E. Mark Haacke, Ph.D.

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Education:

- 1973 B.S., Math and Physics, University of Toronto
- 1975 M.S., Physics, University of Toronto
- 1978 Ph.D., High Energy Physics, University of Toronto

Awards:

1989 Sylvia Sorken Greenfield Award for the best paper in Medical Physics
1992 Fellow of the Society Award for the Society of Magnetic Resonance Imaging
1994 Silver Medal Award, Society of Magnetic Resonance
2004 Gold Medal Award, International Society of Magnetic Resonance in Medicine

RESEARCH INTERESTS, EXPERIENCE, AND VISION FOR IMAGING RESEARCH

My training was originally in theoretical high energy physics. After several years in scattering theory and later applying that theory to geophysical tomography problems, I became interested in imaging research, specifically in magnetic resonance imaging in 1983. During this early birth of MRI using superconducting systems, it was an undiscovered country, and I was lucky enough to be one of the early explorers. During the last 30 years, I have focused on the vasculature of the human body. During the 1980s, I developed MR angiographic methods and in the mid 1990s. I developed the method called susceptibility weighted imaging (SWI). Today SWI is used to image a plethora of diseases. It is often used to image the veins and cerebral microbleeds (CMB) such as in Alzheimer's disease (AD) or traumatic brain injury (TBI). These two methods, MRA and SWI are used throughout the world today in the study of neurodegenerative disease. In the mid 2000s, I began focusing on the next generation of SWI that we call susceptibility weighted imaging and mapping or SWIM which makes it possible to calculate iron content oxygen saturation in the human brain. With these three tools, as well as flow quantification and perfusion imaging, it is now possible to study the complete hemodynamics of the brain in normal subjects and patients with neurodegenerative disease.

Damage to the vascular system may play a major role in a number of key neurological diseases including: Alzheimer's disease, diabetes, multiple sclerosis, Parkinson's disease, stroke and traumatic brain injury. The last five diseases are all risk factors for developing dementia. We are now evaluating the full scope of the vascular system including arterial input at the macroscopic (carotid arteries, for example) and microscopic (arterioles for cerebral amyloid angiopathy and capillaries) levels and venous input at the macroscopic (dural sinuses, for example) and

microscopic (venules for chronic cerebral spinal venous insufficiency and capillaries) levels. As part of this vascular study, we are considering the relationship between iron deposition and age since iron build up and vascular breakdown are both associated with Alzheimer's disease. Iron deposition may in fact be related to endothelial health. The concept of treating the endothelium and vascular system using vitamin D for example is a novel and important direction. Such studies for hypertension offer new hope for slowing or reversing microvascular damage. This out of the box thinking may have dramatic ramifications. One can now begin to hypothesize new concepts such as: *"A major cause of diverse neurological diseases is either arterial or venous vascular damage, the effects of which can be seen with magnetic resonance imaging."* Using iron as an endogenous contrast agent, *"Iron can serve as a surrogate marker for tissue damage; it can be seen in the form of ferritin and hemosiderin using SWI and will directly show the presence of vascular damage."* and perhaps the most exciting *"Monitoring the early involvement of the microvascular system will make it possible to discover the etiology/pathogenesis of Alzheimer's disease, to diagnose it more effectively at an earlier stage and hence to treat it more successfully."*

In the next few years, we plan to use MR imaging to: a) develop new technology to create a practical and complete package for the study of the hemodynamics and fluid dynamics of the brain; b) evaluate the role of venous abnormalities and iron deposition in neurodegenerative disease; c) study the physiology, anatomy and biochemistry of these diseases; and d) perform large scale population studies with imaging to address the issues of diagnosis, progression and etiology of these debilitating diseases.

The Deparment of Biomedical Engineering serves as the perfect home for both M.S. and Ph.D. students alike to pursue their interests in imaging research.

RESEARCH SPACE

Wayne State University MR Research Facility (MRRF) at Harper University Hospital

In addition to the 3T Siemens Verio system, which is the major equipment to be used for this project, MRRF also has sufficient lab space, computers for data collection, and office space for faculty and students.

Laboratory: Our MR center has a chemistry lab that stores a variety of materials and allows us to prepare necessary phantoms for imaging or MR spectroscopy.

The MRRF is committed to the development of MR methods and their application in the pre-clinical and clinical setting to better understand human physiology of TBI. Our MR research group consisting of six MR faculty members, more than 10 Masters and Doctoral students dedicated to animal imaging, spectroscopy, DTI, fMRI, MR data acquisition, and MR angiography. Total of six staff including registered technician, registered nurse and MR experts are dedicated to image processing, data acquisition, MR quality control and research coordination. Our faculty and staff have ample opportunities for intellectual interactions with other investigators, as they have adjunct positions in the medical physics program and in the department of biomedical engineering. We have close collaborative relations with faculties and physicians in other departments in school of medicine, such as neurology, psychiatry and neurosurgery. MRRF has this long history of collegiality with other centers and departments such as Biomedical Engineering Department. This proposed study will be featured in cross-disciplinary collaboration.

Additional equipment available in the MRRF includes: an HP 4805 Vector Voltmeter; an HP 4191A RF Impedance Analyzer; an HP 5383A Frequency Counter; a Tektronix 2465 300 MHz Oscilloscope; two Wavetek 1062 Sweep Generators; two Wavetek 1901C X-Y Display Scopes; a PTS 250 MHz Frequency Synthesizer; a laminar flow hood; 2 humidified CO2/air incubators; a Coulter counter; a Nikon TMS inverted microscope, an AVL 995 automated blood gas analyzer, and an Avotec projector for functional MRI.

Neurophysiology: Two storage oscilloscopes, two seven channel analog data recorders, two audio monitors, AM Systems Model 1700 four channel preamplifier, two CCD black and white cameras, S-VHS VCR, and high resolution monitor, two 16 channel, 12 bit A/D converters with chart recorder, histogram, spike discrimination software (R.C. Electronics ISC-16E), EnduraTec ELF 3200 materials testing instrument with high-bandwidth, low-distortion actuator

Computer: In Detroit Medical Center, the clinical and imaging data is also available, for those with approved access, through the center-wide network. The workstations are also available in designated radiology areas in both Harper Hospital and Detroit Receiving Hospital.

In WSU MRRF, we have a centralized data server to store all of the imaging data after de-identifying the patient personal information. The server could be accessed remotely via SSH and SFTP by authorized personnel. In MRRF, we also have 15 Intel workstation personal computers used for research and can access a supercomputer on campus. With our research agreement with Siemens, we can modify MR sequences as we need. Because the software systems on the 1.5 Sonata and 3T scanners are identical, we can easily modify and transfer sequences between scanners.

Office: Each participating faculty, clinical assistant, and grant manager has his or her own office in their home department. In addition, the MRRF has a total of 2,700 sq ft dedicated office space. All offices are equipped with necessary telephones, network, computing, and printing facilities.

Our state-of-the-art human scanner are in adjacent rooms of procedure area, patient waiting, and dressing areas, front office, computer/scanner equipment room and radiologist reading rooms.

EQUIPMENT

3T Siemens Verio: Our new 3T VERIO, 70 cm Open Bore and Tim (total imaging matrix) system is a state-of the-art scanner ideally suited for neuro-imaging. The main RF coils for neuroimaging include a 32-channel Head Matrix coil, a 12-channel Head Matrix coil, and a 32-channel body coil. The MRI system also has a 4-channel large flex coil for shoulder. The machine comes with a standard VQ-engine gradient coil (45 mT/m gradient strength with 200 mT/m/s slew rate). The available field of view (FoV) is up to 50 cm and the whole body imaging functionality is up to 196 cm. It also includes parallel imaging up to a factor of 16. The MRI system has a host of clinical applications and also has several advanced research software packages for special imaging processing. Major imaging capabilities include Susceptibility Weighted Imaging (SWI), Diffusion Tensor Imaging (DTI), Arterial Spin Labeling (ASL), Matrix Spectroscopy, Time of Flight (ToF) non-contrast MRA, time-resolved angiography with interleaved stochastic trajectories (TWIST), PACE, and Chemical Shift Imaging (CSI). The new 3T Siemens Verio is equipped with visual and auditory presentation systems. These include fMRI control and integration system (Dell), fMRI projector system (Avotec, Inc) and fMRI audio system (Avotec, Inc). The fMRI control and integration system runs presentation, nordicAktiva, E-prime and other commercial stimulus software. The fMRI projector system is a visual

stimulation system with research quality. The SV-6011 includes a projector and screen that are both MRI compatible. This system includes a camera that is used in conjunction with the audio console to allow patients to see into the control room during the scan. fMRI audio system is a hi-fidelity audio system. The SS-3100 includes a transducer and labyrinth headphone that are also MRI compatible and a microphone console for the control room. Together with the camera from SV-6011, the patient can see and hear the scanner operator during non-fMRI scans. This system is also very useful for pediatrics or very nervous patients.

7T Bruker Clinscan: Our Bruker 30cm bore 7T ClinScan system is a preclinically oriented small animal MRI system for translational studies. This system has a Siemens user interface syngo® making all our work transportable to the human 3T machine and vice versa. With ClinScan one can enter the field of translational research and molecular imaging. The main magnet of this system is actively shielded, similar to the human 3T system. The refrigeration technology used for the main magnet has a long helium holding time and requires minimal number of maintenance. The gradient strength is 290 mT/m with a slew rate of 1160 T/m/s. The 7T is equipped with Bruker RF array coil technology in combination with numerous animal handling accessories. The maximum receiver bandwidth is 1 MHz. The RF amplifier has up to 1400 W pulse power. The Siemens clinical user interface syngo enables efficient workflow and highly automated MRI and MRS applications. The host computer of 7T has a dual processor Pentium XEON™ CPU and a high performance image dual processor (2x AMD Opteron). The system provides numerous preclinical applications, including Susceptibility Weighted Imaging (SWI), Diffusion Tensor Imaging (DTI), Arterial Spin Labeling (ASL), Matrix Spectroscopy, Time of Flight (ToF) non-contrast MRA, Chemical Shift Imaging (CSI), and many others.

PERSONNEL UNDER SUPERVISION

The following people are supervised at the MR Research Facility (which involves another 6 faculty several of whom are also affiliated with the BME Department). These include:

1. Lisa Brownschidle, Research Assistant
2. Ana Chaudhary, Research Assistant
3. Judith Farah, Research Assistant
4. Yashwanth Katkury, MR Technologist
5. Zahid Latif, Chief MR Technologist
6. Meng Li, MS, Research Assistant
7. Rachel Martis-Laze, Research Assistant
8. Jessy Mouanenes-Srour, Research Assistant
9. Yimin Shen, PhD, Chief Animal Technologist
10. Yang Xuan, Senior Technologist

GRANTS (LIST ACTIVE, AWARDED, SUBMITTED GRANTS AND PAST SUPPORT)

Active

R01 NS041922 (Juhasz) 07/01/2008 – 04/30/2013
National Institutes of Health/NINDS
Longitudinal neuroimaging in Sturge-Weber syndrome
The major goals of this project are to study the effects of Sturge-Weber syndrome on the brain over time.
Role: Consultant
Direct Costs: $990,000
W81XWH-11-1-0493 (Haacke) 06/02/2011 – 06/01/2013

Department of Defense
Development of Magnetic Resonance Imaging Biomarkers for Traumatic Brain Injury
The major goals of this project are to study the medullary veins and microbleeds in mild traumatic brain injury. This will involve the application of quantitative susceptibility mapping methods to follow CMB changes in time.
Role: PI
Direct Costs: $432,697

Biogen (Haacke) 10/18/2012 – 06/30/2013
Biogen Idec Canada, Inc.
Volumetric Imaging from Academic Inception to Clinical Practice
The purpose of this study will be to develop a system whereby reports generated in a single MRI environment will provide an automated longitudinal measurement of atrophy.
Role: PI
Direct Costs: $30,000

W81XWH-12-1-0522 (Cheng) 10/01/2012 – 09/30/2013
Department of Defense
Development and Testing of Iron Based Phantoms as Standards for the Diagnosis of Microbleeds and Oxygen Saturation with Applications to Dementia, Stroke and Traumatic Brain Injury
The goal of this project is to build prototype phantoms with various geometries and sources of susceptibility to evaluate the iron content measured with MRI to that measured with other techniques such as mass spectroscopy and SQUID-based Magnetometer and compare the different MR methods in order to choose that which provides the best accuracy and precision to build a commercial level prototype phantom and test it across field strengths and manufacturers at a variety of different sites.
Role: Co-I
Direct Costs: $222,403

Office of The VP for Research (Haacke) 10/01/2010 – 09/30/2013
Wayne State University
Center for Traumatic Brain Injury Research
The goal of this incubator is to create an interdisciplinary research environment focused on traumatic brain injury aiming become an international research hub and educational center fostering basic and clinical studies centered on neuroimaging with the idea of integrating new research findings for better TBI assessment and optimal treatment.
Role: PI
Direct Costs: $899,997

DI-2011-33 (Haacke) 01/02/2012 – 01/03/2014
Bayer Pharmaceuticals, Inc.
Comparing Lesion Contrast with both Magnevist and Gadavist and Understanding the Cerebral Perfusion Patterns of Patients with Multiple Sclerosis (MS) using Magnetic Resonance Imaging (MRI)
The major goals of this project are to test the efficacy of two contrast agents, Magnevist and Gadavist in detecting MS lesions and evaluate the changes in cerebral blood flow in MS patients compared to healthy controls.
Role: PI
Direct Costs: $113,400

University Of Saskatchewan (Nichol) 10/01/2009 – 03/31/2014
Canadian Institutes of Health Research (CIHR)
Team in Synchrotron Medical Imaging
The major goals of this project are: 1) map iron in fixed human brains to see changes in metal distribution associated with stroke and 2) Compare DCE MRI with SWI to better understand the etiology of vascular damage prior to the appearance of bleeds and quantify changes in elemental distribution associated with vascular permeability.
Role: Co-I
Direct Costs: $337,300

1R42HL112580-01A1 (Haacke) 08/15/2012 – 01/31/2015
National Institutes of Health
Development of flow and vascular quantification software for the assessment of MR
The major goals of this project are to develop and optimize an image and signal processing software for vascular assessment and flow quantification.
Role: PI
Direct Costs: $787,867

R37 AG011230-16 (Raz) 06/01/2010 – 05/31/2015
National Institutes of Health/NIA
Neural Correlates and Modifiers of Cognitive Aging
The major goals of this project are continuation and expansion of the research activities of the past 16 years to describe course of differential brain aging, mechanisms of differential brain shrinkage, age-related brain changes and approach to study of the biological and cognitive change.
Role: Co-I
Direct Costs: $412,090

Grants Applications (Pending or unfunded):

1R01NS083592-01 (Haacke) 10/01/2013 – 09/30/2017
National Institutes of Health
The role of vascular damage and reduced perfusion in traumatic brain injury.
Role: PI
Direct & Indirect Costs: $3,181,937

Past Support

H133A080044 (Hanks) 10/01/2008 – 09/30/2012
US Department of Education
Michigan Traumatic Brain Injury System (SEMTBIS)
The major goals of this project are to expand and enhance our comprehensive, multidisciplinary model system of care, largely through involvement in innovative research activities aimed to improve outcomes for persons with traumatic brain injury (TBI) and their families. It is a longitudinal grant that follows survivors of TBI and their caregivers up to 17 years post-injury with respect to cognitive, behavioral, physical, and functional outcomes.
Role: Co-I
Direct Costs: $593,022

K08 MH079176A (Behen) 09/03/2007 – 07/31/2012
National Institutes of Health /NIMH
Structural and Functional Neural Correlates of Early Postnatal Deprivation
Goals: Evaluate the neuroanatomical correlates of early social deprivation (ESD) in human children using both state-of-the-art MRI and PET methods.
Role: Co-I
Direct Costs: $680,483

2R01 HL062983-04A2 (Haacke) 09/01/2008 – 05/31/2012
National Institutes of Health
Susceptibility Weighted Imaging (SWI)
Goals: Continue the development of SWI to: a) make it more clinically viable by reducing phase processing artifacts; b) evaluate susceptibility itself by creating a susceptibility map of human tissue; c) study its role as a new MR angiographic method by simultaneously collecting MRA and SWI data; and d) speed up its acquisition time to less than 5 minutes for whole brain coverage, independent of any parallel imaging gain factor.
Role: PI
Direct Costs: $750,000

NSF 06-597 (Dong) 06/01/2008 – 05/31/2011
National Science Foundation
"CRI:IAD Acquisition of Research Infrastructure for Knowledge-enhanced, Large-scale Learning of Multimodality Visual Data"
Role: Co-I
Direct Costs: $270,822

NID H133G080064 (Hanks) 10/01/2008 – 09/30/2010
"Neural Correlates and Modifiers of Cognitive Aging. Neuroanatomical Correlates of Positive Psychology Among People with Traumatic Brain Injury: A Biopsychosocial Model. *A Field Initiated Grant"*
Role: Co-I
Direct Costs: $593,022

NIH R01 AG011230-11 (Raz) 04/01/2005 – 03/31/2010
"Neural Correlates and Modifiers of Cognitive Aging"
Role: Co-I
Direct Costs: $18,085
Annual direct costs: $156,320

GRADUATE STUDENT SUPERVISION

Dissertations in Progress

Ph.D. Students

1. Ramtilak Gattu: "Diffusion tensor imaging"
2. Charbel Habib: "Investigating Multiple Sclerosis Pathological Landmarks Using MRI"
3. Jing Jiang" "Quantitative flow in MRI"
4. Manju Liu: "Imaging iron in neurodegenerative disease"

Ph.D. students outside the Department

1. Saifeng Liu: "Novel filters in quantitative susceptibility mapping"
2. Sagar Buch: "Imaging tissues with no water using quantitative susceptibility mapping"

Ph.D. Dissertations Directed

1. Muhammad Ayaz; *"Visualization Of Iron And Detection Of Microbleeds In The Brain Using Susceptibility Weighted Imaging"*
2. Jaladhar Neelavalli; *"T1 And Susceptibility Contrast At High Fields"*
3. Areen Al Bashir: *"Quantification Of Vascular Parametric Indices Using Dynamic Contrast-Enhanced Magnetic Resonance Imaging"*
4. Samuel Barnes: *"Imaging The Vasculature With Susceptibility Weighted Imaging: Applications And Analysis"*
5. Zhen Wu: *"Traumatic brain injury"*
6. Tang Jin: *"Quantitative susceptibility mapping"*
7. Yingbiao Xu: *"Susceptibility weighted imaging"*

Ph.D. Dissertations Committee Member

1. Nizrine Zakaria, Biomedical Engineering, "Relationship Between Diffusion Tensor Imaging Parameters and Diffuse Axonal Injury in Brain Injury." August 2011. Advisor: John Cavanaugh.
   Ms. Zakaria was a TA and GTA whose research was supported by funding from WSU.
2. Joel Garcia, Chemistry Department. Syntheses and Studies on the Physical and Chemical Properties of Eu^{II}-Containing Cryptates, Implications to Contrast Agents for Magnetic Resonance Imaging". March 2013. Advisor: Matt Allen.

M.S. Students in BME

Ehsan Rouhallah Hamtei

M.S. Theses Committee Member

1. Bijoyananda Adhikary
2. Pavan Kumar Jella
3. Uday Krishnamurthy
4. Lakshman Gollapalli
5. Asad Kahn
6. Yashwanth Katkuri
7. Paul Kokeny
8. Bharani Kristhnamurthy
9. Megha Maheshwari
10. Elena Manova
11. Karen Mok
12. Balaji Myrtheunjayan
13. Madesh Selvan
14. Vindya Sommana

M.S. Theses Directed

1. Hari Prashanth Ramnath; "Quantification of Velocity and Tracking micron sized particles using MRI and CFD"
2. Kaushik Parthasarathy; *"Biocompatibility of Sapphire and Borosilicate Glass for a Cortical Neuroprosthesis using MRI and Histopathology"*
3. Shashwath Meda; *"DTI, SWI and fMRI as Potential Biomarkers for Severity of Traumatic Brain Injury"*
4. Koushik Athreya Govindarajan; *"Evaluation of Traumatic Brain Injury Through MRI"*
5. Shireen Farvin Hm-Meeran; "*Quantification of MR Spectra in Human Brain Using LC Model"*
6. Karthik Praveen Phrabhakaran; *"Verification of the Susceptibility value of de-oxy-hemoglobin in the blood using Susceptibility Weighted Imaging (SWI)"*

7. Rahul Prakash Peethala; *"Accurate Determination of T1 in Presence of RF Field Inhomogenities"*
8. Illaya Elangovan; *"Verification of Magnetic Susceptibilitty Value of De-Oxy-Hemoglobin of Bloof Using Susceptibility Weighted Imaging (SWI)"*
9. Neha Chandila; "*Constraint-Based Region Growing with Local Shape Fitting"*

M.S. Theses Committee Member

1. Sharath Bandaru, "Traumatic Brain Injury Induced Cerebral Blood Flow Changes" Advisor: John Cavanaugh
2. Moyna Choudhary, Advisor: Jiani Hu
3. Ramya Priya Penmesta, Advisor: Jiani Hu
4. Waqar Raza, Advisor: Jiani Hu

Student Awards

1. *Magna Cum Laude Merit Award*, 20th Annual International Society for Magnetic Resonance in Medicine (ISMRM) meeting (oral presentation), Melbourne, Australia May 5-11, 2012, Ramtilak Gattu and co-authors for "Increased FA in acute TBI rat Marmarou model followed by decreased FA during subacute stage: A TBSS study."
2. *First prize in Poster Award Competition*, 3rd Annual TBI Workshop, WSU Program for Traumatic Brain Injury Research, Sharath Bandaru, for his poster entitled: "Chronic caffeine administration improves traumatic brain injury induced cerebral blood flow changes in rats".

Course or Curriculum Development

1. BME 7710: Magnetic Resonance Imaging
2. BME 7720: MR Imaging of Neurovascular Disease
3. BME 7730: Advance Topics in Magnetic Resonance Imaging
4. BME 7680: Special Topics in Traumatic Brain Injury
5. BME 7995: Special Topics: The Imaging and Neuroscience of Traumatic Brain Injury
6. BME 8710: Seminars in Biomedical Imaging

ADMINISTRATIVE ROLES IN THE DEPARTMENT, COLLEGE, OR UNIVERSITY

Administrative Appointments at Wayne State University in Last Five Years

1. Department of Radiology Promotion and Tenure Committee
2. PTBIR Program Director: The WSU Program for Traumatic Brain Injury:
   In the past 3 years, I have put major efforts in bringing together all the pioneers in TBI research at Wayne State University. This effort aimed to create a multidisciplinary environment leading to breakthrough in understanding the pathological aspects of TBI, develop better diagnosis approaches and more efficient treatment regimen.

   The objectives for this research and training incubator include the following subcategories: educational, collaborations and infrastructure.

   Educational:
   a) enhance the reputation of WSU TBI program as an international research hub fostering basic and clinical studies centered on neuroimaging with the idea of integrating new research findings to improve TBI assessment and optimal treatment.
   b) become a national multi-faceted educational center in the field to train students and medical residents in TBI, starting with providing a new neuroscience course on TBI research (summer 2013), and garnering grants for post-doctoral fellows and junior

faculty through programs such as the T32 training grant and K22 Career Transition Awards, respectively.

c) create a number of new faculty positions and new PhD positions with a focus on TBI.
d) organize meetings and seminar series at WSU on an annual basis
e) publish proceedings and transactions of our research breakthroughs.

Collaborations:

a) expand the current collaborations (through projects and grants) and create new collaborations between different faculty members and different departments; while sharing their expertise, a solid base for a TBI program will be created. These collaborations will also initiate new ideas for new proposals.
b) continue to acquire necessary preliminary data for seed funding (private foundations) as well as for federal funding. Preliminary data assure both the investigators and the funding agencies that the specific aims of a project are feasible and the proposal has higher chances to be realizable.
c) Dr. Haacke is promoting BME and TBI in China via new BME research laboratory at North Eastern University in Shenyang and a special session on Imaging at the Chinese Congress of Radiology Oct 18-21, Chengdu, China
d) establish stronger ties with the pharmaceutical industry through our biomarker and treatment research.
e) submit program project grants and an NRRC award if such funding is viable.

Infrastructure:

a) maintain the TBI imaging database
b) maintain the TBI website to enhance collaborative research

JOURNAL ARTICLES IN PAST FIVE YEARS:

1. J. Hu, Y. Yu, Z. Kou, W. Huang, Q. Jiang, Y. Xuan, T. Li, V. Sehgal, C. Blake, E.M. Haacke, R.L. Soulen. A high spatial resolution (1)H magnetic resonance spectroscopic imaging technique for breast cancer with a short echo time. MRI 2008; 26:360-366.
2. K.A. Tong, S. Ashwal, A. Obenaus, J.P. Nickerson, D. Kido, E.M. Haacke. Susceptibility-Weighted MRI: A Review of Clinical Applications in Children. AJNR 2008; 29:9-17.
3. J. Li, J.P. McAllister II, Y. Shen, M.E. Wagshul, J.M. Miller, M.R. Egnor, M.G. Johnston, E.M. Haacke, and M.L. Walker. Communicating Hydrocephalus in Adult Rats with Obstruction of the Basal Cisterns or the Cortical Subarachnoid Space. Experimental Neurology 2008; 211:351-361.
4. J. Hu, Y. Yu, C. Juhasz, Z. Kou, Y. Xuan, Z. Latif, K. Kudo, H.T. Chugani, E.M. Haacke. MR Susceptibility Weighted Imaging (SWI) Complements Conventional Contrast Enhanced T1 Weighted MRI in Characterizing Brain Abnormalities of Sturge-Weber Syndrome. JMRI 2008; 28:300-307.
5. C.E.A. Batista, H.T. Chugani, J.Hu, E.M. Haacke, M.E. Behen, E.J. Helder, C. Juhasz. MR Spectroscopic Imaging Detects Abnormalities in Normal-Appearing Frontal Lobe of Patients With Sturge-Weber Syndrome. J Neuroimaging 2008; 18:306-313.
6. D.S. Pandian, C. Ciulla, E.M. Haacke, J. Jiang, M. Ayaz. Complex threshold method for identifying pixels that contain predominantly noise in magnetic resonance images. JMRI 2008; 28:727-735.
7. Y. Shen, Y-C. N. Cheng, G. Lawes, J. Neelavalli, C. Sudakar, R. Tackett, H.P. Ramnath, E.M. Haacke. Quantifying magnetic nanoparticles in non-steady flow by MRI. Magn Reson Mater Phy 2008; 21:345–356.
8. Y. Xu and E.M. Haacke. An iterative reconstruction technique for geometric distortion-corrected segmented echo-planar imaging. MRI 2008; 26:1406-1414.

9. B.G. Sood, Y. Shen, Z. Latif, X. Chen, J. Sharp, J. Neelavalli, A. Joshi, T.L. Slovis, E.M. Haacke. Aerosol Delivery in Ventilated Newborn Pigs: An MRI Evaluation. Pediatr Res. 2008; 64:159-164.
10. Rowe, D.B., Haacke, E.M.: Thresholding Complex Magnetic Resonance Images Using Magnitude and Phase. Proc. Am. Stat. Assoc., Biometrics Section. 2008;13:1922-1929.
11. E. M Haacke, S. Mittal, Z. Wu, J. Neelavalli, Y.C. Cheng. Susceptibility-weighted imaging: technical aspects and clinical applications, Part 1. AJNR 2009; 30:19-30.
12. Z. Wu, S. Mittal, K. Kish, Y. Yu, J. Hu, E.M. Haacke. Identification of calcification with MRI using susceptibility-weighted imaging: a case study. JMRI 2009; 29:177-182.
13. Hu J., W. Feng, J. Hua, Q. Jiang, Y. Xuan, T. Li, M. Haacke. A high spatial resolution in vivo 1H magnetic resonance spectroscopic imaging technique for the human breast at 3T. Med Phys 2009; 36:4870-4877.
14. Y.C. Cheng, J. Neelavalli, E.M. Haacke. Limitations of calculating field distributions and magnetic susceptibilities in MRI using a Fourier based method. Phys Med Biol. 2009; 54:1169-1189.
15. S. Mittal, Z. Wu, J. Neelavalli, E.M. Haacke. Susceptibility-Weighted Imaging: Technical Aspects and Clinical Applications, Part 2. AJNR 2009; 30:232-252.
16. E.M. Haacke, M. Makki, Y. Ge, M. Maheshwari, V. Sehgal, J. Hu, M. Selvan, Z. Wu, Z. Latif, Y. Xuan, O. Khan, J. Garbern. Characterizing Iron Deposition in Multiple Sclerosis Lesions Using Susceptibility Weighted Imaging. JMRI 2009; 29;537-544.
17. S.R.S. Barnes and E.M. Haacke. Susceptibility Weighted Imaging: Clinical Angiographic Applications. MRI Clinical N Am 2009; 17;47-61.
18. J. Neelavalli, Y-C.N. Cheng, J. Jiang, E.M. Haacke. Removing Background Phase Variations in Susceptibility Weighted Imaging Using a Fast, Forward-Field Calculation. JMRI 2009; 29;937-948.
19. Y. Ge, V.M. Zohrabian, E-O. Osa, J. Xu, H. Jaggi, J. Herbert, E.M. Haacke, R.I. Grossman. Diminished visibility of cerebral venous vasculature in multiple sclerosis by susceptibility-weighted imaging at 3.0 T. JMRI 2009; 29;1190-1194. PMID: 19388109.
20. E.S. Manova, C.A. Habib, A.S. Boikov, M. Ayaz, A. Khan, W.M. Kirsch, D.K. Kido, E.M. Haacke. Characterizing the mesencephalon using susceptibility weighted imaging. AJNR 2009; 30;569 –574.
21. Q. Yang, J. Liu, S.R.S. Barnes, Z. Wu, K. Li, J. Neelavalli, J. Hu, and E.M. Haacke. Imaging the Vessel Wall in Major Peripheral Arteries using Susceptibility Weighted Imaging: Visualizing Calcifications. JMRI 2009; 30;357-365.
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