Personal Statement

Nicholas J. Tustison, DSc

I am a data scientist specializing in medical image analysis with technical expertise and international recognition in the development of high-quality, open-source software with targeted application in clinical areas such as neuro, pulmonary, and cardiac imaging research. Ever since returning to the University of Virginia in 2010, I have been the lead technical scientist for various projects in multiple departments across multiple institutions charged with the development and deployment of computational techniques for generating salient imaging biomarkers in small- and large-scale studies.

Following my undergraduate studies in physics and computer science, I completed master's and doctoral degrees in biomedical engineering from the University of Virginia and Washington University in Saint Louis, respectively, where my work included the development of mathematical models for quantification of lung and cardiac imaging biomarkers. Following my graduate training, I continued my post-graduate education at the University of Pennsylvania under the direction of Dr. James C. Gee, a technical pioneer in the area of medical image registration. While at the University of Pennsylvania, my colleague, Dr. Brian B. Avants, and I began development of the Advanced Normalization Tools (ANTs)—a software package which has since become one of the most widely used toolkits in the field for imaging processing and analysis. Not only is it used by many premier academic research groups, including widespread use in various departments at the University of Virginia, but, due to its open-source nature, companies such as General Electric (G.E.) and International Business Machines (I.B.M.) also employ ANTs. These contributions to the field complement my many other software and algorithmic inclusions in the Insight Toolkit —the largest open-source, medical image analysis software package in the world with origins linked to the Visible Human Project and supported by the National Library of Medicine of the National Institutes of Health with significant investments on the part of both industrial and academic institutions. In fact, I am one of the top contributors in terms of new software modules having recently been part of the team which completely refactored the image registration framework.

Since all too often in our field "papers are simply advertisements for the science," my colleagues and I have participated in several unbiased competitions in order to properly evaluate our data science approaches. For example, the ANTs-based Symmetric Normalization (SyN) image registration framework was deemed independently to be the top-performing algorithm for both brain and lung image normalization in addition to being the only algorithm that not only is publicly available but available for uses beyond strictly research. In 2013 my colleagues and I won an international competition in Nagoya, Japan for automatically segmenting brain tumor tissue from multi-modal MRI. The machine learning technique that we developed for the competition has since been used by several other groups in addition to our generation of new technology for segmenting cohorts with white matter lesions associated with multiple sclerosis and white matter hyperintensities associated with traumatic brain injury. In 2014, we won the best paper award for cardiac motion correction. Most

recently, in 2015, my colleagues and I published and provided to the public a complete pipeline for extracting cortical thickness measures in the brain from MRI which was shown to outperform the only other such available approach, viz., the well-known FreeSurfer package of Harvard University. Such measures are extremely salient in identifying neurodegeneration in diseases such as Alzheimers and other conditions which affect brain development.

Given my role in the development of such widely used data science approaches, I have given numerous tutorials at various conferences and to such recognized groups as the Laboratory of NeuroImaging (LONI) at the University of Southern California and the Montreal Neurological Institute associated with McGill University. This has led to an expansion of my circle of collaborators beyond the University of Virginia to include a joint appointment at the University of California, Irvine and a pending appointment at the University of Pennsylvania.

I am honored to be affiliated with the University of Virginia and feel extremely fortunate to work with its high quality faculty in exploring interesting research questions. I look forward to continuing my career path at UVa where I plan to continue focusing on innovations related to computational medical image analysis and offering crucial expertise in for imaging data science.