BioMedical Engineering and Imaging Institute

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Message from the Director

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With summer upon us, COVID-19 restrictions lifting, and vaccinations rising, there is much to celebrate. I am grateful to my team for their persistence and strength throughout the uncertainty of the last sixteen months. While we all take time to enjoy the summer sunshine and re-opening of borders, we will not relent in our efforts to understand this disease and its long-term effects, alongside collaborators across the health system.

BMEII is full of so many talented and dedicated people, and it is a joy to see several faculty, staff, and post-docs recognized for their service and innovation through recent awards. We continue to expand and hire across our research programs and welcome applications from under-represented groups. I hope you enjoy this edition of the BMEII newsletter, and I wish you all an enjoyable and healthy summer. Thank you for your support.

BMEII News & Updates

BMEII in the News

COVID-19 research conducted at BMEII has gained national attention in recent months. Both NBC Today and NBC News covered our imaging research investigating cardiac inflammation in post-acute sequelae of SARS Co-V- 2 (PASC) patients. These features follow patients who have experienced persisting symptoms of COVID and important research happening across the country and here at Mount Sinai to understand what the longterm effects of COVID are and why some patients experience extended illness.

THE LONG ROAD TO RECOVERY
SEARCH FOR WHY ONE-THIRD OF COVID SURVIVORS HAVE LONG-TERM SYMPTOMS

SUNDAY TODAY

Congratulations Corner

Yael Jacob, PhD, a postdoctoral fellow in the Balchandani Lab, is a recipient of the inaugural Friedman Brain Institute Postdoc Innovator Award. The award will provide $25,000 to support innovative research by a postdoctoral fellow in any laboratory affiliated with the Friedman Brain Institute. Dr. Jacob will apply the funding towards her project entitled "Network based real-time neurofeedback using ultra-high field MRI to reduce rumination levels in depression."

ImagingNation Podcast

Join us on ImagingNation, a podcast where we discuss all things imaging science, research, innovation, and society. Listen to our latest episodes on Apple and Spotify.

BMEII is hiring!

We are looking for innovative, motivated faculty, postdocs, researchers, and support staff to join our team. Visit our website for all open positions and instructions on how to apply.

Welcome, New BMEII Staff

Ghadi Abboud is a post-doctoral fellow in Dr. Taouli 's Cancer and Body Imaging lab, where he works on quantitative MRI applications in various abdominal diseases. He completed his medical training and radiology residency in Beirut, Lebanon. He also holds an EMBA from the University of Balamand, Lebanon.

Jessica Fernandes joined BMEII as a Senior Associate Researcher and manages the Nanomedicine lab. Originally from Brazil, Jessica completed a BS in Biomedical Science at UFPR (Federal University of Paraná) and MS in Biosciences and Biotechnology at Fiocruz (Carlos Chagas Institute). She has developed expertise in monoclonal and bi-specific antibodies production and cellular and molecular biology.

Chendi Cao joined BMEII as a post-doctoral fellow in Dr. Yang's Cardiovascular Imaging group and focuses on novel imaging techniques for comprehensive cardiovascular magnetic resonance (CMR) imaging using non-Cartesian trajectories and motion-correction techniques. His research will consist of pulse sequence programming and development, acquisition of image data on patients and healthy volunteers, image reconstruction with Gadgetron. He obtained his PhD in Computer Science and MS, BS in Statistics from Kansas State University.

Patrick Tanella is a Program Coordinator for Dr. Taouli's Cancer and Body Imaging lab, where he assists with RECIST requests, the annual research retreat, and general lab support. Prior to joining BMEII, Patrick completed his BA in Psychology and Art History at Vassar College in addition to spending a semester at University College London. He is interested in connecting art and public health, and hopes to merge the two disciplines by using painting as a holistic form of therapy for cancer patients.

Our STAR Clinical Research Managers

Two of our clinical research staff were recently honored by Dr. David Reich, President of The Mount Sinai Hospital with the STAR Award for the exceptional compassion and care they have shown throughout the COVID-19 pandemic. These awards are given to employees who exemplify the Mount Sinai values and service standards of empathy, equity, teamwork, creativity, agility, safety, compassion, and excellence.

Renata Pyzik, MS, MA, is a Project Manager who has worked on cardiovascular imaging studies at BMEII for six years. Renata plays an instrumental role in managing Dr. Fayad's clinical research studies, including maintaining local and FDA/NIH compliance, establishing new projects, managing databases, analyzing data, and coordinating recruitment. Renata says, "Improving diagnostics and searching for new technologies, like imaging techniques, has always been a driving force for me. I am inspired by Dr. Zahi Fayad and the BMEII staff to advance educationally and professionally." One memorable experience from the last year involved the early detection of lung cancer in a patient participating
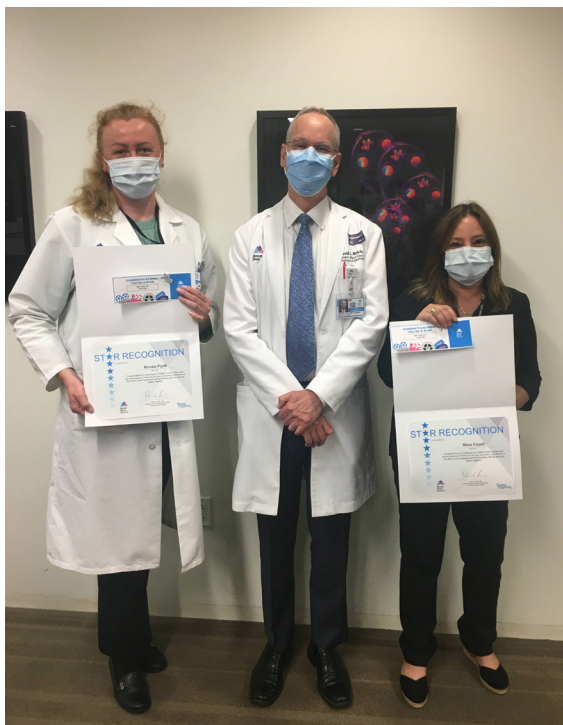
On May 26, Dr. David Reich surprised Renata Pyzik (left) and Rima Fayad (right) with the Mount Sinai STAR Award.

in COVID-19 imaging research. Catching the disease early is potentially lifesaving, and the patient was extremely grateful for the discovery. Beyond BMEII, Renata is very active and enjoys competitive skating, tour guiding, crocheting and needlepoint. She is also passionate about fundraising for families with children with special needs.

Rima Fayad, MPH, is a Clinical Research Manager and has been with BMEII for 14 years. She recruits and consents patients participating in cardiac imaging studies and ensures adherence to safety measures, regulatory compliance, and study protocols. Despite the challenges of maintaining a safe environment for patients and staff during the pandemic, Rima loves being able to meet and form relationships with research participants, and always keeps safety in mind. Recently, a patient wrote a letter in gratitude for Rima's courteous and professional attitude and for how well she and our research techs were able to put him at ease. For Rima, the STAR award inspires her to keep doing better. She emphasizes the importance of teamwork and is grateful to be part of BMEII. Outside of work, Rima enjoys running, traveling, hosting friends, and spending time with family.

If you would like to nominate STAR employees for embodying Mount Sinai values, visit: https://sinaicentral.mssm.edu/star/

Rising Star

Li Feng, PhD

Dr. Li Feng is an Assistant Professor of Radiology at the Icahn School of Medicine at Mount Sinai. Dr. Feng obtained his PhD in Biomedical Imaging from NYU School of Medicine in 2015. His research has primarily focused on development of novel rapid motion-robust and quantitative MRI techniques combining advanced acquisition schemes (e.g. golden-angle radial sampling) and image reconstruction strategies (e.g. compressed sensing and deep learning). These new methods can enable acquisition of diverse and comprehensive information in a single, rapid and continuous stream. Over the last decade, Dr. Feng has led the development of several fast and ultrafast MRI techniques. One of them, called Golden-angle RAdial Sparse Parallel (GRASP) MRI, has been successfully translated into the clinic for a broad spectrum of applications

and optimize new dynamic MRI techniques based on GRASP MRI for rapid free-breathing and easy-to-use perfusion quantification in the liver. The proposed new methods are expected to achieve improved imaging performance, reduced reconstruction time and substantially simplified perfusion analysis compared to existing MRI methods. These new technical developments will be integrated into the clinical setting to generate a new liver MR perfusion framework, which would enable significant progress towards improved characterization and management of many liver diseases with high clinical impact, such as hepatocellular carcinoma (HCC). It could also change the entire experience of MR imaging for physicians, for patients and for technologists.

regional function evaluation of the lung, and therefore there is a pressing clinical need to develop new imaging methods for this purpose. This project aims to develop a novel MRI technique for non-invasive and radiation-free imaging of pulmonary anatomy and function with improved motion robustness, which will enable a 10-minute free-breathing "one-stop-shop" examination of the lung. As a scientific community, we are still learning the long-term effects of COVID-19. Thus, this new method proposed by Dr. Feng holds great potential to improve management of any lingering effects of this disease, and it can also be applied to evaluate other pulmonary diseases.

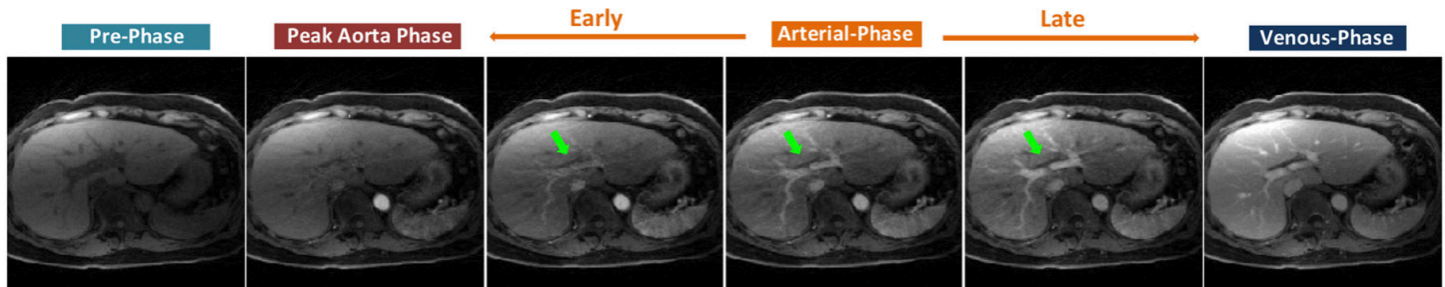In addition, together with Mingqian Huang, MD, Musculoskeletal Chief, Dr. Feng

Figure 1: Fast free-breathing 3D dynamic contrast-enhanced MRI (DCE-MRI) of the liver using the GRASP technique. High resolution contrast-enhanced liver images at multiple time points can be obtained for clinical use.

and has resulted in increase of the utility, the simplicity, and the cost-effectiveness of MRI. Dr. Feng was named as a Junior Fellow of the International Society for Magnetic Resonance in Medicine (ISMRM) in 2015 and was a winner of the Early Career Award in Basic Science from the Society for Cardiovascular Magnetic Resonance (SCMR) in 2014. Dr. Feng is also a recipient of the 2021 Junior Faculty Council Award for Academic Excellence at Mount Sinai.

Dr. Feng was recently awarded a 4-year R01 grant by the NIH/NIBIB to develop

Dr. Feng has received a fundable score on another recent NIH R01 submission, which is now being considered for funding. Building on Dr. Feng's expertise in GRASP MRI and its variant, called XD-GRASP (GRASP with eXtra Dimensions) MRI, this grant proposal aims to evaluate the long-term consequences of COVID-19 on the lungs. Tracking damage in the lungs is important for early identification of COVID-19-induced pulmonary diseases such as lung fibrosis or lung function reduction. However, existing clinical methods are insufficient for simultaneous structure and

recently initiated a project in collaboration with a company called Hyperfine, which develops and builds bedside portable low-field MRI scanners with a mission of making MRI machines for every place and everyone. The main purpose of this project is to investigate the performance of the Hyperfine MRI scanner in musculoskeletal applications and to evaluate whether a low-field portable MRI scanner could achieve sufficient diagnostic image quality in assessing different diseases in the knee joint compared to routine clinical MRI scanner.

Conflict of interest disclosure: Dr. Feng is one of the named inventors in a patent on the GRASP and XD-GRASP MRI techniques.
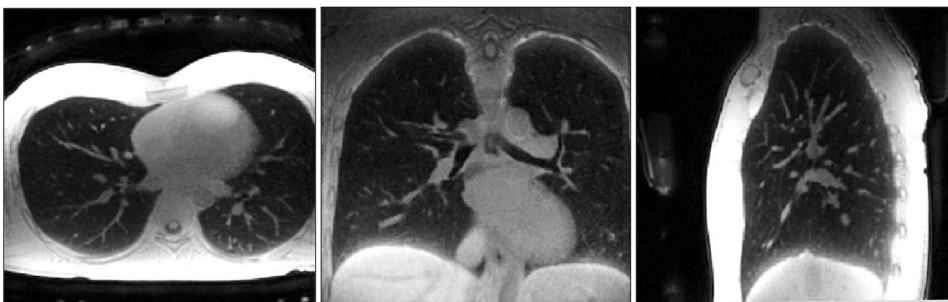

Figure 2: Fast free-breathing 3D non-contrast MRI of the lung with submillimeter isotropic spatial resolution using the XD-GRASP technique. Good delineation of lung structure can be obtained without radiation exposure and without the need for breath holding.

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International Society for Magnetic Resonance in Medicine (ISMRM) Presented Abstracts

Several BMEII and Radiology faculty presented scientific and educational talks and posters at the May 2021 ISMRM virtual conference. The sessions are available at this link (login required).

Section Name	Session Type	Abstract Title (Note: links are only active for registered attendees)	Presenter Name
Elastography	Scientific Talk	Tumor stiffness and stiffness change using 3D MR elastography are markers of tumor lymphocyte infiltration and immunotherapy response in HCC.	Paul Kennedy, PhD* Lab: Taouli
Simultaneous Multiparameter & Multidimensional Cardiovascular MRI	Educational Talk	Basics of Multidimensional Imaging	Li Feng, PhD* Lab: Feng
RF Design I	Scientific Talk	Enhanced Ultra-High Field Brain MRI Using a Wireless Radiofrequency Sheet	Akbar Alipour, PhD* Lab: Balchandani
Spectroscopy: ACQ/Recon/Analysis	Scientific Poster	Ultrahigh-field echo-planar spectroscopic imaging with semi-adiabatic spatial-spectral pulses	Gaurav Verma, PhD* Lab: Balchandani
Safety	Scientific Talk	RF safety and image quality testing of deep brain stimulation electrodes with 3T MRI	Gaurav Verma, PhD* Lab: Balchandani
Multiple Sclerosis	Scientific Talk	Prediction of multiple sclerosis clinical progression using whole brain adiabatic T1rho and Relaxation Along a Fictitious Field imaging	Ivan Jambor, MD* Radiology
Artificial Intelligence (Machine Learning & Deep Learning) Applications to Neuroradiology	Scientific Poster	Classification Between Epilepsy Patients and Healthy Controls Using Multi-Modal Structure-Function Brain Network	Yael Jacob, PhD* Lab: Balchandani
MRI in Stroke: Vessels, Flow & Tissue Structure	Scientific Talk	GraspMRA: High Temporal Resolution, Non-Contrast Enhanced, Time-Resolved 4D MR Angiography Using Golden-angle Radial Sparse Parallel Imaging	Li Feng, PhD* Lab: Feng
Fat & Metabolism	Scientific Talk	MP-Dixon-GRASP: Magnetization-Prepared Multiecho GRASP MRI for Free-Breathing Fat/Water-Separated 3D T1 Mapping	Li Feng, PhD* Lab: Feng
Cancer: Contrast Agents & MRS	Scientific Poster	Estimation of capillary level input function for abbreviated breast Dynamic Contrast-Enhanced MRI using deep learning approach	Li Feng, PhD Lab: Feng
Imaging of Heart Failure	Scientific Talk	Cardiovascular magnetic resonance T1rho endogenous contrast can detect early myocardial fibrosis in hypertrophic cardiomyopathy	Yang Yang, PhD Lab: Fayad
CEST, MT &T1P	Scientific Poster	Whole-brain amide CEST at 3T with a steady-state radial MRI acquisition	Xiang Xu, PhD Lab: Xu
Quantitative Cardiovascular Tissue Characterization	Scientific Talk	Comparison of free-breathing self-gated continuous IR spiral T1 mapping: dual flip angle versus Bloch-Siegert B1-corrected techniques	Yang Yang, PhD Lab: Fayad
Imaging Metabolites: CEST, MR & MRS	Scientific Talk	A digital human head phantom for validation of retrospective motion correction in glucoCEST MRI	Xiang Xu, PhD Lab: Xu
Prostate	Scientific Poster	Machine learning challenge using uniform prostate MRI scans from 4 centers (PRORAD)	Ivan Jambor, MD Radiology
Machine Learning for Quantitative Imaging	Scientific Talk	Self-supervised Deep Learning for Rapid Quantitative Imaging	Li Feng, PhD Lab: Feng

*Indicates presenting author

Engineering & Medicine Seminar Series

For an updated schedule of lectures, check out our webpage. The series will take place on Zoom for the remainder of the year. Interested in presenting? Contact Mallory Stellato at mallory.stellato@mssm.edu.
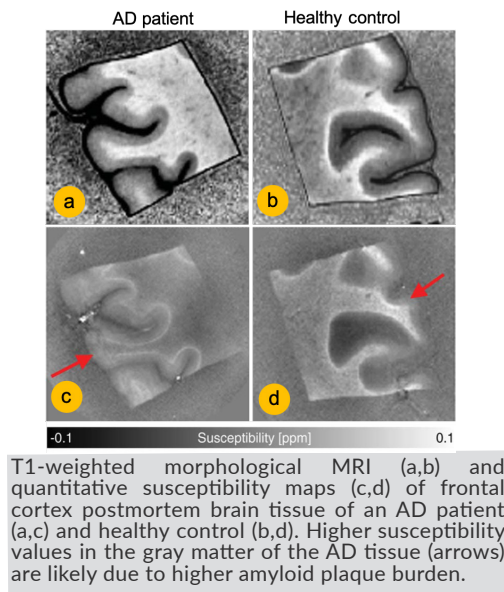
Exciting New Grants

Sara Lewis, MD, Associate Professor, and **Octavia Bane, PhD**, Instructor of Diagnostic, Molecular and Interventional Radiology, are co-recipients of an R01 award from the NIDDK, for their project proposal "Characterization of Renal Allograft Fibrosis and Prediction of Outcome Using a Quantitative MRI Approach". The purpose of the project is to validate a robust, quantitative multiparametric (mp)MRI approach based on diffusion-weighted and relaxometry (T1 and T1rho) MRI to accurately and non-invasively measure renal transplant fibrosis and clinical outcome. Concomitantly with detecting and staging renal transplant fibrosis, the study aims to detect and stage other histopathological diagnoses of inflammation, and to assess the added values of urinary biomarkers of fibrosis. mpMRI in combination with urinary biomarkers will then be used to predict renal transplant outcome over 2 years. The bi-center, prospective study is based on the collaboration of imaging scientists, transplant nephrologists and renal pathologists at Mount Sinai and Weill Cornell Medical Center (WCMC). The study aims to recruit 120 patients with renal transplant scheduled to undergo indication biopsy at Mount Sinai, and 120 patients scheduled to undergo indication or surveillance biopsy at WCMC. Patients will be imaged at 3T with mpMRI protocols harmonized between the two centers.

Akbar Alipour, PhD, a post-doctoral fellow in the Balchandani Lab received funding for his project "Quantifying beta amyloid plaques aggregation in Alzheimer's diseases using 7T MRI" from the Alzheimer's Disease Research Center Developmental Projects (Mount Sinai ADRC/NIA) for funding. Alzheimer's disease (AD) is definitively diagnosed with conformity only by detecting biomarkers as seen under microscopy and only on postmortem neuropathology. Since definitive diagnosis comes too late to effect management, there is need for an accurate noninvasive technique to characterize AD onset. Higher regional brain iron concentrations in patients with AD are associated with beta amyloid plaques and neurofibrillary tangles. Iron accumulation was fou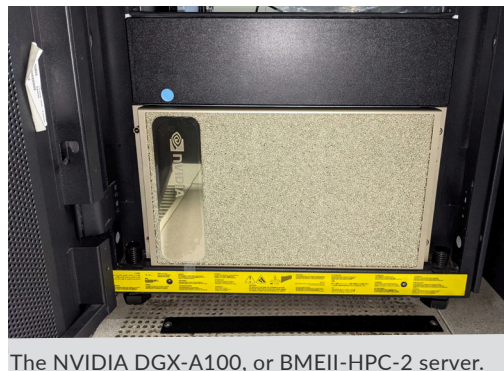nd to increase the production of amyloid precursor protein and thus might be directly involved in the formation of beta amyloid plaques. The detection of amyloid plaques on MRI relies on precise co-localization of these deposits with iron, which allows them to appear more conspicuous on high-field MRI. MRI at ultra-high field strength, such as 7T, increases sensitivity by offering improved signal-to-noise ratio and MR contrast. High-field MRI is one technique by which AD has been increasingly studied non-invasively and in vivo. Therefore, the magnetic susceptibility at 7T MRI is increased in the amyloid plaque-containing regions of AD tissue compared with brains of healthy controls, features that may elucidate pathology underlying susceptibility changes over time in AD patients."

T1-weighted morphological MRI (a,b) and quantitative susceptibility maps (c,d) of frontal cortex postmortem brain tissue of an AD patient (a,c) and healthy control (b,d). Higher susceptibility values in the gray matter of the AD tissue (arrows) are likely due to higher amyloid plaque burden.

BMEII Expands Artificial Intelligence Technology

As BMEII continues to increase our artificial intelligence (AI) and deep-learning capabilities, we have acquired an NVIDIA DGX-A100 server, one of the latest instruments developed by NVIDIA to accelerate AI development. From training to inference, this third-generation supercomputer was built to support the largest AI datasets and to optimize and accelerate the computing power of multiple workloads. With six times the training performance of its predecessor and eight GPUs, the DGX-A100 (BMEII-HPC-2) server will boost efficiency and allow for parallel computing. Now, our researchers can train more innovative and comprehensive neural networks within a shorter turnaround time, processing millions of images in one day. BMEII-HPC-2 provides BMEII with the performance of 5 petaFLOPS AI and 10 petaFLOPS INT8. The server runs NVIDIADGX Server 5 based on Ubuntu 20.04 and can support other OS through either Linux containers or virtual machines.

The NVIDIA DGX-A100, or BMEII-HPC-2 server.

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