM} between liver and HCC for the SSM. Reproducibility of the SSM and the TM is limited in HCC, the SSM showing worse reproducibility.

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UPCOMING MEETINGS

- ISMRM - May 10-16, 2014 Milan, Italy - Registration and Housing Open
- HBM - June 8-12 2014 Hamburg, Germany - Early registration rates available until March 13
- TMII 2014 Symposium - May 28 & 29, 2014 - Check back soon for more details
- BIC Day - TBD - Check back soon TMII 2014 Symposium - TBD - Check back soon

CORE SPOTLIGHT

Core Overview

Mission & Equipment

The Translational and Molecular Imaging Institute (TMII) is responsible for providing support for all in vivo imaging research at The Mount Sinai Medical Center. TMII Imaging Core is the backbone of the Translational and Molecular Imaging Institute and is responsible for coordinating, supporting and executing imaging research at Mount Sinai including, neuroimaging, cardiovascular imaging, cancer imaging, nanomedicine (molecular imaging and drug delivery), and image processing in the preclinical and clinical settings.

The Core is fully staffed to support all the image acquisition, image analysis, scheduling, and performance of the proposed experiments. The Core has an extensive and expanding inventory of preclinical (large and small) and clinical research imaging facilities and equipment, including ancillary support which encompasses exam rooms, imaging processing workstations, laboratories (wet lab space, cell and chemistry preparation and a radio nuclear lab), animal preparation and holding rooms, and testing rooms. The Core's resources are fully supported by user fees drawn from research grants, instrumentation grants, industry contracts, and

agreements. Our core facilities are available for use to all qualified investigators from academic, medical, government, and industry laboratories. We do not offer a clinical imaging service.

Our current instrumentation and services include:

- Human Imaging (3T MRI, 7T MRI, 3T MR/PET, CT)
- Human Mock MRI
- Human and Animal Imaging Peripherals
- Human and Animal Anesthesia and Monitoring
- Large Animal Imaging (3T MRI, 7T MRI, 3T MR/PET)
- Small Animal MRI (9.4T, 7T)
- Small Animal US
- Small Animal Optical Imaging (Fluorescence, Bioluminescence and Near-infrared)
- Dissecting Microscope with Digital Camera
- Staff-Assisted Imaging (imaging technologists, nurse, etc.)
- Imaging Processing and Data Analysis
- Scheduling
- Training
- Consultation

UPCOMING LECUTRES

Date	Location	Lecture / Event	
Mon Feb 3rd **10:30 – 11:30am**	**Hess Davis Conference Center** **2nd Floor – Davis Auditorium**	**Georges El Fakhri, Ph.D., DABR** Director, Center for Advanced Medical Imaging Sciences Co-Director, Division of Nucl Med & Mol Imaging Professor of Radiology Harvard Medical School	**"Challenges and Opportunities in Simultaneous PET-MR"**
Wed Feb 5th **11:00 – 12:00am**	**Hess Davis Conference Center** **2nd Floor – Davis Auditorium**	**Leo K. Tam, PhD** Yale University, Biomedical Engineering Sc.B. 2007, Brown University, Mathematics - Physics	**"Nonlinear Gradient Encoding: Design and Implementation on a Siemens 3T Human Scanner"**
Wed, Feb 19th **11:00 – 12:00pm**	**Hess Davis Conference Center** **2nd Floor – Davis Auditorium**	**Jonathan H Gillard BSc MD FRCP FRCR MBA** Professor of Neuroradiology University of Cambridge University Department of Radiology Cambridge University Hospitals Foundation Trust	**"Assessment of plaque risk in man: What can MR and biomechanics contribute?"**
Thurs, Feb 20th **12:00-1:00pm**	**Hess Davis Conference Center** **2nd Floor – Davis Auditorium**	**Nicole Seiberlich, PhD** Assistant Professor, Biomedical Engineering Case Western Reserve University Cleveland, Ohio	**"Rapid Magnetic Resonance Imaging using Novel Parallel Imaging Techniques"**
Wed, March 5th **11:00-12:00pm**	**Hess Davis Conference Center** **2nd Floor – Davis Auditorium**	**Spencer Bowen, PhD** Research Fellow Department of Radiology, MGH Charlestown, MA	**"Quantification in hybrid MR-PET"**
Wed, March 12th **11:00-12:00pm**	**Hess Building – 9th Floor** **Conference Room 101**	**Robert Turner, PhD** Director, Department of Neurophysics, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig	**Title: TBA**

For more information on these and other events goto: http://tmii.mssm.edu/events/

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