# CURRICULUM VITAE

Nicholas J. Tustison

Associate Professor

Department of Radiology and Medical Imaging

1. **Education**

2004 D.Sc. Biomedical Eng. Washington University in St. Louis

2000 M.S. Biomedical Eng. University of Virginia

1998 B.S. Applied Physics:

Computer science emphasis Brigham Young University

1. **Post-Graduate Education**

2005 Post-doctoral fellowship University of Pennsylvania

1. **Academic Appointments**

2017- Associate Professor University of Virginia

2018- Visiting Associate Researcher University of California, Irvine

2010-17 Assistant Professor University of Virginia

2016-18 Visiting Assistant Researcher University of California, Irvine

Pend. Adjunct Professor University of Pennsylvania

1. **Other Employment Pertaining to Current Professional Appointments**

Nov 2006-June 2010 Staff Scientist University of Pennsylvania

1. **Honors and Awards**

* 1st place, EMPIRE10 lung registration competition, MICCAI Conference 2010 (Team: Gang Song, Nick Tustison, Brian Avants, Jim Gee).
* 1st place, BRATS2013 multimodal brain tumor segmentation competition, MICCAI Conference 2013 (Team: Nick Tustison, Max Wintermark, Chris Durst, Brian Avants).
* Best paper award, STACOM2014 cardiac motion estimation challenge, MICCAI Conference 2014 (Team: Nick Tustison, Yang Yang, Michael Salerno).

1. **Areas of Research Interest**

I am a data scientist specializing in medical image analysis with technical expertise and international recognition in the development of high-quality, open-source computational strategies for clinically oriented research. My interests are focused on algorithmic and methodological innovation particularly with respect to medical imaging data which target a variety of applications including neuroscience, pulmonary, and cardiac research avenues.

1. **Current Projects**

**ANTs Development and Maintenance**

ANTs is a systematic framework for quantitative biological image analysis built on the Insight ToolKit.  ANTs was first created by Brian Avants and I as a way to rapidly disseminate our latest research to the community of scientists who depend on imaging analytics and to allow them to study different organ systems, species or modalities with the same sound foundation.  While originally focused on diffeomorphic image registration, ANTs grew to incorporate methods for segmentation, feature extraction and, more recently, full statistical pipelines via ANTsR. Brian, I and others, continue to develop and maintain ANTs and its interface to the R statistical projects known as ANTsR.

**Deep Learning in Medical Imaging**

Recent advancements in the community are due to recent adoption of deep learning technologies for common tasks such as image segmentation, classification, and object localization. I was the recent awardee of an NVIDIA academic grant in which I received a Titan XP GPU for my research. As a result, I started the open-source repository *ANTsRNet* which houses implementations of common network architectures. These are currently being developed for use in various projects including those given below.

**Traumatic Brain Injury**

*Neuroimaging analysis for the CENC*—As one of the major responses to Operations Enduring Freedom and Iraqi Freedom, the Chronic Effects of Neurotrauma Consortium (CENC) was established to research the effects of traumatic brain injury in military service members. As part of the neuroimaging core, my responsibilities include development and deployment of image analysis techniques for large-scale data processing for statistical analysis.

*White matter hyperintensity segmentation in TBI cohort—*White matter hyperintensities (WMHs) are foci of abnormal signal intensity in white matter regions seen with magnetic resonance imaging (MRI). These imaging features are associated with normal aging and have shown prognostic value in neurological conditions such as traumatic brain injury (TBI). The impracticality of manually quantifying these lesions limits their clinical utility and motivates the utilization of machine learning techniques for automated segmentation workflows. We are currently developing a machine-learning framework with tailored features for segmenting WMHs in a TBI cohort. This framework is provided publicly through the Advanced Normalization Tools (ANTs) and ANTsR toolkits.

**Imaging biomarkers for pulmonary lung diseases**

*Quantitative assessment of hyperpolarized gas imaging in the lungs*— Clinically, lung imaging has played a limited role for the diagnosis and treatment of asthma. Spirometry is commonly employed despite its inadequacies for early detection and inability to provide regional information. Recent developments in MRI research utilizing noble gases, such as helium-3 and xenon-129, have demonstrated the capability of visualizing alveolar and bronchial air spaces. We are currently developing targeted algorithms for generating potential imaging biomarkers from hyperpolarized gas imaging.

*ITK-Lung*— This project is aimed at improving pulmonary scientists’ ability to explore clinical hypotheses concerning the structure and function of the human lung using multi-modal imaging data. Scientific research has been significantly enhanced by recent emphases on open-data and open-source tools. This success has been quite apparent within the neuroimaging community but no such publicly available computational resources exist for pulmonary imaging. By providing publicly available, user-friendly, widely interoperable, and extensively validated tools for pulmonary imaging analysis and mapping, the project will enable a broad field of scientists to leverage modern imaging technologies more effectively in answering basic science questions about the lung, which will lead to clinical insights and advancements.

**Brain tumor classification**

(With Dr. Sohil Patel) We aim to comprehensively characterize the neuroimaging phenotypes of currently defined glioma subtypes. Analysis of CT and MRI features of diffuse gliomas will be undertaken by independent human readers with the goal of identifying reproducible and specific imaging metrics that predict glioma subtype. Machine learning technology will also be employed, including deep learning neural network analysis, to classify gliomas according to their molecular subtype. This work will be used to exploit neuroimaging to advance the classification of diffuse gliomas beyond the current WHO 2016 scheme.

**Collaborations with UC Irvine (Mike Yassa)**

*Structural MR imaging biomarkers for Alzheimers disease—*The Alzheimer’s Disease Neuroimaging Initiative is a large-scale investigation of the progression of Alzheimer’s Disease (AD) through the study of targeted biomarkers including those extracted from imaging data. An important aspect of this initiative is the public availability of the data to facilitate individual exploration of hypotheses. Current collaborative efforts with colleagues at UC Irvine involve using the ANTs cortical thickness pipelines to determine regional changes in the cortex in the presence of AD.

*Machine learning techniques for hippocampal subfield segmentation*—Recent standardization in MRI acquisition protocols for hippocampal subfields has been accompanied by relevant segmentation approaches. We are currently developing a publicly available extension of the well-known ASHS (automatic segmentation of hippocampal subfields) pipeline with the targeted application of extending the ANTs cortical thickness pipeline to integrate hippocampal subfield segmentations.

**Teaching Activities**

*Feb. 2008-present: ANTs and ANTsR online support.*

As one of the two primary developers of the Advanced Normalization Tools (ANTs, originating at sourceforge.net on 2008-06-26 and now residing at <http://stnava.github.io/ANTs/>), I provide online support, assistance, and online workable examples for our large user base. ANTs is a systematic framework for quantitative biological image analysis built on the Insight ToolKit.  ANTs was first created by Brian Avants and I as a way to rapidly disseminate our latest research to the community of scientists who depend on imaging analytics and to allow them to study different organ systems, species or modalities with the same sound foundation.  While originally focused on diffeomorphic image registration, ANTs grew to incorporate methods for segmentation, feature extraction and, more recently, full statistical pipelines via ANTsR.  In 2014, there were nearly 2000 citations to ANTs and the software is cloned, downloaded or otherwise accessed over 100-200 times per week, on average.

**Workshops and Tutorials**

*August 2016: ANTs workshop, MD Anderson, Houston, TX, USA.*

This was a repeat of the tutorial given in Montreal of May 2015.

*October 2015: ANTs Workshop for the Chronic Effects of Neurotrauma Consortium (CENC), Baylor College, Houston, TX, USA.*

This was a repeat of the tutorial given in Montreal of May 2015.

*October 2015:* [*SimpleITK tutorial*](http://www.itk.org/Wiki/SimpleITK/Tutorials/MICCAI2015)*, MICCAI, Munich, Germany.*

I helped organize and teach this half-day tutorial to introduce students and researchers to the ITK version 4 registration framework through the SimpleITK interface. Using a hands-on teaching method, numerous examples were prepared and solved in real time to learn the various components of the new registration framework including linear and deformable transforms, similarity metrics, and relevant optimizers. Guidance regarding tuning the various parameters was also provided.

*July 2015: ANTs workshop, Laboratory of Neuroimaging, Marina Del Rey, USA.*

This was a repeat of the tutorial given in Montreal of May 2015.

*May 2015: CREATE-MIA Summer Workshop,* [*ANTs Workshop*](http://aggie.cim.mcgill.ca:8080/create-mia/events/create-mia-summer-school-2015)*, Montreal, Canada.*

The two primary developers of ANTs (Brian Avants and Nicholas Tustison) created and provided a two-day tutorial for teaching the framework’s basic ideas and applications.  The morning sessions highlighted ANTs use cases and research.  The afternoon sessions showed attendees how to use the system to analyze a multiple modality neuroimaging dataset derived from publicly available data with statistical analysis performed using the ANTsR interface with the R statistical project.

*February 2012: SPIE Medical Imaging Workshop, Open source tools for medical image analysis, San Diego, USA*.

I was invited to give a presentation on medical image analysis tools that were publicly available with a special emphasis on my own work. Topics covered included preprocessing optimal registration approaches for brain and pulmonary MRI, ventilation-based segmentation for hyperpolarized gas MRI, and the latest image preprocessing techniques.

1. **Other Professional Activities (Boards, Editorships, etc.)**

2015-present Chronic Effects of Neurotrauma Consortium (CENC) Imaging Core

2014-2015 Frontiers Topic Editor: *Neuroinformatics with the Insight Toolkit*

2012-present SPIE Medical Imaging Conference Program Committee

2012-present Frontiers in Neuroinformatics Review Editorial Board

2004-present Developer, Insight Toolkit, National Library of Medicine

**Manuscript Reviews**:

* Academic Radiology
* American Journal of Neuroradiology
* Annals of Biomedical Engineering
* Artificial Intelligence in Medicine
* Biomedical Signal Processing and Control
* Computers in Biology and Medicine
* Computerized Medical Imaging and Graphics
* Focused Ultrasound Foundation ad hoc grant reviewer
* Human Brain Mapping
* Image and Vision Computing
* International Journal of Pattern Recognition and Artificial Intelligence
* IEEE Transactions on Cybernetics
* IEEE Transactions on Medical Imaging
* IEEE Transactions on Pattern Analysis and Machine Intelligence
* IEEE Transactions on Biomedical Engineering
* Insight Journal
* Medical Image Computing and Computer Assisted Intervention
* International Journal of Biomedical Imaging
* International Journal of Computer Vision
* International Workshop on Medical Imaging and Augmented Reality
* IEEE International Symposium on Biomedical Imaging
* Journal of Computed Tomography
* Journal of Electronic Imaging
* Journal of Magnetic Resonance Imaging
* Journal of Neurotrauma
* Journal of the Optical Society of America A
* Magnetic Resonance in Medicine
* Medical Physics
* Medical Image Analysis
* Neurobiology of Aging
* NeuroImage
* NeuroImage: Clinical
* Neuroradiology
* PLOS ONE
* Respirology
* SIAM Journal on Imaging Sciences

1. **Papers Published or in Press**

### **Peer Reviewed**

(Corresponding author indicated by \*. Trainee mentored by Dr. Tustison is underlined.)

1. K Qing, **NJ Tustison**, JP Mugler 3rd, JF Mata, Z Lin, L Zhao, D Wang, X Feng, JY Shin JY, SJ Callahan, MP Bergman, K Ruppert, TA Altes, JM Cassani, and YM Shim. Probing Changes in Lung Physiology in COPD Using CT, Perfusion MRI, and Hyperpolarized Xenon-129 MRI, *Academic Radiology*, 26(3):326-334, Mar 2019.

Dr. Tustison provided direction with respect to the software used and guidance on analysis protocols.

1. **Nicholas J. Tustison**, Brian B. Avants, Zixuan Lin, Xue Feng, Nicholas Cullen, Jaime F. Mata, Lucia Flors, James C. Gee, Talissa A. Altes, John P. Mugler III, and Kun Qing. Convolutional Neural Networks with Template-Based Data Augmentation for Functional Lung Image Quantification, *Academic Radiology*, 26(3):412-423, Mar 2019.
2. Andrew T. Grainger, **Nicholas J. Tustison**, Kun Qing, Rene Roy, Stuart S. Berr, and Weibin Shi. Deep learning-based quantification of abdominal fat on magnetic resonance images. *PLoS One*, 13(9):e0204071, Sep 2018. Cited 1 time; IF = 2.766.

Dr. Tustison provided trained the deep learning models.

1. Neha Sinha, Chelsie N., Berg, **Nicholas J. Tustison**, Ashlee Shaw, Diane Hill, Michael A. Yassa, and Mark A. Gluck. APOE ε4 Status in Healthy Older African Americans is Associated with Deficits in Pattern Separation and Hippocampal Hyperactivation,  *Neurobiology of Aging*, 26;69:221-229, May 2018. Cited 1 time; IF = 4.454.

Dr. Tustison provided direction with respect to the software used and guidance on analysis protocols.

1. Reagh ZM, Noche JA, **Tustison NJ**, Delisle D, Murray EA, and Yassa MA. Functional Imbalance of Anterolateral Entorhinal Cortex and Hippocampal Dentate/CA3 Underlies Age-Related Object Pattern Separation Deficits, *Neuron,* 97(5):1187-1198, Mar 2018*.* Cited 11 times, IF = 14.318.

Dr. Tustison provided direction with respect to the software used and guidance on analysis protocols.

1. Xin Y, Cereda M, Hamedani H, Pourfathi M, Siddiqui S, Meeder N, Kadlacek S, Duncan I, Profka H, Rajaei J, **Tustison N**, Gee J, Kavanagh B, and Rizi R. Unstable Inflation Causing Injury: Insight from Prone Position and Paired CT Scans, *American Journal of Respiratory and Critical Care Medicine*, 33(2):112-123, Mar 2018. Cited 5 times; IF = 15.24.

Dr. Tustison provided direction with respect to the software used and guidance on analysis protocols.

1. Das S, Xie L, Wisse L, Ittyerah R,  **Tustison N**, Dickerson B, Yushkevich P, and Wolk D. Longitudinal and cross-sectional structural MRI correlates of AV-1451 uptake, *Neurobiology of Aging,* 66:49-58, Feb 2018. Cited 8 times; IF = 4.454.

Dr. Tustison provided direction with respect to the software used and guidance on analysis protocols.

1. Barbosa Jr. EM, Shou H, Simpson S, Gee J,  **Tustison N**, and Lee JC, Quantitative CT metrics from the transplanted lung can predict FEV1 after lung transplantation, *Journal of Thoracic Imaging*, 33(2):112-123, Mar 2018. Cited 2 times; IF = 1.624.

Dr. Tustison provided direction with respect to the software used and guidance on analysis protocols.

1. Cereda M, Xin Y, Hamedani H, Bellani G, Kadlecek S, Clapp J, Guerra L, Meeder N, Rajaei J, **Tustison NJ**, Gee JC, Kavanagh BP, and Rizi RR. Tidal Changes on CT and Progression of ARDS, *Thorax*, 72(11):981-989, Nov 2017.  Cited 4 times; IF = 9.655.

Dr. Tustison provided direction with respect to the software used and guidance on analysis protocols.

1. Barbosa Jr. EM, Simpson S, Lee JC, **Tustison N**, Gee J, and Shou H, Multivariate modeling using quantitative CT metrics may improve accuracy of diagnosis of bronchiolitis obliterans syndrome after lung transplantation, *Computers in Biology and Medicine*, 89:275-281, Oct 2017. Cited 1 time; IF = 2.115; Rank 23 out of 78 bioengineering.

Dr. Tustison provided direction with respect to the software used and guidance on analysis protocols.

1. Maga AM, **Tustison NJ**, and Avants BB. A population level atlas of *Mus musculus* craniofacial skeleton and automated image based shape analysis, *Journal of Anatomy*, 231(3):433-443, Sep 2017.  Cited 1 times; IF = 2.479; Rank 4 out of 21 anatomy and morphology.

Dr. Tustison provided direction with respect to the software used and guidance on analysis protocols.

1. Pontré B, Cowan, DiBella E, Kulaseharan S, Likhite D, Noorman N, Tautz L,  **Tustison N**, Wollny G, Young AA, and Suinesiaputra A. An Open Benchmark Challenge for Motion Correction of Myocardial Perfusion MRI, *IEEE Journal of Biomedical and Health Informatics*, 21(5):1315-1326, Sep 2017. Cited 1 times; IF = 2.093; Rank 29 out of 143 computer science, information systems, 26 out of 104 computer disciplinary applications, 13 out of 56 mathematics and computational biology, and 8 out of 20 medical informatics.

Dr. Tustison participated in the challenge described by the manuscript and won the best paper award.

1. Ladd AC, Browhan DG, Thomas RR, Keeney PM, Berr SB, Khan MS, Portell FR, Shakenov MZ, Antkowiak PF, Kundu B,  **Tustison NJ**, Bennett Jr. JP. RNA-seq Analyses Reveal that Cervical Spinal Cords and Anterior Motor Neurons from Amyotrophic Lateral Sclerosis Subjects Show Reduced Expression of Mitochondrial DNA-Encoded Respiratory Genes, and rhTFAM May Correct This Respiratory Deficiency, *Brain Research* 1667:74-83, Jul 2017. Cited 3 times; IF =

Dr. Tustison provided direction with respect to the software used and guidance on analysis protocols.

1. Altes TA, Johnson M, Fidler M, Botfield M,  **Tustison NJ**, Leiva-Salinas C, de Lange EE, Froh D, and Mugler III JP. Use of hyperpolarized helium-3 MRI to assess response to ivacaftor treatment in patients with cystic fibrosis, *Journal of Cystic Fibrosis*, 16(2):267-274, Mar 2017. Cited 20 times; IF =

Dr. Tustison provided direction with respect to the software used and guidance on analysis protocols.

1. Stone JR\*, Wilde EA, Taylor BA, Tate DF, Levin H, Bigler ED, Scheibel RS, Newsome MR, Mayer AR, Abildskov T, Black GM, Lennon MJ, York GE, Agarwal R, DeVillasante J, Ritter JL, Walker PB, Ahlers ST, and **Tustison NJ**. Supervised learning technique for the automated identification of white matter hyperintensities in traumatic brain injury, *Brain Inj,* 30(12) :1442-1451, 2016. Cited 5 times; IF = 1.822; Rank 187 out of 256 neurosciences and 17 out of 65 rehabilitation.

Dr. Tustison provided direction with respect to the software used and guidance on

analysis protocols.

1. Wilde EA\*, Bigler ED, Huff TJ, Wang H, Black GM, Christensen Z, Goodrich-Hunsaker N, Petrie JA, Abildskov T, Taylor BA, Stone JR, **Tustison NJ**, Newsome MR, Levin HS, Chu ZD, York GE, and Tate DF. Quantitative Structural Neuroimaging of Mild Traumatic Brain Injury in the Chronic Effects of Neurotrauma Consortium (CENC): Comparison of Volumetric Data within and across Scanners, *Brain Inj,* 30(12) :1442-1451, 2016. Cited 7 times; IF = 1.822; Rank 187 out of 256 neurosciences and 17 out of 65 rehabilitation.

Dr. Tustison provided direction with respect to the software used and guidance on analysis protocols.

1. Flors L, Mugler JP, De Lange EE, Miller GW, Mata JF, **Tustison N**, Ruset IC, Hersman WW, and Altes TA. Hyperpolarized Gas Magnetic Resonance Lung Imaging in Children and Young Adults, *J Thorac Imag*, 31(5):285-295, Sep 2016. Cited 9 times; IF = 1.723; Rank 71 out of 124 radiology, nuclear medicine, and medical imaging.

Dr. Tustison provided the image analysis techniques for quantifying ventilation.

1. Filiano AJ, Xu Y, **Tustison NJ**, Marsh RL, Baker W, Smirnov I, Overall CC, Gadani SP, Turner SD, Weng Z, Peerzade SN, Chen H, Lee KS, Scott MM, Beenhakker MP, Litvak V, and Kipnis J\*. Unexpected role of interferon-γ in regulating neuronal connectivity and social behaviour, *Nature*, 535(7612):425-9, Jul 2016. Cited 148 times; IF = 38.138; Rank 1 out of 63 multidisciplinary sciences.

Dr. Tustison performed the fMRI analysis.

1. **Tustison NJ\***, Qing K, Wang C, Altes TA, and Mugler JP, III. Atlas-based estimation of lung and lobar anatomy in proton MRI. *Magn Reson Med*, 76(1):315-20, Jul 2016. Cited 11 times; IF = 3.571; Rank 20 out of 125 radiology, nuclear medicine & medical imaging.
2. Allen GI, Amoroso N, Anghel C, Balagurusamy V, Bare CJ, Beaton D, Bellotti R, Bennett DA, Boehme K, Boutros PC, Caberlotto L, Caloian C, Campbell F, Neto EC, Chang Y-C, Chen B, Chen C-Y, Chien T-Y, Clark T, Das S, Davatzikos C, Deng J, Dillenberger D, Dobson RJB, Dong Q, Doshi J, Duma D, Errico R, Erus G, Everett E, Fardo DW, Friend SH, Fröhlich H, Gan J, St George-Hyslop P, Ghosh SS, Glaab E, Green RC, Guan Y, Hong M-Y, Huang C, Hwang J, Ibrahim J, Inglese P, Jiang Q, Katsumata Y, Kauwe JSK\*, Klein A\*, Kong D, Krause R, Lalonde E, Lauria M, Lee E, Lin X, Liu Z, Livingstone J, Logsdon BA, Lovestone S, Lyappan A, Ma M, Malhotra A, Mangravite LM\*, Maxwell TJ, Merrill E, Nagorski J, Namasivayam A, Narayan M, Naz M, Newhouse SJ, Norman TC, Nurtdinov RN, Oyang Y-J, Pawitan Y, Peng S, Peters MA\*, Piccolo SR, Praveen P, Priami C, Sabelnykova VY, Senger P, Shen X, Simmons A, Sotiras A, Stolovitzky G, Tangaro S, Tateo A, Tung Y-A, **Tustison NJ**, Varol E, Vradenburg G, Weiner MW, Xiao G, Xie L, Xie Y, Xu J, Yang H, Zhan X, Zhou Y, Zhu F, Zhu H, and Zhu S. Alzheimer's Disease Neuroimaging Initiative. Crowdsourced estimation of cognitive decline and resilience in Alzheimer's disease. *Alzheimers Dement*, 12(6) :645-53, Jun 2016. Cited 41 times; IF = 12.407; Rank 3 out of 192 clinical neurology.

The ANTs software library, written by Dr. Tustison, was used to provide cortical thickness measures.

1. Hasan KM\*, Mwangi B, Cao B, Keser Z, **Tustison NJ**, Kochunov P, Frye RE, Savatic M, and Soares J. Entorhinal cortex thickness across the human lifespan. *J of Neuroimaging*, 26(3) :278-82, May 2016. Cited 10 times; IF = 1.734; Rank 128 out of 192 clinical neurology, 12 out of 14 neuroimaging, and 65 out of 125 radiology, nuclear medicine & medical imaging.

The entorhinal cortical thickness measures for the well-known ADNI data set were provided by Dr. Tustison.

1. Pustina DP\*, Coslett BH, Turkeltaub PE, **Tustison N**, Schwartz MF, and Avants B. Automated segmentation of chronic stroke lesions using LINDA: Lesion Identification with Neighborhood Data Analysis, *Hum Brain Mapp*, 37(4) :1405-21, Apr 2016. Cited 40 times; IF = 5.969; Rank 2 out of 14 neuroimaging, 27 out of 252 neurosciences, 5 out of 125 radiology, nuclear medicine & medical imaging.

The core machine learning framework was written by Dr. Tustison and enhanced for lesion application.

1. Altes TA, Mugler JP, III, Ruppert K, **Tustison NJ**, Gersbach J, Szentpetery S, Meyer CH, de Lange EE, and Teague WG\*. Clinical Correlates of Lung Ventilation in Asthmatic Children. *J Allergy Clin Immun*, 137(3) :789-796, Mar 2016. Cited 17 times; IF = 11.476; Rank 1 out of 24 allergy, 6 out of 148 immunology.

Dr. Tustison provided the image analysis techniques for quantifying ventilation.

1. Qing K, Altes TA, **Tustison NJ**, Feng X, Chen X, Mata JF, Miller GW, de Lange EE, Tobias WA, Cates GD, Jr., Brookeman JR, and Mugler JP, III\*. Rapid Acquisition of Helium-3 and Proton 3D Image Sets of the Human Lung in a Single Breath-hold using Compressed Sensing. *Magn Reson Med*, 74(4):1110-5, October 2015. Cited 11 time; IF = 3.571; Rank 20 out of 125 radiology, nuclear medicine & medical imaging.

Dr. Tustison provided the image analysis techniques for quantifying ventilation.

1. Menze BH\*, Jakab A, Bauer S, Kalpathy-Cramer J, Farahani K, Kirby J, Burren Y, Porz N, Slotboom J, Wiest R, Lanczi L, Gerstner E, Weber M-A, Arbel T, Avants BB, Ayache N, Buendia P, Collins DL, Cordier N, Corso JJ, Criminisi A, Das T, Delingete H, Demiralp C, Durst CR, Dojat M, Doyle S, Festa J, Forbes F, Geremia E, Glocker B, Golland P, Guo X, Hamamci A, Iftekharuddin KM, Jena R, John NM, Konukoglu E, Lashkari D, Mariz JA, Meier R, Pereira S, Precup D, Price SJ, Riklin-Raviv T, Reza SMS, Ryan M, Schwartz L, Shin H-C, Shotton J, Silva CA, Sousa N, Subbanna NK, Szekely G, Taylor TJ, Thomas OM, **Tustison NJ**, Unal G, Vasseur F, Wintermark M, Ye DH, Zhao L, Zhao B, Zikic D, Prastawa M, Reyes M, and Leemput KV. The Multimodal Brain Tumor Image Segmentation Benchmark (BRATS). *IEEE Trans Med Imaging*, 34(10):1993-2024, October 2015. Cited 872 times; IF = 3.390; Rank 5 out of 100 computer science, interdisciplinary applications, 12 out of 76 biomedical engineering, 18 out of 249 electrical & electronic engineering, 3 out of 24 imaging science & photographic technology, 21 out of 125 radiology, nuclear medicine & medical imaging.

This manuscript details automated brain tumor segmentation competitions for the years 2012 and 2013. Dr. Tustison competed in and won the competition in 2013.

1. Roberts JM, **Tustison N**, Stone J,Avants B, Cook P, and Yassa MA. Entorhinal cortical thickness, ApoE4 status, and cognitive decline in ADNI participants. *Alzheimers Dement,* 11(7), Supplement, Page P35, July 2015. Cited 0 times ; IF = 12.407; Rank 3 out of 192 clinical neurology.

Dr. Tustison provided the processed ADNI data and mentored the first author in the use of ANTs to derive further measurements for this publication.

1. Durst CR\*, Michael N, **Tustison NJ**, Patrie JT, Raghavan P, Wintermark M, and Velan SS. Noninvasive Evaluation of the Regional Variations of GABA using Magnetic Resonance Spectroscopy at 3 Tesla. *Magn Reson Imaging*, 33(5):611-7, June 2015. Cited 13 times; IF = 2.090; Rank 49 out of 125 radiology, nuclear medicine & medical imaging.

The ANTs software library, written by Dr. Tustison, was used to provide the quantitative image measures.

1. **Tustison NJ\***, Shrinhidi KL, Wintermark M, Durst CR, Kandel BM, Gee JC, Grossman MC, and Avants BB. Optimal symmetric multimodal templates and concatenated random forests for supervised brain tumor segmentation (simplified) with ANTsR. *Neuroinformatics*, 13(2):209-225, April 2015. Cited 91 times; IF = 2.825; Rank 13 out of 102 computer science, interdisciplinary applications, 124 out of 252 neurosciences.
2. Avants BB\*, Johnson HJ, and **Tustison NJ**. Neuroinformatics and The Insight ToolKit. *Front Neuroinform,* 9:5, March 2015. Cited 5 times; IF = 3.261; Rank 8 out of 57 mathematical and computational biology, 105 out of 252 neurosciences.

This is an opinion piece introducing a special issue all the co-authors co-edited.

1. Avants B\*, Duda J, Kilroy E, Jann K, Kandel B, Yan L, Jog M, **Tustison N**, Smith R, Wang Y, Krasileva K, Rapretto M, and Wang D. The Pediatric Template of Brain Perfusion, *Scientific Data*, February 2015. Cited 26 times (new journal).

The ANTs software library, written by Drs. Avants and Tustison, was used to provide the quantitative image measures.

1. Xin Y, Song G, Cereda M, Kadlecek S, Hamedani H, Jiang Y, Rajaei J, Clapp J, Profka H, Meeder N, Wu J, **Tustison N**, Gee J, and Rizi R. Semi-Automatic Segmentation of Longitudinal Computed Tomography Images in a Rat Model of Lung Injury by Surfactant Depletion. *J Appl Physiol,* 118(3):377-85, February 2015. Cited 12 times; IF = 3.056; Rank 26 out of 83 physiology, 8 out of 81 sport sciences.

The ANTs software library, written by Dr. Tustison, was used to provide the quantitative image measures.

1. Yoder JH, Peloquin JM, Song G, **Tustison NJ**, Moon SM, Wright AC, Vresilovic EJ, Gee JC, and Elliott DM\*. Internal Human Intervertebral Disc 3D Strains Under Axial Compression Quantified Non-invasively with MRI and Image Registration. *J Biomech Eng-T ASME*, 136(11), Nov 2014. Cited 28 times; IF = 1.780; Rank 51 out of 73 biophysics, 37 out of 76 biomedical engineering.

The ANTs software library, written by Dr. Tustison, was used to provide the quantitative image measures.

1. **Tustison NJ\***, Cook PA, Klein A, Song G, Das SR, Duda JT, Kandel BM, van Strien N, Stone JR, Gee JC, and Avants BB. Large-Scale Evaluation of ANTs and FreeSurfer Cortical Thickness Measurements. *NeuroImage*, 99:166-179, Oct 2014. Cited 177 times; IF = 6.357; Rank 1 out of 14 neuroimaging, 24 out of 252 neurosciences, 3 out of 125 radiology, nuclear medicine & medical imaging.
2. Said N, Elias WE, Raghavan P, Cupino A, **Tustison N**, Frysinger R, Patrie J, Xin W, and Wintermark M\*. Correlation of Diffusion Tensor Tractography and Intraoperative Macro-Stimulation during Deep Brain Stimulation for Parkinson's Disease. *J Neurosurg,* 25:1-7, July 2014. Cited 12 times; IF = 3.737; Rank 39 out of 192 clinical neurology, 20 out of 198 surgery.

The ANTs software library, written by Dr. Tustison, was used to provide the quantitative image measures.

1. Wintermark M\*, **Tustison NJ**, Patrie JT, Xin W, Demartini N, Eames M, Sumer S, Lau B, Cupino A, Snell J, Hananel A, Kassell N, and Aubry JF. T1-weighted MRI as a substitute to CT for refocusing planning in MR-guided focused ultrasound. *Phys Med Biol*, 59(13):3599-614, July 2014. Cited 10 times; IF = 2.761; Rank 21 out of 76 biomedical engineering, 34 out of 125 radiology, nuclear medicine and medical imaging.

The ANTs software library, written by Dr. Tustison, was used to provide the quantitative image measures.

1. Teague WG\*, **Tustison NJ**, and Altes TA. Ventilation Heterogeneity in Asthma. *J Asthma,* 51(7):677-84, Sept 2014. Cited 28 times; IF = 1.854; Rank 18 out of 25 allergy, 39 out of 58 respiratory system.
2. Avants BB\*, **Tustison NJ**, Stauffer M, Song G, Wu B, and Gee JC. The Insight ToolKit Image Registration Framework. *Front Neuroinform*, 8:44, 2014. Cited 129 times; IF = 3.261; Rank 8 out of 57 mathematical & computational biology, 105 out of 252 neurosciences.

Dr. Tustison was one of the principal architects and developers of the ITK image registration toolkit.

1. Wintermark M\*, Huss DS, Shah BB, **Tustison N**, Druzgal TJ, Kassell N, and Elias J. Thalamic Connectivity in Patients with Essential Tremor Treated with MR Imaging-guided Focused Ultrasound: In Vivo Fiber Tracking by Using Diffusion-Tensor MR Imaging. *Radiology*, 272(1):202-9, July 2014. Cited 32 times; IF = 6.867; Rank 2 out of 125 radiology, nuclear medicine and medical imaging.

The ANTs software library, written by Dr. Tustison, was used to provide the quantitative image measures.

1. **Tustison NJ\***, Avants BB, Cook PA, Kim J, Whyte J, Gee JC, and Stone JR. Logical Circularity in voxel-based analysis: normalization strategy may induce statistical bias. *Hum Brain Mapp*, 35:745-759, March 2014. Cited 31 times; IF = 5.969; Rank 2 out of 14 neuroimaging, 27 out of 252 neurosciences, 5 out of 125 radiology, nuclear medicine & medical imaging.
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1. **Tustison NJ\*** and Avants BB. Explicit B-spline regularization in diffeomorphic image registration. *Front Neuroinform*, 7:39, 2013. Cited 70 times; IF = 3.261; Rank 8 out of 57 mathematical & computational biology, 105 out of 252 neurosciences.
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The ANTs software library, written by Dr. Tustison, was used to provide the quantitative image measures.

1. Yilmaz C, **Tustison NJ**, Dane DM, Ravikumar P, Takahashi M, Gee JC, and Hsia CCW. Functional computed tomography: Progressive adaptation in regional mechanics following extensive lung resection, *J Appl Physiol*, 111(4):1150–8, October 2011. Cited 15 times; IF = 3.056; Rank 26 out of 83 physiology, 8 out of 81 sport sciences.

The ANTs software library, written by Dr. Tustison, was used to provide the quantitative image measures.

1. Avants BB\*†, **Tustison NJ**†, Wu J, Cook PA, and Gee JC. An Open Source Framework for n-Tissue Segmentation with Evaluation on Public Data, *Neuroinformatics*, 9(4):381–400, December 2011. Joint first authorship. Cited 217 times; IF = 2.825; Rank 13 out of 102 computer science, interdisciplinary applications, 124 out of 252 neurosciences.
2. Murphy K\*, van Ginneken B, Reinhardt JM, Kabus S, Ding K, Deng X, Cao K, Du K, Christensen GE, Garcia V, Vercauteren T, Ayache N, Commowick O, Malandain G, Glocker B, Paragios N, Navab N, Gorbunova V, Sporring J, de Bruijne M, Han X, Heinrich MP, Schnabel JA, Jenkinson M, Lorenz C, Modat M, McClelland JR, Ourselin S, Muenzing SEA, Viergever MA, De Nigris D, Collins DL, Arbel T, Peroni M, Li R, Sharp GE, Schmidt-Richberg A, Ehrhardt J, Werner R, Smeets D, Loeckx D, Song G, **Tustison N**, Avants B, Gee JC, Staring M, Klein S, Stoel BC, Urschler M, Werlberger M, Vandemeulebroucke J, Rit S, Sarrut D, and Pluim JPW. Evaluation of Registration Methods on Thoracic CT: The EMPIRE10 Challenge, *IEEE Trans Med Imaging*, 30(11):1901–20, November 2011. Cited 331 times; IF = 3.390; Rank 5 out of 100 computer science, interdisciplinary applications, 12 out of 76 biomedical engineering, 18 out of 249 electrical & electronic engineering, 3 out of 24 imaging science & photographic technology, 21 out of 125 radiology, nuclear medicine & medical imaging.

This manuscript details a lung registration challenge occurring in 2010. Dr. Tustison’s team competed in and won the competition.

1. **Tustison NJ\***, Avants BB, Altes TA, de Lange EE, Mugler III JP, and Gee JC. Ventilation-Based Segmentation of the Lungs Using Hyperpolarized 3He MRI, *J Magn Reson Imaging*, 34(4):831–841, October 2011. Cited 39 times; IF = 3.210; Rank 23 out of 125 radiology, nuclear medicine and medical imaging.
2. Barbosa Jr EM\*, Song G, **Tustison N**, Kreider M, Gee JC, Gefter W, and Torigian DA. Computational Analysis of Thoracic Multidetector Row HRCT for Segmentation and Quantification of Small Airway Air Trapping and Emphysema in Obstructive Pulmonary Disease, *Acad Radiol*, 18(10):1258-1269, October 2011. Cited 31 times; IF = 1.751; Rank 63 out of 125 radiology, nuclear medicine and medical imaging.

The ANTs software library, written by Dr. Tustison, was used to provide the quantitative image measures.

1. **Tustison NJ\***, Avants BB, Siqueira M, and Gee JC. Topological Well-Composedness and Glamorous Glue: A Digital Gluing Algorithm for Topologically Constrained Level Set Segmentation, *IEEE T Image Process*, 20(6):1756-1771, June 2011. Cited 5 times; IF = 3.625; Rank 12 out of 123 computer science, artificial intelligence, 14 out of 249 electrical and electronic engineering.
2. **Tustison NJ\***, Cook TS, Song G, and Gee JC. Pulmonary Kinematics from Image Data—A Review, *Acad Radiol*, 18(4):402–417, April 2011. Cited 16 times; IF = 1.751; Rank 63 out of 125 radiology, nuclear medicine and medical imaging.
3. **Tustison NJ\***, Awate SP, Song G, Cook TS, and Gee JC. Point Set Registration Using Havrda-Charvat-Tsallis Entropy Measures. *IEEE Trans Med Imaging*, 30(2):451–460, February 2011. Cited 23 times; IF = 3.390; Rank 5 out of 100 computer science, interdisciplinary applications, 12 out of 76 biomedical engineering, 18 out of 249 electrical & electronic engineering, 3 out of 24 imaging science & photographic technology, 21 out of 125 radiology, nuclear medicine & medical imaging.
4. Avants BB\*, **Tustison NJ**, Song G, Cook PA, Klein A, and Gee JC. A Reproducible Evaluation of ANTs Similarity Metric Performance in Brain Image Registration, *NeuroImage*, 54(3):2033–2044, February 2011. Cited 1173 times; IF = 6.357; Rank 1 out of 14 neuroimaging, 24 out of 252 neurosciences, 3 out of 125 radiology, nuclear medicine & medical imaging.

Drs. Avants and Tustison jointly wrote the software and performed the evaluation.

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3. **Tustison NJ\***, Awate SP, Cai J, Altes TA, Miller GW, de Lange EE, Mugler III JP, and Gee JC. Pulmonary Kinematics from Tagged Hyperpolarized Helium-3 MRI, *J Magn Reson Imaging*, 31(5):1236–1241, May 2010. Cited 15 times; IF = 3.210; Rank 23 out of 125 radiology, nuclear medicine and medical imaging.
4. **Tustison NJ\***, Avants BB, and Gee JC. Directly manipulated free-form deformation image registration. *IEEE T Image Process,* 18(3):624–35, March 2009. Cited 72 times; IF = 3.625; Rank 12 out of 123 computer science, artificial intelligence, 14 out of 249 electrical and electronic engineering.
5. Siqueira M\*, Latecki LJ, **Tustison N**, Gallier J, and Gee J. Topological Repairing of 3D Digital Images. *J Math Imaging Vis,* 30(3):249–274, March 2008. Cited 29 times; IF = 1.552; Rank 54 out of 123 computer science, artificial intelligence, 23 out of 104 computer science, software engineering, 34 out of 257 applied mathematics.

Dr. Tustison implemented the repairing algorithm and ran the evaluation.

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Dr. Tustison ran the software to perform the evaluation.

**B. Books and/or Chapters**

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8. **Tustison NJ**, Gee JC: N4ITK: Nick’s N3 ITK Implementation for MRI Bias Field Correction, Insight Journal 2009, http://hdl.handle.net/10380/3053, Publication of the Month December 2009.
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**D. Abstracts and Conference Proceedings**

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7. **Tustison N**, Yang Y, and Salerno. Advanced Normalization Tools for Cardiac Motion Correction. Statistical Atlases and Computational Models of the Heart - Imaging and Modelling Challenges - 5th International Workshop, STACOM 2014, Held in Conjunction with MICCAI 2014, Boston, MA, USA, September 18, 2014. Lecture Notes in Computer Science 8896, Springer 2015.
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1. **Tustison NJ**, Amini AA: Lagrangian and Eulerian biventricular strains from anatomical NURBS models using tagged MRI. In: Proceedings of SPIE: Medical Imaging 2006: Physiology, Function, and Structure from Medical Images, 5746:192–204, San Diego, 2005.
2. **Tustison NJ**, Abendschein D, Amini AA: Biventricular myocardial kinematics based on tagged MRI from anatomical NURBS models. In: Proceedings of the IEEE Computer Vision and Pattern Recognition (CVPR), 2:514, Quebec City, 2004.
3. **Tustison NJ**, Amini AA: Myocardial Kinematics Based on Tagged MRI From Geometric Deformable Models. Proceedings of SPIE: Medical Imaging 2006: Physiology, Function, and Structure from Medical Images, 5369:22-33, San Diego, 2004.
4. **Tustison NJ**, Amini AA: Tracking Myocardial Beads from SPAMM-MRI with a 4-D B- Spline Model. In: Proceedings of the 2nd Joint EMBS/BMES Conference, pp. 993–994, Houston, 2002.
5. **Tustison NJ**, Abendschein D, Davila-Roman VG, Amini AA: Myocardial Strain Imaging with Tagged MRI. In: Proceedings of the 16th International Conference on Pattern Recognition (ICPR), 1:723–726, Quebec City, 2002.
6. Cooley B, Acton ST, Salerno M, Brookeman JR, **Tustison NJ**, de Lange EE, Altes TA: Automated Scoring of Hyperpolarized Helium-3 MR Lung Ventilation Images: Initial Development and Validation. In: Proceedings of the 11th annual Meeting of the International Society for Magnetic Resonance in Medicine (ISMRM), Honolulu, 2002.
7. **Tustison NJ**, Yablonskiy D, Conradi M, Amini AA: Deformable Registration of 3HeMR and X-ray CT images of the lungs. In: Proceedings of the 11th annual Meeting of the International Society for Magnetic Resonance in Medicine (ISMRM), Honolulu, 2002.
8. Spellman MJ, Hagspiel KD, Altes TA, Mugler III JP, Mata JF, **Tustison NJ**, Brookeman JR: MR Virtual Colonoscopy using Hyperpolarized 3He as an Endoluminal Contrast Agent. In: Proceedings of the 8th Annual Meeting of the International Society for Magnetic Resonance in Medicine (ISMRM), Philadelphia, 1999.
9. **Invited Lectures and Symposiums**

Oct. 2014 *Logical Circularity in Voxel-Based Analysis*, Laboratory of

Neuroimaging, University of Southern California, Los Angeles,

USA.

Sep. 2013 *Big × (Science + ~~Data~~Imaging) @ UVA*, School of Medicine Retreat,

University of Virginia, Charlottesville, VA, USA.

Apr. 2012 *Computational Image Analysis of TBI*, Department of Physical

Medicine and Rehabilitation, University of Virginia, Charlottesville, USA.

Dec. 2011 *Logical Circularity in Voxel-Based Analysis*, University of Iowa, Iowa City, USA.

Nov. 2010 *Computational Tools for the Xbox 360 Generational Radiologist*, Department of Radiology and Medical Imaging, University of Virginia, Charlottesville, USA.

1. **Financial Resources (Grants and Contracts)**

Sponsor: NIH-NHLBI

Title: ITK-Lung: A software framework for lung image processing and analysis

Role: Site PI

Period:

Sponsor: NIH-NHLBI

Title: Hyperpolarized Xenon-129 MRI: a new multi-dimensional biomarker to determine pulmonary physiologic responses to COPD therapeutics

Role: Co-investigator

Period:

Sponsor: NIH-NHLBI

Title: Xe129 MRI of the lung: A new technology to assess treatment for

COPD

Role: Co-investigator

Period: 7/1/2016 – 6/30/2017

Sponsor: NASA/Medical University of South Carolina

Title: Human Cerebral Vascular Autoregulation and Venous Outflow In

Response to Microgravity-Induced Cephalad Fluid Redistribution

Role: Co-investigator

Period: 5/16/2013 – 5/15/2018

Sponsor: NIH-NHLBI

Title: Simultaneous Xe129 MRI of Regional Lung Ventilation and Gas Uptake in COPD

Role: Co-investigator

Period: 7/1/2011 – 5/31/2016

Sponsor: The Geneva Foundation

Title: Brain Injury Biomarkers and Behavioral Characterization of mTBI in Soldiers Following Repeated, Low-Level Blast Exposure

Role: Co-investigator

Period: 1/1/2013 – 5/31/2015

Sponsor: NIH-NHLBI

Title: Single-session bronchial thermoplasty for severe asthmatics guided by Hxe MRI

Role: Principal investigator on UVa subcontract

Period: 9/1/2011 – 1/31/2015

Sponsor: NIH-NHLBI

Title: Regulatory Advancement of HXe as an MRI Contrast Agent

Role: Co-investigator

Period: 9/1/2011 – 1/31/2015

Sponsor: Novartis Pharmaceuticals Corp.

Title: Hyperpolarized noble-gas enhanced imaging of b2-agonist

pharmacodynamics and pharmacokinetics in mild to moderate

asthma

Role: Co-investigator

Period: 10/15/2010 – 5/31/2014

Sponsor: Naval Medical Research Center

Title: Experienced Breacher Study

Role: Co-investigator – UVa subcontract

Period: 6/1/2012 – 5/30/2014

Sponsor: Vertex Pharmaceuticals, Inc.

Title: A Phase II, Single-Blind, Placebo-Controlled Crossover Study to

Evaluate the Effect of VX-770 on Hyperpolarized Helium-3 Magnetic Resonance Imaging in Subjects with Cystic Fibrosis, the G551D Mutation and FEV1 ≥40% Predicted

Role: Physicist

Period: 9/9/2010 – 9/8/2012

Sponsor: NIH-NLM

Title: Fundamental Refactoring of Deformable Image Registration in ITK

with Distributed Computing and GPU Acceleration

Role: Principle investigator of UVa subcontract

Period: 7/1/2011 – 6/30/2012