OMB No. 0925-0001 and 0925-0002 (Rev. 09/17 Approved Through 03/31/2020)

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.  
Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: Nicholas J. Tustison, D.Sc.

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

POSITION TITLE: Associate Professor of Radiology and Medical Imaging

EDUCATION/TRAINING (Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)

| INSTITUTION AND LOCATION | DEGREE  (if applicable) | Completion Date  MM/YYYY | FIELD OF STUDY |
| --- | --- | --- | --- |
| Brigham Young University | BS | 04/1998 | Applied Physics: Computer Science Emphasis |
| University of Virginia | MS | 05/2000 | Biomedical Engineering |
| Washington University in St. Louis | DSc | 08/2004 | Biomedical Engineering |
| University of Pennsylvania | Postdoctoral | 09/2006 | Medical Image Analysis |

**A. Personal Statement**

I am well-suited to significantly contribute to the quantitative analyses proposed in this project entitled “Advanced Normalization Tools.” My formal training is in quantitative medical image analysis and I have authored several articles detailing innovative image analysis techniques and large-scale studies in neuroimaging including the winning entry in the brain tumor segmentation competition held in conjunction with the well-respected MICCAI conference. As a core developer of the open-source Insight Toolkit (National Library of Medicine) and a founder of the Advanced Normalization Tools (ANTs), I have extensive experience with robust software and algorithm development and employing these tools in robust pipelines for large-scale studies.

Ongoing and recently completed projects that I would like to highlight include:

RO1 HL133889

Gee (PI), Role: PI of UVa subcontract

06/01/2017 – 05/31/2022

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

Citations:

1. **Tustison NJ**, Cook PA, Holbrook AJ, Johnson HJ, Muschelli J, Devenyi GA, Duda JT, Das SR, Cullen NC, Gillen DL, Yassa MA, Stone JR, Gee JC, and Avants BB for the Alzheimer’s Disease Neuroimaging Initiative. The ANTsX ecosystem for quantitative biological and medical imaging. *Scientific Reports*. 11(1):9068, April 2021. PMID: 33907199.
2. **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. PMID: 25433513.
3. **Tustison NJ**, Cook PA, Klein A, Song G, Das SR, Duda JT, Kandel BM, van Strien N, Stone JR, Gee JC, Avants BB: Large-Scale Evaluation of ANTs and FreeSurfer Cortical Thickness Measurements, NeuroImage, 2014 October, 99:166-79. PMID: 24879923.
4. **Tustison NJ**, Avants BA, Cook PA, Zheng Y, Egan A, Yuskevich PA, Gee JC: N4ITK: improved N3 bias correction, IEEE Trans Med Imag, 2010 June; 29(6):1310-1320. PMCID: PMC3071855.

**B. Positions, Scientific Appointments, and Honors**

**Positions and Scientific Appointments**

2004-2005 Research Fellow, Penn Image Computing and Science Laboratory, University of Pennsylvania, Philadelphia, PA

2005-2010 Senior Research Investigator, Penn Image Computing and Science Laboratory, University of Pennsylvania, Philadelphia, PA

2010-2017 Assistant Professor, Department of Radiology and Medical Imaging, University of Virginia, Charlottesville, VA

2016-2018 Visiting Assistant Researcher, Department of Neurobiology and Behavior, University of California, Irvine, Irvine, CA

2017-Present Associate Professor, Department of Radiology and Medical Imaging, University of Virginia, Charlottesville, VA

2018-Present Visiting Associate Researcher, Department of Neurobiology and Behavior, University of California, Irvine, Irvine, CA

2018-Present Secretary, Insight Software Consortium

**Honors**

2014 Best paper award, STACOM2014 cardiac motion estimation challenge, MICCAI Conference 2014

2013 BRATS2013 multimodal brain tumor segmentation competition, MICCAI Conference 2013

2010 EMPIRE10 lung registration competition, MICCAI Conference 2010

**C. Contributions to Science**

* + - 1. **Working with colleagues from the University of Pennsylvania, I have made important contributions (both practical and theoretical) to image registration—a fundamental processing step in many medical image analysis tasks. These include contributions to biological modeling using parsimonious transformations described by diffeomorphisms which are smooth transforms with differentiable inverses. The utility of such transforms spans the gamut of possible applications from cardiac and lung mechanics to brain mapping. Other utilities have included point set similarity metrics for other application domains. In support of open science and reproducibility, I have made these contributions available through the Insight Toolkit (ITK) of the National Institutes of Health for other researchers to use. Additionally, my colleagues and I have won several competitions related to our image registration contributions. Specifically, the EMPIRE10 (registration of CT lung images) and STACOM2014 (cardiac motion estimation) challenges were both won using our image registration contributions.**

1. Avants BB, **Tustison NJ**, Stauffer M, Song G, Wu B, Gee JC: The Insight ToolKit image registration framework, 2014 April, 8:44. PMCID4009425
2. **Tustison NJ**, Avants BB: Explicit B-spline regularization in diffeomorphic image registration, Front Neuroinform, 2013 December, 7:39. PMCID: PMC3870320
3. **Tustison NJ**, Awate SP, Song G, Cook TS, Gee JC: Point set registration using Havrda-Charvat-Tsallis entropy measures, IEEE Trans Med Imag, 2011 February, 30(2):451-460. PMID: 20937578
4. **Tustison NJ**, Avants BA, Gee JC: Directly manipulated free-form deformation image registration, IEEE Trans Image Process, 2009 March; 18(3):624-635. PMID: 19171516
   * + 1. **In general, my contributions have been methodological. Most importantly, these contributions have been made available as open source software through the Advanced Normalization Tools (ANTs) and the underlying Insight Toolkit (ITK) of the National Library of Medicine of the NIH. ANTs was first created 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 now incorporates novel and cutting-edge methods for image cleaning, segmentation, feature extraction and, more recently, complete statistical pipelines via ANTsR. In 2014, there were nearly 2,000 citations to ANTs and the software is cloned, downloaded or otherwise accessed over 100-200 times per week, on average at github. The sourceforge site hosts a similar number of visits and downloads. ANTsR is accessed on average 50 times per week---a substantial number for new software. There are also over 500 discussion topics on the ANTs sourceforge community site, nearly 100 topics on the github site and over 50 help-focused emails to the personal addresses of developers. Generally, response time to requests for help is within a few hours with rare occasions taking up to a day or two and is primarily split between myself and my colleague, Brian Avants. Recent development includes the open-source ANTsRNet (https://github.com/ntustison/ANTsRNet)---an R-based implementation of common deep learning architectures.**
5. **Tustison NJ**, Cook PA, Holbrook AJ, Johnson HJ, Muschelli J, Devenyi GA, Duda JT, Das SR, Cullen NC, Gillen DL, Yassa MA, Stone JR, Gee JC, and Avants BB for the Alzheimer’s Disease Neuroimaging Initiative. The ANTsX ecosystem for quantitative biological and medical imaging. *Scientific Reports*. 11(1):9068, April 2021. PMID: 33907199.
6. Avants BB, **Tustison NJ**, Song G, Cook PA, Klein A, Gee JC: A reproducible evaluation of ANTs similarity metric performance in brain image registration, Neuroimage 2011 February, 54(3):2033-2044. PMCID: PMC3065962.
7. Avants BB\*, **Tustison NJ**\*, Wu J, Cook PA, Gee JC: An open source framework for *n*-tissue segmentation with evaluation on public data, Neuorinformatics, 2011 Dec, 9(4):381-400, PMCID: PMC3297199. \*Joint first authorship
8. **Tustison NJ**, Avants BA, Cook PA, Zheng Y, Egan A, Yuskevich PA, Gee JC: N4ITK: improved N3 bias correction, IEEE Trans Med Imag, 2010 June; 29(6):1310-1320. PMCID: PMC3071855.
   * + 1. **My colleagues and I have also raised very important critiques with respect to foundational tools used in neuroimaging research and general scientific practices. In one publication, we demonstrated how a common image mapping technique for determining statistical differences in populations results in significant false positives. This issue dovetails with related selection bias issues in the fMRI literature and in neuroscience research practices. We have also provided researchers and reviewers with guidelines for assessing the relative performance of scientific software and the pitfalls associated with instrumentation bias where software is viewed as a scientific instrument requiring proper usage.**

1. **Tustison NJ**, Avants BB, Cook PA, Kim J, Whyte J, Gee JC, Stone JR: Logical circularity in voxel-based analysis: normalization strategy may induce statistical bias, Hum Brain Mapp, 2014 March, 35:745--759 PMID: 23151955.
2. **Tustison NJ**, Johnson HJ, Rohlfing T, Klein A, Ghosh SS, Ibanez L, Avants BB: Instrumentation bias in the use and evaluation of scientific software: recommendations for reproducible practices in the computational sciences, Front Neurosci, 2013 September, 7:162, PMCID: PMC3766821.

**Complete List of Published Work in MyBibliography:** [**https://www.ncbi.nlm.nih.gov/myncbi/1TywuikZnK45a/bibliography/public/**](https://www.ncbi.nlm.nih.gov/myncbi/1TywuikZnK45a/bibliography/public/)