

Jacob Daniel Hinkle

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RESEARCH INTERESTS **Applications of statistics, geometry, and imaging:** shape analysis, differential geometry, inverse problems, scientific visualization

APPLICATIONS Image analysis, tomography, radiation oncology, X-ray diffraction, neuro- and cardiac imaging, electron microscopy, biofuels, photovoltaics, materials science

EMPLOYMENT **Oak Ridge National Laboratory (ORNL)**, Oak Ridge, TN
2017 – present, Research Scientist,
Computational Sciences and Engineering Division (CSED)
National Renewable Energy Laboratory (NREL), Golden, CO
2016 – 2017, Research Scientist,
2014 – 2016, Postdoctoral Researcher, Computational Science Center

EDUCATION **University of Utah**, Salt Lake City, UT
PhD, Bioengineering, 2015
Miami University, Oxford, OH
Magna cum Laude
BS, Physics, May 2006
BS, Mathematics, May 2006

SOFTWARE Code for open source projects available at bitbucket.org/jhinkle and at github.com/jacobhinkle

- **lagomorph** – Diffeomorphic image registration library based on PyTorch, enabling high performance training of neural architectures involving image registration components.
- **unmix_xrd** – Bayesian unmixing and classification of X-ray diffraction (XRD) spectra, developed under XRD Phase Mapping for Materials Discovery LDRD at NREL.
- **daft** – Haskell library and domain specific language for statically type-checked polymorphic records, for use in custom scenario modelling applications. Used in production in the Scenario Evaluation, Regionalization & Analysis (SERA) project at NREL.
- **tiltrecon** – novel Bayesian image reconstruction methods for electron tomography, developed under C3Bio and BESC funding for bioimaging at NREL.
- **TomoPore** – porosimetry and enzyme accessibility quantification from 3D electron tomography, developed under C3Bio and BESC funding for analyzing cell wall morphology at NREL.
- **PyCA: Python for Computational Anatomy** – an open-source C++ CUDA library with Python bindings, providing a framework for advanced image and shape analysis, such as diffeomorphic image registration.
- **ImageRegression** – open-source Python package, using the PyCA library to enable diffeomorphic geodesic and polynomial regression on image time-series data.
- **pyManifoldStats/jlManifoldStats** – open-source packages written in both Python and Julia, implementing Frechet averaging and Riemannian polynomial regression on shape space.
- **utrecon** – Four-dimensional image reconstruction from image slices or cone-beam CT projection data, using diffeomorphic motion model.
- **autocalib** – Auto-calibrating CT reconstruction software, enabling iterative conebeam CT reconstruction from uncalibrated projection data. Collaboration with GE Healthcare.

Programming skills: Python, C/C++, Haskell, CUDA, R, PyTorch, Tensorflow, Stan/PyMC3, Julia, shell scripting

ISSUED PATENTS

- [1] Jacob Hinkle, Sarang Joshi, Bill J Salter, P Thomas Fletcher, and Brian Wang. “Image Reconstruction Incorporating Organ Motion”. Issued Patent US8824756. Sept. 2014.

PUBLISHED
JOURNAL
PUBLICATIONS

- [2] Devanshu Agrawal, Theodore Papamarkou, and Jacob Hinkle. “Wide Neural Networks with Bottlenecks are Deep Gaussian Processes”. In: *Journal of Machine Learning Research* 21.175 (2020), pp. 1–66.
- [3] Theodore Papamarkou, Hayley Guy, Bryce Kroencke, Jordan Miller, Preston Robinette, Daniel Schultz, Jacob Hinkle, Laura Pullum, Catherine Schuman, Jeremy Renshaw, et al. “Automated detection of corrosion in used nuclear fuel dry storage canisters using residual neural networks”. In: *Nuclear Engineering and Technology* (2020).
- [4] M Todd Young, Jacob D Hinkle, Ramakrishnan Kannan, and Arvind Ramanathan. “Distributed Bayesian optimization of deep reinforcement learning algorithms”. In: *Journal of Parallel and Distributed Computing* 139 (2020), pp. 43–52.
- [5] Shang Gao, John X Qiu, Mohammed Alawad, Jacob D Hinkle, Noah Schaeferkoetter, Hong-Jun Yoon, Blair Christian, Paul A Fearn, Lynne Penberthy, Xiao-Cheng Wu, et al. “Classifying cancer pathology reports with hierarchical self-attention networks”. In: *Artificial Intelligence in Medicine* 101 (2019), p. 101726.
- [6] Nikhil Singh, Jacob Hinkle, Sarang Joshi, and P Thomas Fletcher. “Hierarchical Geodesic Models in Diffeomorphisms”. In: *International Journal of Computer Vision* 117 (1 2016), pp. 70–92.
- [7] Jacob Hinkle, Peter N Ciesielski, Kenny Gruchalla, Kristin R Munch, and Bryon S Donohoe. “Biomass accessibility analysis using electron tomography”. In: *Biotechnology for Biofuels* 8 (1 Dec. 2015), pp. 1–16.
- [8] Jacob Hinkle, P Thomas Fletcher, and Sarang Joshi. “Intrinsic polynomials for regression on Riemannian manifolds”. In: *Journal of Mathematical Imaging and Vision* 50.1-2 (2014), pp. 32–52.
- [9] Amit Sawant, Paul Keall, Kim Butts Pauly, Marcus Alley, Shreyas Vasanaawala, Billy W Loo Jr., Jacob Hinkle, and Sarang Joshi. “Investigating the Feasibility of Rapid MRI for Image-Guided Motion Management in Lung Cancer Radiotherapy”. In: *BioMed Research International* 2014 (Jan. 2014). DOI: 10.1155/2014/485067.
- [10] Amit Sawant, Paul Keall, Kim Butts Pauly, Marcus Alley, Shreyas Vasanaawala, Billy W Loo Jr, Jacob Hinkle, and Sarang Joshi. “Investigating the feasibility of rapid MRI for image-guided motion management in lung cancer radiotherapy”. In: *BioMed research international* 2014 (2014).
- [11] Martin Szegedi, Jacob Hinkle, Prema Rassiah, Vikren Sarkar, Brian Wang, Sarang Joshi, and Bill Salter. “Four-dimensional tissue deformation reconstruction (4D TDR) validation using a real tissue phantom”. In: *Journal of Applied Clinical Medical Physics (JACMP)* 14.1 (Jan. 2013), pp. 115–132. ISSN: 15269914.
- [12] Jacob Hinkle, Martin Szegedi, Brian Wang, Bill Salter, and Sarang Joshi. “4D CT image reconstruction with diffeomorphic motion model”. In: *Medical Image Analysis* 16 (Aug. 2012), pp. 1307–1316.
- [13] Vikren Sarkar, Brian Wang, Jacob Hinkle, Victor J Gonzalez, Ying J Hitchcock, Prema Rassiah-Szegedi, Sarang Joshi, and Bill J Salter. “Dosimetric evaluation of a “virtual” image-guidance alternative to explicit 6 degree of freedom robotic couch correction”. In: *Practical Radiation Oncology* 2.2 (Apr. 2012), pp. 122–137.

CONFERENCE
PUBLICATIONS

- [14] Sarah E Geneser, Jacob Hinkle, Robert M Kirby, Brian Wang, Bill Salter, and Sarang Joshi. “Quantifying variability in radiation dose due to respiratory-induced tumor motion”. In: *Medical Image Analysis* 15 (2011), pp. 640–649.
- [15] Brian Sands, Morgan Welsh, Seda Kin, Ramesh Marhatta, Jacob Hinkle, and S Burçin Bayram. “Raman scattering spectroscopy of liquid nitrogen molecules: An advanced undergraduate physics laboratory experiment”. In: *Amer. J. Phys.* 73 (2007), p. 488.
- [16] S Burçin Bayram, Seda Kin, Morgan J Welsh, and Jacob Hinkle. “Collisional depolarization of Zeeman coherences in the $^{133}\text{Cs}6p^2P_{3/2}$ level: Double-resonance two-photon polarization spectroscopy”. In: *Phys. Rev. A* 73.4 (2006), p. 042713.
- [17] Sudip K. Seal, Seung-Hwan Lim, Dali Wang, Jacob Hinkle, Dalton Lunga, and Aristeidis Tsaris. “Toward Large-Scale Image Segmentation on Summit”. In: *49th International Conference on Parallel Processing - ICPP*. ICPP '20. Edmonton, AB, Canada: Association for Computing Machinery, 2020. ISBN: 9781450388160. DOI: 10.1145/3404397.3404468.
- [18] Devanshu Agrawal, Hong-Jun Yoon, Georgia Tourassi, and Jacob D Hinkle. “Computer-aided detection using non-convolutional neural network Gaussian processes”. In: *SPIE Medical Imaging*. International Society for Optics and Photonics. 2019.
- [19] Mohammed Alawad, Shang Gao, John Qiu, Noah Schaefferkoetter, Jacob D Hinkle, Hong-Jun Yoon, J Blair Christian, Xiao-Cheng Wu, Eric B Durbin, Jong Cheol Jeong, et al. “Deep Transfer Learning Across Cancer Registries for Information Extraction from Pathology Reports”. In: *2019 IEEE EMBS International Conference on Biomedical & Health Informatics (BHI)*. IEEE. 2019, pp. 1–4.
- [20] Abhishek Dubey, Jacob Hinkle, Blair Christian, and Georgia Tourassi. “Extraction of Tumor Site from Cancer Pathology Reports using Deep Filters”. In: *The 10th ACM Conference on Bioinformatics, Computational Biology, and Health Informatics (ACM-BCB)*. 2019.
- [21] Hong-Jun Yoon, John X Qiu, J Blair Christian, Jacob Hinkle, Folami Alamudun, and Georgia Tourassi. “Selective Information Extraction Strategies for Cancer Pathology Reports with Convolutional Neural Networks”. In: *INNS Big Data and Deep Learning conference*. Springer, Cham. 2019, pp. 89–98.
- [22] Guannan Zhang, Jiaxin Zhang, and Jacob D Hinkle. “Learning nonlinear level sets for dimensionality reduction in function approximation”. In: *Neural Information Processing Systems (NeurIPS)*. 2019.
- [23] M Todd Young, Jacob Hinkle, Arvind Ramanathan, and Ramakrishnan Kannan. “HyperSpace: Distributed Bayesian Hyperparameter Optimization”. In: *2018 30th International Symposium on Computer Architecture and High Performance Computing (SBAC-PAD)*. IEEE. 2018, pp. 339–347.
- [24] Bryon Donohoe, Jacob Hinkle, Peter Ciesielski, Michael Crowley, Nathan Mosier, Clint Chapple, and Michael Himmel. “Microfibril orientation, spacing and bundling in secondary cell walls: Implications for catalytic deconstruction”. In: *Abstracts of papers of the American Chemical Society*. Vol. 253. Amer. Chemical Soc. 1155 16th St, NW, Washington, DC 20036 USA. 2017.
- [25] P. Muralidharan, J. Hinkle, and P. T. Fletcher. “A MAP estimation algorithm for Bayesian polynomial regression on Riemannian manifolds”. In: *2017 IEEE International Conference on Image Processing (ICIP)*. Sept. 2017, pp. 215–219. DOI: 10.1109/ICIP.2017.8296274.
- [26] Caleb Rottman, Jacob Hinkle, Arvidas Cheryauka, Ross T Whitaker, and Sarang C Joshi. “Joint 3D image and geometry estimation for mobile interventional C-arms”. In: *CARS*. Vol. 10. 2015.

- [27] Nikhil Singh, Jacob Hinkle, Sarang Joshi, and P Thomas Fletcher. “An efficient parallel algorithm for hierarchical geodesic models in diffeomorphisms”. In: *Biomedical Imaging (ISBI), 2014 IEEE 11th International Symposium on*. IEEE. 2014, pp. 341–344.
- [28] Jacob Hinkle and Sarang Joshi. “IDiff: Irrotational Diffeomorphisms for Computational Anatomy”. In: *Information Processing in Medical Imaging (IPMI)*. Vol. 7917. Springer. Asilomar, California, June 2013, pp. 754–765.
- [29] Nikhil Singh, Jacob Hinkle, Sarang Joshi, and P. Thomas Fletcher. “A Hierarchical Geodesic Model for Diffeomorphic Longitudinal Shape Analysis”. In: *Information Processing in Medical Imaging (IPMI)*. Vol. 7917. Springer. June 2013, pp. 560–571.
- [30] Nikhil Singh, Jacob Hinkle, Sarang Joshi, and P. Thomas Fletcher. “A Vector Momenta Formulation of Diffeomorphisms for Improved Geodesic Regression and Atlas Construction”. In: *International Symposium on Biomedical Imaging (ISBI)*. **Best Paper Award**. Apr. 2013.
- [31] Jacob Hinkle, Prasanna Muralidharan, P Thomas Fletcher, and Sarang C Joshi. “Polynomial Regression on Riemannian Manifolds”. In: *European Conference on Computer Vision (ECCV)*. Florence, Italy, Oct. 2012, pp. 1–14.
- [32] Jacob Hinkle, Ganesh Adluru, Eugene Kholmovski, Edward DiBella, and Sarang Joshi. “4D MAP MRI Image Reconstruction”. In: *International Conference on Computer Vision Theory and Applications (VISAPP)*. Angers, France, May 2010.
- [33] Jacob Hinkle, P Thomas Fletcher, Brian Wang, Bill J Salter, and Sarang Joshi. “4D MAP Image Reconstruction Incorporating Organ Motion”. In: *Information Processing in Medical Imaging (IPMI)*. Vol. 5636. Springer. Williamsburg, Virginia, July 2009, pp. 676–687.

INVITED TALKS

- [34] Jacob Hinkle. *The Statistical Study of Shape Change*. Invited by Data Analysis and Visualization Group, Computational Sciences Center. National Renewable Energy Laboratory (NREL), Golden, CO, Feb. 2014.
- [35] Jacob Hinkle. *Polynomial Regression on Riemannian Manifolds*. Invited by Dr. Darryl Holm, Dept. of Applied Mathematics. Imperial College, London, England, Nov. 2012.

WORKSHOP PRESENTATIONS

- [36] Jacob Hinkle, Tom Fletcher, and Sarang Joshi. *Polynomial Regression on Riemannian Manifolds*. Presented at FRG Shape Meeting hosted by ENS Cachan. Paris, France, May 2012.
- [37] Jacob Hinkle, Tom Fletcher, and Sarang Joshi. *Riemannian Polynomial Regression*. Presented at Workshop on Geometry and Statistics in Bioimaging: Manifolds and Stratified Spaces (GEOSTAT). Sønderborg, Denmark, Oct. 2012. URL: <http://csgb.dk/activities/2012/geostat/>.

CONFERENCE PRESENTATIONS

- [38] Jacob Hinkle, Theodore Papamarkou, and Devanshu Agrawal. *Practical Bayesian Inference for Shallow CNNs in NLP*. 2020.
- [39] Jacob Hinkle and Sarang Joshi. *IDiff: Irrotational Diffeomorphisms for Computational Anatomy*. Asilomar, California: Springer, June 2013.
- [40] Jacob Hinkle, Brian Wang, Bill Salter, P Thomas Fletcher, and Sarang Joshi. *4D MAP Image Reconstruction*. Asilomar Conference on Signals, Systems, and Computers, Pacific Grove, CA. Nov. 2012.

- [41] Jacob Hinkle, Ganesh Adluru, Eugene Kholmovski, Edward DiBella, and Sarang Joshi. *4D MAP MRI Image Reconstruction*. Mountain West Biomedical Engineering Conference, Park City, Utah. Sept. 2010.
- [42] Jacob Hinkle, Ganesh Adluru, Eugene Kholmovski, Edward DiBella, and Sarang Joshi. *4D MAP MRI Image Reconstruction*. Angers, France, May 2010.
- [43] Jacob Hinkle, P Thomas Fletcher, Brian Wang, Bill J Salter, and Sarang Joshi. *4D MAP Image Reconstruction Incorporating Organ Motion*. Williamsburg, Virginia: Springer, July 2009.
- [44] Jacob Hinkle, Sarah Geneser, Brian Wang, Bill Salter, and Sarang Joshi. *Development and Testing of a Novel, 4D Maximum a Posteriori (MAP) Image Reconstruction Algorithm*. Anaheim, California, July 2009.

POSTER
PRESENTATIONS

- [45] Jacob Hinkle, Peter Ciesielski, Kenny Gruchalla, Kristin Munch, and Bryon Donohoe. “Biomass Accessibility Analysis Using Electron Tomography”. BioEnergy Science Center (BESC) Annual Retreat. Chattanooga, TN, June 2015.
- [46] Jacob Hinkle, Peter Ciesielski, Kenny Gruchalla, Kristin Munch, and Bryon Donohoe. “Catalyst Accessibility and Product Escape in 3DEM”. Center for Direct Catalytic Conversion of Biomass to Biofuels (C3Bio) Annual Retreat. Purdue University, West Lafayette, IN, Oct. 2015.
- [47] Jacob Hinkle, Peter Ciesielski, Kenny Gruchalla, Bryon Donohoe, and Kristin Munch. “Large-Scale Segmentation of Cellulose Microfibrils Using Electron Tomography”. BioEnergy Science Center (BESC) Characterization Workshop. University of Georgia, Athens, GA, Dec. 2014.
- [48] Jacob Hinkle, Peter Ciesielski, Kenny Gruchalla, Bryon Donohoe, and Kristin Munch. “Segmentation of Lamellar Sheets of Cellulose Using Electron Tomography”. BioEnergy Science Center (BESC) Annual Retreat. Chattanooga, TN, May 2014.
- [49] Jacob Hinkle, Prasanna Muralidharan, P Thomas Fletcher, and Sarang C Joshi. “Polynomial Regression on Riemannian Manifolds”. European Conference on Computer Vision (ECCV). Florence, Italy, Oct. 2012.
- [50] Jacob Hinkle, Sarah Geneser, Brian Wang, Bill Salter, and Sarang Joshi. “Incorporation of Motion into Stereotactic Body Radiation Therapy Treatment of Liver Cancer”. Mountain West Biomedical Engineering Conference, Park City, Utah. 2009.

TEACHING AND
SERVICE

University of Tennessee, Knoxville, TN

Primary Instructor: DSE 512 – Intro. to Data Science and Computing II
2021–Present

- Prepared course material, delivered lectures, graded assignments and projects.
- Served as primary instructor and defined scope of course.
- Covered topics including HPC, computer architecture, parallel programming, containers, and distributed computing for deep learning.

Primary Instructor: DSE 511 – Intro. to Data Science and Computing I
2020–Present

- Prepared course material, delivered lectures, graded assignments and projects.
- Served as primary instructor and defined scope of course.
- Covered topics including Linux, Git, Python, Anaconda, Reproducibility, Collaboration via code and data.

National Renewable Energy Lab, Golden, CO

Co-Organizer: NREL's Data Science Brown Bag Series
2016–Present

- Monthly seminar on data science, analysis, and visualization

University of Utah, Salt Lake City, UT

Teaching Assistant: Introduction to Probability and Statistics
2009–2011

- Taught 2–3 lectures each semester with 25–30 students
- Graded weekly assignments
- Held regular office hours and study groups
- Assisted preparing and proctoring exams

Organizer: Scientific Computing and Imaging Institute's Imaging Lunch
2009–2011

- Weekly seminar on image analysis, presented by faculty, students, and visitors
- Responsibilities included finding, scheduling, and facilitating presenters

MENTORSHIP

Ph.D. Thesis advisor: Inzamam Haque (expected graduation: 2023)

Ph.D. Thesis advisor: Devanshu Agrawal (graduated October 2020)