

**BIOGRAPHICAL SKETCH**



NAME: **Donahue, Manus Joseph**

eRA COMMONS USER NAME (credential, e.g., agency login): **DONAHUMJ**

POSITION TITLE: **Associate Professor of Neurology, Psychiatry, Physics, and Radiology**

EDUCATION / TRAINING

| **INSTITUTION AND LOCATION** | **DEGREE** | **COMPLETION DATE**  **MM/YYYY** | **FIELD OF STUDY** |
| --- | --- | --- | --- |
|  |  |  |  |
| Duke University, Durham, NC, USA | BS | 05/2003 | Physics |
| Duke University, Durham, NC, USA | BA | 05/2003 | Philosophy |
| The Johns Hopkins School of Medicine, Baltimore, MD, USA | PhD | 11/2007 | Biophysics |
| University of Oxford, Oxford, Oxfordshire, UK | Post-doc | 11/2009 | Clinical Neurology  (FMRIB Centre) |

# A. Personal Statement

My research interests have focused on developing and implementing novel computational and imaging approaches to better understand tissue function in health and disease, both in children and adults. To this end, I have worked on developing new methods for quantifying physiological parameters such as blood flow, blood volume, lymphatic flow, oxygen extraction fraction, the metabolic rate of oxygen consumption, and structural and functional connectivity both in the central nervous system and periphery. A major emphasis is to identify subtle changes in physiology (e.g., biomarkers) that precede overt symptoms and clinical disease manifestations and as such can be used to triage patients for disease-modifying therapies prior to irreversible tissue damage. Applications of this work by my lab and our immediate collaborators focus on cerebrovascular disease and stroke, lymphatic disorders, neonatal hypoxia, cerebral plasticity, anemia, fat disorders, neurodegeneration (Parkinson’s disease and Huntington’s disease), dementia, multiple sclerosis, and schizophrenia. A recent emphasis of this work has also been to improve hospital theranostic procedures in such a way that they maximize patient benefit and cost-effectiveness. Finally, I am committed to teaching, and have taught courses in imaging science at Vanderbilt University, have taught in and co-organized the functional MRI educational session at the International Society for Magnetic Resonance in Medicine, and I mentor several undergraduate and graduate students, as well as post-doctoral fellows and residents.

1. **Donahue MJ**, Achten E, Cogswell PM, De Leeuw FE, Derdeyn CP, Dijkhuizen RM, et al. Consensus statement on current and emerging methods for the diagnosis and evaluation of cerebrovascular disease. J Cereb Blood Flow Metab. 2017 Jan 1. doi: 10.1177/0271678X17721830. [PMID: 28816594](https://www.ncbi.nlm.nih.gov/pubmed/28816594)
2. **Donahue MJ**, Near J, Blicher JU, Jezzard P. Baseline GABA concentration and fMRI response. Neuroimage. 2010 Nov 1;53(2):392-8. [PMID: 20633664](https://www.ncbi.nlm.nih.gov/pubmed/?term=Baseline+GABA+concentration+and+fMRI+response.+Neuroimage)
3. **Donahue MJ**, Donahue PCM, Rane S, Strother MK, Scott A, Smith SA. Assessment of lymphatic impairment and interstitial protein accumulation in patients with breast cancer treatment-related lymphedema using CEST MRI. Magn Reson Med. 2016 Jan;75(1):345-55. [PMID: 25752499.](https://www.ncbi.nlm.nih.gov/pubmed/?term=Assessment+of+lymphatic+impairment+and+interstitial+protein+accumulation+in+patients+with+breast+cancer+treatment-related+lymphedema+using+CEST+MRI.)
4. Jordan LC, Gindville MC, Scott AO, Juttukonda MR, Strother MK, Kassim AA, Chen SC, Lu H, Pruthi S, Shyr Y, **Donahue MJ.** Non-invasive imaging of oxygen extraction fraction in adults with sickle cell anaemia. Brain. 2016 Mar;139(Pt 3):738-50. [PMID: 26823369.](https://www.ncbi.nlm.nih.gov/pubmed/?term=Non-invasive+imaging+of+oxygen+extraction+fraction+in+adults+with+sickle+cell+anaemia)

# B. Positions and Honors

*Positions and Employment*

2003-2007 Biophysics Graduate Student, Johns Hopkins University, Baltimore, MD, USA

2005-2007 MR Technologist, Kennedy Krieger Institute, Baltimore, MD, USA

2008-2009 Dunhill Fellow in Neuroimaging, Oxford University, Oxford, UK

2009-2010 Assistant Professor, Radiology, Johns Hopkins University, Baltimore, MD, USA

2010-2015 Assistant Professor, Radiology, Psychiatry, Neurology, and Physics, Vanderbilt University, Nashville, TN, USA

2015-Present Associate Professor, Radiology, Psychiatry, Neurology, and Physics, Vanderbilt University, Nashville, TN, USA

*Honors*

1995 Eagle Scout

2000-2003 Duke University Physics Honors Society

2008-2009 Research Scholar, University College, University of Oxford

2011 Luton Rising Star, Department of Psychiatry, Vanderbilt University

**C. Contribution to Science**

*The following contributions are summarized from more than 100 peer-reviewed manuscripts*

**1. Development of imaging tools for assessing cerebral blood volume.** Arterial dilation is facilitated by microvascular smooth muscle cells and is closely linked to cerebral blood flow (CBF) regulation. Autoregulatory increases in arterial cerebral blood volume (aCBV) may have a role in maintaining sufficient CBF in patients with reduced cerebral perfusion pressure and early-stage steno-occlusive disease. Total CBV quantification in humans is possible using invasive contrast agents and MRI, positron emission tomography, computed tomography and single photon emission computed tomography. However, noninvasive approaches for measuring CBV in humans is useful for performing longitudinal studies of CBV regulation and for patients with contraindications to contrast agents. I have worked on developing MRI approaches for non-invasively measuring CBV-weighted changes using vascular-space-occupancy (VASO) and absolute CBV using VASO MRI with dynamic subtraction.

1. **Donahue MJ**, Lu H, Jones CK, Edden RA, Pekar JJ, van Zijl PC. Theoretical and experimental investigation of the VASO contrast mechanism. Magn Reson Med. 2006 Dec;56(6):1261-73. [PMID: 17075857](https://www.ncbi.nlm.nih.gov/pubmed/?term=Theoretical+and+experimental+investigation+of+the+VASO+contrast+mechanism)
2. **Donahue MJ**, van Laar PJ, van Zijl PC, Stevens RD, Hendrikse J.Vascular space occupancy (VASO) cerebral blood volume-weighted MRI identifies hemodynamic impairment in patients with carotid artery disease. J Magn Reson Imaging. 2009 Mar;29(3):718-24. [PMID: 19243067](https://www.ncbi.nlm.nih.gov/pubmed/?term=Vascular+space+occupancy+(VASO)+cerebral+blood+volume-weighted+MRI+identifies+hemodynamic+impairment+in+patients+with+carotid+artery+disease)
3. **Donahue MJ**, Blicher JU, Østergaard L, Feinberg DA, MacIntosh BJ, Miller KL, Günther M, Jezzard P. Cerebral blood flow, blood volume, and oxygen metabolism dynamics in human visual and motor cortex as measured by whole-brain multi-modal magnetic resonance imaging. J Cereb Blood Flow Metab. 2009 Nov;29(11):1856-66. doi: 10.1038/jcbfm.2009.107. [PMID: 19654592](https://www.ncbi.nlm.nih.gov/pubmed/?term=Cerebral+blood+flow%2C+blood+volume%2C+and+oxygen+metabolism+dynamics+in+human+visual+and+motor+cortex+as+measured+by+whole-brain+multi-modal+magnetic+resonance+imaging)
4. **Donahue MJ**, Sideso E, MacIntosh BJ, Kennedy J, Handa A, Jezzard P. Absolute arterial cerebral blood volume quantification using inflow vascular-space-occupancy with dynamic subtraction magnetic resonance imaging. J Cereb Blood Flow Metab. 2010 Jul;30(7):1329-42. [PMID: 20145656](https://www.ncbi.nlm.nih.gov/pubmed/?term=Absolute+arterial+cerebral+blood+volume+quantification+using+inflow+vascular-space-occupancy+with+dynamic+subtraction+magnetic+resonance+imaging)

**2. Development of imaging tools for assessing the lymphatic circulation.** The lymphatic system is one of the most often overlooked bodily systems, yet is fundamental to a spectrum of debilitating conditions, including infection, cancer, cancer-treatment morbidity, cardiovascular disease, and obesity. The ability to grow technologies that can be applied readily in clinical settings to evaluate lymphatic structure and function is likely fundamental to improving the management of patients with these conditions. In this line of work, principles of arterial spin labeling (ASL) and chemical exchange saturation transfer (CEST) magnetic resonance imaging (MRI), two popular and noninvasive methods for measuring blood flow and biochemical profiles in brain, breast, and liver, are applied to assess internal measures of lymphatic system dysfunction in multiple stages of impairment and in response to interventions.

1. Rane S, Donahue PM, Towse T, Ridner S, Chappell M, Jordi J, Gore J, **Donahue MJ**. Clinical feasibility of noninvasive visualization of lymphatic flow with principles of spin labeling MR imaging: implications for lymphedema assessment. Radiology. 2013 Dec;269(3):893-902. [PMID: 23864103](https://www.ncbi.nlm.nih.gov/pubmed/?term=Clinical+feasibility+of+noninvasive+visualization+of+lymphatic+flow+with+principles+of+spin+labeling+MR+imaging%3A+implications+for+lymphedema+assessment)
2. **Donahue MJ**, Donahue PCM, Rane S, Strother MK, Scott A, Smith SA. Assessment of lymphatic impairment and interstitial protein accumulation in patients with breast cancer treatment-related lymphedema using CEST MRI. Magn Reson Med. 2016 Jan;75(1):345-55. [PMID: 25752499](https://www.ncbi.nlm.nih.gov/pubmed/?term=Assessment+of+lymphatic+impairment+and+interstitial+protein+accumulation+in+patients+with+breast+cancer+treatment-related+lymphedema+using+CEST+MRI.)
3. Crescenzi R, Donahue PM, Hartley KG, Desai AA, Scott AO, Braxton V, Mahany H, Lants SK, **Donahue MJ.** Lymphedema evaluation using noninvasive 3T MR lymphangiography. J Magn Reson Imaging. 2017 Feb 28. doi: 10.1002/jmri.25670. [PMID: 28245075](https://www.ncbi.nlm.nih.gov/pubmed/28245075)
4. Donahue PM, Crescenzi R, Scott AO, Braxton V, Desai A, Smith SA, Jordi J, Meszoely IM, Grau AM, Kauffmann RM, Sweeting RS, Spotanski K, Ridner SH, **Donahue MJ**. Bilateral Changes in Deep Tissue Environment After Manual Lymphatic Drainage in Patients with Breast Cancer Treatment-Related Lymphedema. Lymphat Res Biol. 2017 Mar;15(1):45-56. doi: 10.1089/lrb.2016.0020. [PMID: 28323572](https://www.ncbi.nlm.nih.gov/pubmed/?term=28323572)

**3. Clinical implementation of cerebrovascular reactivity MRI protocols in patients with ischemic cerebrovascular disease.** Patients with intracranial arterial (atherosclerotic and non-atherosclerotic) stenosis are at elevated risk for stroke and short-term new or recurrent stroke rate is high (10-20%) in these patients even on standard of care therapies. We have applied novel, noninvasive MRI approaches to obtain a more comprehensive measure of tissue viability in this at-risk population, and in ongoing trials are using this information to triage patients for surgical or medical management.

1. **Donahue MJ**, Dethrage LM, Faraco CC, Jordan LC, Clemmons P, Singer R, Mocco J, Shyr Y, Desai A, O'Duffy A, Riebau D, Hermann L, Connors J, Kirshner H, Strother MK. Routine clinical evaluation of cerebrovascular reserve capacity using carbogen in patients with intracranial stenosis. Stroke. 2014 Aug;45(8):2335-41. [PMID: 24938845](https://www.ncbi.nlm.nih.gov/pubmed/?term=Routine+clinical+evaluation+of+cerebrovascular+reserve+capacity+using+carbogen+in+patients+with+intracranial+stenosis)
2. Arteaga DF, Strother MK, Faraco CC, Jordan LC, Ladner TR, Dethrage LM, Singer RJ, Mocco J, Clemmons PF, Ayad MJ, **Donahue MJ**. The vascular steal phenomenon is an incomplete contributor to negative cerebrovascular reactivity in patients with symptomatic intracranial stenosis. J Cereb Blood Flow Metab. 2014 Sep;34(9):1453-62. [PMID: 24917040](https://www.ncbi.nlm.nih.gov/pubmed/?term=The+vascular+steal+phenomenon+is+an+incomplete+contributor+to+negative+cerebrovascular+reactivity+in+patients+with+symptomatic+intracranial+stenosis)
3. Strother MK, Anderson MD, Singer RJ, Du L, Moore RD, Shyr Y, Ladner TR, Arteaga D, Day MA, Clemmons PF, **Donahue MJ**. Cerebrovascular collaterals correlate with disease severity in adult north american patients with Moyamoya disease. AJNR Am J Neuroradiol. 2014 Jul;35(7):1318-24. [PMID: 24651814](https://www.ncbi.nlm.nih.gov/pubmed/?term=Cerebrovascular+collaterals+correlate+with+disease+severity+in+adult+north+american+patients+with+Moyamoya+disease)
4. **Donahue MJ**, Strother MK, Hendrikse J. Novel MRI approaches for assessing cerebral hemodynamics in ischemic cerebrovascular disease. Stroke. 2012 Mar;43(3):903-15. [PMID: 22343644](https://www.ncbi.nlm.nih.gov/pubmed/?term=Novel+MRI+approaches+for+assessing+cerebral+hemodynamics+in+ischemic+cerebrovascular+disease)

**4. Characterizing relationships between neurochemistry and functional brain imaging signals.** Functional magnetic resonance imaging (fMRI) using the blood oxygenation level-dependent (BOLD) technique has been widely applied to noninvasively map brain activity. However, the BOLD signal is only an indirect marker of neuronal activity that arises consequential to ongoing, and stimulus-evoked modulations in, hemodynamics (cerebral blood flow: CBF; and volume: CBV), neurotransmission (glutamate: Glu; and gamma-aminobutyric acid: GABA) and metabolism (cerebral metabolic rate of oxygen: CMRO2). The overall goals of this line of work are to apply and integrate novel MRI and spectroscopy approaches in humans at moderate and high magnetic field strengths to understand more completely the relationship between functional MRI signal and neurotransmission.

1. **Donahue MJ**, Near J, Blicher JU, Jezzard P. Baseline GABA concentration and fMRI response. Neuroimage. 2010 Nov 1;53(2):392-8. [PMID: 20633664](https://www.ncbi.nlm.nih.gov/pubmed/?term=Baseline+GABA+concentration+and+fMRI+response.+Neuroimage)
2. **Donahue MJ**, Rane S, Hussey E, Mason E, Pradhan S, Waddell KW, Ally BA. γ-Aminobutyric acid (GABA) concentration inversely correlates with basal perfusion in human occipital lobe. J Cereb Blood Flow Metab. 2014 Mar;34(3):532-41. [PMID: 24398941](https://www.ncbi.nlm.nih.gov/pubmed/?term=24398941)
3. **Donahue MJ**, Blicher JU, Østergaard L, Feinberg DA, MacIntosh BJ, Miller KL, Günther M, Jezzard P. Cerebral blood flow, blood volume, and oxygen metabolism dynamics in human visual and motor cortex as measured by whole-brain multi-modal magnetic resonance imaging. J Cereb Blood Flow Metab. 2009 Nov;29(11):1856-66. [PMID: 19654592](https://www.ncbi.nlm.nih.gov/pubmed/?term=Cerebral+blood+flow%2C+blood+volume%2C+and+oxygen+metabolism+dynamics+in+human+visual+and+motor+cortex+as+measured+by+whole-brain+multi-modal+magnetic+resonance+imaging)
4. **Donahue MJ**, Stevens RD, de Boorder M, Pekar JJ, Hendrikse J, van Zijl PC. Hemodynamic changes after visual stimulation and breath holding provide evidence for an uncoupling of cerebral blood flow and volume from oxygen metabolism. J Cereb Blood Flow Metab. 2009 Jan;29(1):176-85. [PMID: 18797471](https://www.ncbi.nlm.nih.gov/pubmed/?term=Hemodynamic+changes+after+visual+stimulation+and+breath+holding+provide+evidence+for+an+uncoupling+of+cerebral+blood+flow+and+volume+from+oxygen+metabolism)

**5. Utilizing ultra-high-field MRI (e.g., 7 Tesla) to better understand functional MRI contrast and mechanisms of neurovascular coupling.** While most clinical MRI scanning is performed at intermediate field strengths of 1.5-3.0T, higher field (e.g., 7 Tesla) permits higher signal-to-noise ratio (SNR) as well as improved functional specificity. I have worked on developing high-field MRI protocols and applying these protocols to more thoroughly interrogate mechanisms of fMRI contrast and neurovascular coupling.

1. Siero JC, Hendrikse J, Hoogduin H, Petridou N, Luijten P, **Donahue MJ**. Cortical depth dependence of the BOLD initial dip and poststimulus undershoot in human visual cortex at 7 Tesla. Magn Reson Med. 2015 Jun;73(6):2283-95. [PMID: 24989338](https://www.ncbi.nlm.nih.gov/pubmed/?term=Cortical+depth+dependence+of+the+BOLD+initial+dip+and+poststimulus+undershoot+in+human+visual+cortex+at+7+Tesla)
2. **Donahue MJ**, Hoogduin H, Smith SM, Siero JC, Chappell M, Petridou N, Jezzard P, Luijten PR, Hendrikse J. Spontaneous blood oxygenation level-dependent fMRI signal is modulated by behavioral state and correlates with evoked response in sensorimotor cortex: a 7.0-T fMRI study. Hum Brain Mapp. 2012 Mar;33(3):511-22. [PMID: 21455940](https://www.ncbi.nlm.nih.gov/pubmed/?term=Spontaneous+blood+oxygenation+level-dependent+fMRI+signal+is+modulated+by+behavioral+state+and+correlates+with+evoked+response+in+sensorimotor+cortex)
3. Polders DL, Leemans A, Hendrikse J, **Donahue MJ**, Luijten PR, Hoogduin JM. Signal to noise ratio and uncertainty in diffusion tensor imaging at 1.5, 3.0, and 7.0 Tesla. JMRI. 2011 Jun;33(6):1456-63. [PMID: 21591016](https://www.ncbi.nlm.nih.gov/pubmed/?term=Signal+to+noise+ratio+and+uncertainty+in+diffusion+tensor+imaging+at+1.5%2C+3.0%2C+and+7.0+Tesla)
4. **Donahue MJ**, Hoogduin H, van Zijl PC, Jezzard P, Luijten PR, Hendrikse J. Blood oxygenation level-dependent (BOLD) total and extravascular signal changes and ΔR2\* in human visual cortex at 1.5, 3.0 and 7.0 T. NMR Biomed. 2011 Jan;24(1):25-34. [PMID: 21259367](https://www.ncbi.nlm.nih.gov/pubmed/?term=Blood+oxygenation+level-dependent+(BOLD)+total+and+extravascular+signal+changes+and+%CE%94R2*+in+human+visual+cortex+at+1.5%2C+3.0+and+7.0+T)

*A complete list of publications can be found* [*here*](https://www.ncbi.nlm.nih.gov/pubmed/?term=manus+donahue+OR+donahue+MJ+and+vanderbilt)

# D. Research Support

Ongoing support

**2R01NR015079-05 (PI=Donahue MJ)** 07/01/2018 - 06/30/2023

NIH/NINR

Imaging biomarkers of lymphatic dysfunction

*Role: PI*

**1R01 NS097763-01 (PI=Donahue MJ)** 07/01/2016 - 06/30/2021

NIH/NINDS

Imaging collaterals and tissue metabolism in patients with Moyamoya syndrome

*Role: PI*

**LFA12 (PI=Donahue MJ)** 09/01/2017 - 08/31/2019

Lipedema Foundation

Utilizing molecular tissue profiles and lymphatic clearance to improve clinical discriminatory capacity in patients with lipedema

*Role: PI*

**5R01NS09751202 (PI=Frederick B; Vanderbilt Site PI=Donahue MJ)** 09/01/2016 - 05/31/2022

Mechanisms of cerebrovascular reactivity in health and disease

*Role: Vanderbilt site PI (subcontract with Harvard Medical Center)*

**1R01 NR015079 (PI=Donahue MJ)** 07/01/2014 - 06/30/2018

NIH/NINR (in no cost extension)

Imaging lymphatic function in patients with breast cancer related lymphedema

*Role: PI*

**5R01 NS078828 (PI=Donahue MJ)** 06/01/2012 - 04/30/2017

NIH/NINDS (in no cost extension)

Characterizing hemodynamic compensation and stroke risk in stenosis patients

*Role: PI*

**Strategically focused research network (PI=Beckman J)** 04/01/2018 - 03/31/2021

American Heart Association

Microvascular disease determines limb outcomes in peripheral artery disease

*Role: Co-Investigator*

**1R01-NS096127-01 (PI=Jordan LC)** 03/01/2016 - 02/28/2021

NIH/NINDS

MRI-based quantitative brain oxygen metabolism identifying high risk of infarct recurrence in sickle cell anemia

*Role: Co-Investigator*

**1R01NS100980-01A1 (PI=Jefferson AJ)** 09/01/2017 - 06/30/2021

NIH/NIA

Cardiovascular predictors of cerebrovascular health in older adults

*Role: Co-Investigator*

**5R01NS097783 (PI=Claassen DO)** 08/01/2016 - 05/31/2021

NIH/NINDS

Biological determinants of impulsivity in Parkinson’s disease

*Role: Co-Investigator*

**2R01MH070560-07A1 (PI=Heckers S)** 09/27/2013 - 07/31/2018

NIH/NIMH

Imaging Hippocampal Function in Psychosis

*Role: Co-Investigator*

Completed support (recent selected)

**14CSA20380466 (Co-PIs=Donahue MJ and Jordan LC)** 07/01/2014 - 06/30/2017

American Heart Association

MRI-based quantitative brain oxygen metabolism mapping in sickle cell anemia

*Role: Co-PI*

**14GRNT20150004 (PI=Donahue MJ)** 07/01/2014 - 06/30/2016

American Heart Association

Characterization of Regional Chemical and Vascular Uncoupling in Following Ischemic Stroke

*Role: PI*

**5R01EB016695-02 (PI=Grissom W)**  04/10/2014 - 03/31/2018

NIH/NIBIB

Three-dimensional patient-tailored RF pulses for spin echo neuroimaging at 7T

*Role: Co-Investigator*

**1R21 MH099218-01A1 (PI=Taylor W)** 07/15/2013 - 06/30/2015

NIH/NIMH

Frontal hypo perfusion effects on antidepressant outcomes in geriatric depression

*Role: Co-Investigator*

**SPRINT-MIND, Donahue (PI=Donahue MJ, Vanderbilt Site)**  10/01/2011 - 09/30/2015

Multi-center Trial

Assessing performance of blood pressure medication using 3T MRI

*Role: PI (Vanderbilt Site)*