BRIAN B. AVANTS, Ph.D.

AI & Machine Learning Executive · **Computational Anatomy Pioneer** · **Founder, Cingulate LLC**

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github.com/stnava · ANTsX linkedin.com/in/brian-avants Google Scholar: 57,500+ Citations · h-index: 71 0000-0002-4212-3362

EXECUTIVE PROFILE: Entrepreneurial AI/ML executive, principal data scientist, and computational imaging pioneer with 20+ years of experience translating mathematical foundations into global open-source software and regulatory-grade clinical trial biomarkers. Co-creator and lead architect of the **ANTsX ecosystem** (`ANTs`, `ANTsPy`, `ANTsR`, `ANTsPyNet`, `ANTsPyMM`)—the international gold standard for medical image registration and morphometry (**57,500+ citations, h-index 71**). Author of four papers each cited more than 6,000 times (`SyN`, `N4ITK`, BRATS, and the ANTs registration evaluation). Proven track record building and leading high-performing machine learning teams across biotech (**Biogen**), global clinical trial CROs (**Invicro**), venture consulting (**Cingulate LLC**), and academic/defense research (**UPenn, UVA, Brown ICERM**).

57,500+ Citations	**h-index: 71 / i10: 166**	**#1 Ranked Benchmarks**	**Phase I–III AI Leadership**
Top-cited medical imaging creator	180+ peer-reviewed publications	Klein, EMPIRE10, BRATS, SATA	Aduhelm (*Nature* cover), PPMI, UKBB

CORE COMPETENCIES & STRATEGIC CAPABILITIES

AI & Machine Learning: Multi-View Representation Learning (`SiMLR`), Stiefel Manifold Optimization (`NSA-Flow`), Deep Computational Anatomy, Normalizing Flows, 3D Super-Resolution, Disease Subtyping & Staging (`subtyper`, Aligned-UMAP), Multimodal Learning.

Clinical Trials & Biotech: Quantitative Imaging Biomarkers (MRI, Amyloid/Tau/TSPO PET, DTI, rs-fMRI, CT), Phase I–III Trial Endpoint Strategy, Patient Stratification, Translational Neuroscience (Alzheimer's, Parkinson's, FTD, ALS, TBI/Blast), Biobank Phenotyping.

Engineering & Product: Open-Source Ecosystem Architecture (`ANTsX`, `ITKv4`, `Neuroconductor`), C++, Python, PyTorch, TensorFlow/Keras, R, CMake, High-Performance Cloud & Distributed Clinical Pipelines, Automated Quality Control.

ENTREPRENEURIAL, EXECUTIVE & INDUSTRY EXPERIENCE

Founder & Principal Consultant — 2018 – Present

Cingulate LLC — Portsmouth, NH

- Founded and lead a specialized AI, computational anatomy, and quantitative biomarker consultancy delivering machine learning architecture and clinical trial analytics for biotechnology, pharmaceutical, defense (DoD/CDMRP), and academic clients.
- Created **NSA-Flow** (*Non-Negative Stiefel Approximating Flow*, PyTorch) and **SiMLR** (*Similarity-driven Multi-view Linear Reconstruction*, *Nature Comp. Sci.* 2021) for interpretable, sparse multi-omics and multi-modal neuroimaging representation learning.
- Lead quantitative phenotyping and normative neuroimaging library development across major population and disease cohorts, including the **UK Biobank** ($N > 40,000$), **Parkinson's Progression Markers Initiative (PPMI)**, and **LIMBIC-CENC**.

Senior Director of Machine Learning — 2018 – 2024

Invicro (a Konica Minolta Company) — Boston, MA

- Directed enterprise Machine Learning strategy and clinical trial software engineering across neurodegenerative, neuro-oncology, pulmonary, and multi-species therapeutic pipelines for a leading global imaging CRO.
- Architected and deployed **ANTsPyMM** and automated deep learning quality control, tissue/lesion segmentation, and concurrent 3D super-resolution pipelines to accelerate biomarker readouts in multi-center clinical trials.
- Led multi-institutional AI collaborations (with Michael J. Fox Foundation, NIH/NIA, and pharma sponsors) on multimodal patient representation learning with missing modalities (*ICLR* 2023) and longitudinal Parkinson's disease subtyping (*Patterns* 2023, *EJHG* 2024).

Associate Director, Translational & Advanced Analytics (Biomarkers) — 2016 – 2018

Biogen — Cambridge, MA

- Served as lead integrative imaging data scientist for the **Aducanumab (Aduhelm)** clinical trial program (Phase 1b PRIME and Phase 3 ENGAGE/EMERGE), driving quantitative biomarker evaluation and patient stratification in Alzheimer's disease.
- Conducted confirmatory amyloid PET SUVR reference/target region optimization and generated the primary visualization featured on the **cover of *Nature*** (Sevigny et al., 2016; Chiao et al., *J. Nucl. Med.* 2018).
- Pioneered longitudinal resting-state fMRI network biomarker analytics in amyloid-beta positive subjects (*Neurobiology of Aging* 2018) and launched **ANTsPy** to unify deep learning with diffeomorphic registration.

Algorithm Developer, Imaging Department — 1999 – 2000

Siemens Corporate Research — Princeton, NJ

- Developed adaptive minimal-path vessel tracking and 3D segmentation algorithms for CTA and CE-MRA volumetric clinical imaging systems.

ACADEMIC & RESEARCH APPOINTMENTS

Visiting Associate Professor of Radiology and Medical Imaging — 2018 – Present

University of Virginia School of Medicine — Charlottesville, VA

- Co-lead multi-view machine learning and neuroimaging biomarker studies investigating neuroinflammation (TSPO PET), brain volume change, and functional/structural connectivity in military Special Operations personnel and breachers exposed to repetitive blast overpressure (*J. Neurotrauma* 2020, 2022, 2024).
- Co-architect of the **Normative Neuroimaging Library** (*J. Neurotrauma* 2024) and **Deep Computational Anatomy via Latent-Aligned Multiview Normalizing Flows** (2026).

Visiting Scholar, Institute for Computational and Experimental Research in Mathematics (ICERM) — Spring 2020

Brown University — Providence, RI

- Invited visiting scientist for the semester program *"Model and Dimension Reduction in Uncertain and Dynamic Systems"*; established the mathematical foundations for similarity-driven multi-view embeddings (`SiMLR`).

Assistant Professor of Radiology (2012–2016) | **Research Associate (2008–2012)** | **Postdoctoral Fellow (2006–2008)** **2006 – 2016**

University of Pennsylvania, Penn Image Computing and Science Laboratory (PICSL) Philadelphia, PA

- Invented **Symmetric Diffeomorphic Image Registration (`SyN`)** (*Med. Image Anal.* 2008; 7,700+ citations) and co-developed **N4ITK** bias correction (*IEEE TMI* 2010; 8,400+ citations), **Atropos** segmentation, **Eigenanatomy**, and **SCCAN**.
- Principal Investigator on NIH Big Data to Knowledge (BD2K) K01 Career Development Award (*Imaging Genomics of Pediatric Executive Function*); Image Analysis Lead on IARPA KRNS; Registration Architecture Lead for the NLM **Insight ToolKit (ITKv4)** redesign.

FLAGSHIP SOFTWARE PRODUCTS & OPEN-SOURCE ECOSYSTEM

ANTs (C++ Core)	**Creator & Lead Architect (2008–Present):** Premier open-source library for diffeomorphic image registration (`SyN`), bias correction (`N4`), tissue segmentation (`Atropos`), and cortical thickness (`DiReCT`).
ANTsPy & ANTsPyNet	**Co-Creator & Architect (2017–Present):** Python & Keras/TensorFlow/PyTorch deep learning ecosystem for automated brain extraction, Deep Atropos, HippMapp3r, brain age, and 3D super-resolution.
ANTsPyMM	**Lead Architect (2021–Present):** Automated multi-modal neuroimaging phenotyping pipeline (T1w, FLAIR, rs-fMRI, DTI, neuromelanin) with integrated outlier detection and quality control for clinical trials and biobanks.
ANTsR & subtyper	**Creator & Lead Designer (2012–Present):** Statistical imaging, multivariate sparse canonical correlation (`SCCAN`), `SiMLR`, and longitudinal disease subtyping/staging packages in R.
NSA-Flow (`nsa_flow`)	**Creator (2025–Present):** PyTorch matrix optimization package implementing Non-Negative Stiefel Approximating Flow for orthogonalish, sparse, interpretable representation learning (github.com/stnava/nsa_flow).
Insight ToolKit (ITKv4)	**Registration Development Lead (2002–Present):** Led the NLM-funded architectural overhaul of deformable image registration, metrics, and transforms for the global ITK medical imaging standard.

Reach (Nov 2026): ANTsX GitHub organization 2,900+ stars / 700+ forks; `ANTsPy` 30,000+ PyPI downloads per month; core dependency of fMRIPrep, QSIPrep, Nipype, Clinica, and TemplateFlow.

SELECTED HIGH-IMPACT & RECENT PUBLICATIONS (OUT OF 180+ PEER-REVIEWED WORKS)

- **Tustison, N. J., Avants, B. B., Cook, P. A., Gee, J. C., & Stone, J. R.** (2026). *Deep Computational Anatomy via Latent-Aligned Multiview Normalizing Flows*. bioRxiv / PubMed (PMID: 42146611).
- **Theodorou, B., Dadu, A., Avants, B., Nalls, M., Sun, J., & Faghri, F.** (2026). *Realistic PET image synthesis from MRI for automated inference of brain atrophy and Alzheimer's*. **iScience**, 29(5), 115747.
- **Avants, B. B., et al.** (2025). *Non-Negative Stiefel Approximating Flow: Orthogonalish Matrix Optimization for Interpretable Embeddings*. **arXiv**:2511.06425; & *Joint representations from multi-view MRI-based learning support cognitive and functional performance domains*. **medRxiv**.
- **Tustison, N. J., Yassa, M. A., ..., Stone, J. R., & Avants, B. B.** (2024). *ANTsX neuroimaging-derived structural phenotypes of UK Biobank*. **Scientific Reports**, 14(1), 8848.
- **Stone, J. R., Avants, B. B., Tustison, N. J., et al.** (2024). *Neurological effects of repeated blast exposure in Special Operations personnel*. **Journal of Neurotrauma**, 41(7–8), 942–956; & *Normative Neuroimaging Library* (2024), **J. Neurotrauma**, 41(23–24), 2497–2512.
- **Yang, Z., Wen, J., Erus, G., Avants, B. B., et al.** (2024). *Brain aging patterns in a large and diverse cohort of 49,482 individuals*. **Nature Medicine**, 30, 3015–3026.
- **Wu, Z., Dadu, A., Tustison, N., Avants, B., Nalls, M., Sun, J., & Faghri, F.** (2023). *Multimodal Patient Representation Learning with Missing Modalities and Labels*. **International Conference on Learning Representations (ICLR)**.
- **Dadu, A., ..., Avants, B., Hesterman, J., & Gunn, R.** (2023). *Application of Aligned-UMAP to longitudinal biomedical studies*. **Patterns** (Cell Press), 4(6), 100741.
- **Avants, B. B., Tustison, N. J., & Stone, J. R.** (2021). *Similarity-driven multi-view embeddings from high-dimensional biomedical data*. **Nature Computational Science**, 1(2), 143–152.
- **Tustison, N. J., Cook, P. A., ..., Gee, J. C., & Avants, B. B.** (2021). *The ANTsX ecosystem for quantitative biological and medical imaging*. **Scientific Reports**, 11(1), 9068.
- **Tustison, N. J., Avants, B. B., Cook, P. A., Zheng, Y., Egan, A., Yushkevich, P. A., & Gee, J. C.** (2010). *N4ITK: Improved N3 bias correction*. **IEEE Transactions on Medical Imaging**, 29(6), 1310–1320.
- **Avants, B. B., Epstein, C. L., Grossman, M., & Gee, J. C.** (2008). *Symmetric diffeomorphic image registration with cross-correlation: Evaluating automated labeling of elderly and neurodegenerative brain*. **Medical Image Analysis**, 12(1), 26–41.

EDUCATION & BENCHMARK HONORS

Ph.D. in Bioengineering — University of Pennsylvania, Philadelphia, PA **2005**

Dissertation: *Diffeomorphometry for Computational Anatomy* · NIH Institute for Medicine and Engineering Trainee

M.S. in Computer Science — University of Pennsylvania, Philadelphia, PA **2002**

Focus: Computational Geometry, Computer Vision, and Numerical Optimization

B.A. in Physics and Literature — New College of Florida, Sarasota, FL **1998**

With High Honors · National Merit Scholar (1994) · Humana Future Healthcare Researcher Scholar (1995)

Selected Benchmark & Scientific Awards: STACOM Best Paper Award (MICCAI 2014) · **1st Place, BRATS Brain Tumor Segmentation Challenge** (MICCAI 2013, ANTsR) · **1st Place, SATA Segmentation Challenge** (MICCAI 2013, ANTs) · **"Standard Setting" Registration Benchmark** (MICCAI 2013 Multi-Atlas Challenge) · **1st Overall, EMPIRE10 International Lung CT Registration Challenge** (*IEEE TMI* 2010) · **1st Rank, Klein International Brain MRI Registration Evaluation** (*NeuroImage* 2009) · **MICCAI Young Investigator Award** (2007).