J. Derek Tucker

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Education

2011–2014 **Statistics**, *Florida State University*, Tallahassee, FL, *Ph.D.*
Thesis Title: Functional Component Analysis and Regression Using Elastic Methods

2007–2009 **Electrical Engineering**, *Colorado State University*, Fort Collins, CO, *M.S.*
Thesis Title: Coherence-based Underwater Target Detection for Side-Scan Sonar Imagery

2004–2007 **Electrical Engineering**, *Colorado State University*, Fort Collins, CO, *B.S.*
Minor: Mathematics Cum Laude

Ph.D. Thesis

title *Functional Component Analysis and Regression Using Elastic Methods*

supervisors Dr. Anuj Srivastava and Dr. Wei Wu

description Constructing generative models for functional observations is an important task in statistical function analysis. In general, functional data contains both phase (or x or horizontal) and amplitude (or y or vertical) variability. Traditional methods often ignore the phase variability and focus solely on the amplitude variation. Ignoring phase variability leads to a loss of structure in the data, and inefficiency in data models. This dissertation presents three approaches that include phase variability. The first relies on separating the phase (x-axis) and amplitude (y-axis), then modeling these components using joint distributions. The second combines the phase-variability into the objective function for two component analysis methods and the third approach combines the phase-variability into the functional linear regression model.

Experience

2020–Present **Adjunct Professor**, *University of Illinois*, Champaign, IL
Teach topics course in functional data anlysis, serve on graduate committee, and engagement in the Statistics Department

2017–Present **Principal Member of the Technical Staff**, *Sandia National Laboratories*, Albuquerque, NM
Research in pattern theoretic approaches to problems in image analysis, computer vision, signal processing, and functional data analysis
Detailed achievements:
- Lead research projects in functional data analysis and spatio-temporal correlation of points.
- Lead research in advancements in nuclear forensics using functional and shape data analysis.
- Statistics SME for Cybersecurity.
- Team lead on multiple teams in sensor exploitation and long haul communications.

2014–2017 **Senior Member of the Technical Staff**, *Sandia National Laboratories*, Albuquerque, NM
Research in pattern theoretic approaches to problems in image analysis, computer vision, signal processing, and functional data analysis
Detailed achievements:
- PI on Fellow Directed LDRD project in spatio-temporal correlation of points.
- Development of algorithms for the registration of remote sensor imagery which provide uncertainty.
- Development of algorithms for functional statistical process control.
- Development of methods for statistical analysis of doppler signatures;
- Team lead on multiple teams in sensor exploitation and long haul communications.

2009–2014 **Research Engineer**, *Naval Surface Warfare Center*, Panama City, FL
Sonar analysis and automatic target recognition development.
Detailed achievements:
- Development of signal processing algorithms for sonar image based target detection and classification.
- Transition of developed theoretical methods to testing and eventual use in Navy systems.
- Development of methods of alignment and statistical analysis of sonar signals using a new metric.
- Team lead in automatic target recognition algorithm development.

2007–2009 **Research Engineer**, *Information System Technologies, INC*, Fort Collins , CO
Automatic target recognition development.
Detailed achievements:
- Development of signal processing algorithms for the detection of transient signals using sensor networks.
- Developed HMM-based transient detection algorithm for sniper detection and localization.
- Programming and development of on-board application of signal processing algorithms on motes and specialized FPGA sensor board.

2006–2009 **Research Assistant**, *Colorado State University*, Fort Collins , CO

Automatic target recognition development.
Detailed achievements:

- Developed detection and classification algorithms using coherence-based feature extraction method.
- Applied developed algorithms to sonar imagery for the detection of targets in underwater scenarios.
- Benchmarking and validation of satellite cloud detection and classification using MSG-SEVIRI data.

Honors and Awards

- IEEE Senior Member - 2019
- SNL Mission Innovation Award - 2019
- SNL ERA Team Winner, "Venom Spider Bite" - 2017
- DNI Team Award, "IARPA SLiCE" - 2017
- SNL ERA Team Winner, "Mica Data Link" - 2016
- IEEE Journal of Oceanic Engineering Outstanding Reviewer - 2013-2014
- Top First Year Student in Computational Statistics - Fall 2011
- Tau Beta Pi - April 2006
- Eta Kappa Nu - November 2005
- CSU College of Engineering Dean's List - All Semesters Attended
- Eagle Scout Award - December 1998

Advising

- Current Students
- Joel Upston - Ph.D. Mathematics - UNM - Expected Graduation: Summer 2022 - Topic: Sea Ice Model Calibration using Proper Metrics
- Past Students
- Trevor Harris - Ph.D. Statistics - UIUC - Graduation: Summer 2021 - Topic: Data Depth and Functional Data Analysis - Prof at TAMU

Volunteer Opportunities

Instructor Jan 2019 - Present NM 4-H. Shooting Sports Coach and Instructor

Chair Jan 2018 - Present Backcountry Horseman of New Mexico, Albuquerque, NM. Chair of organizing state and chapter activities for volunteer and political action

Board Member Jan 2016 - Present Backcountry Horseman of New Mexico - Pecos Chapter, Edgewood, NM. Help plan/lead volunteer trail maintenance projects in the Santa Fe and Cibola National Forests.

Assistant District Commissioner	April 2017 - April 2019 Boy Scouts of America, Albuquerque, NM. Assist the Great Southwest Council Sandia District in administration of BSA programs across multiple packs and troops.
Chartered Organization Representative	Jan 2016 - April 2017 Boy Scouts of America, Edgewood, NM. Advisor to a Cub Scout Pack 465 and Boy Scout Troop/Team/Crew 465, involves the mentoring of youth and leaders in a successful program.
Venture Scout Crew Advisor	June 2006 - Jan 2016 Boy Scouts of America, Fort Collins, CO & Chipley, FL. Advisor to a high adventure boy scout crew, involves planning of trips, guiding, and mentoring.
Vice President	Fall 2006 - 2007 Tau Beta Pi, Colorado Delta Chapter, Fort Collins, CO. Supervised Initiation Ceremony of New Members.
Advisor	May 2008 - May 2009 Tau Beta Pi, Colorado Delta Chapter, Fort Collins, CO. Provide assistance and guidance to current student officers of chapter.
Missionary	July 2002 - July 2004 Fort Worth Texas, The Church of Jesus Christ of Latter-day Saints

Professional Memberships

- ASA - Sep. 2011 - Present
- IEEE - Sep. 2004 - Present
- Eta Kappa Nu - Nov. 2005 - Present
- Tau Beta Pi - April 2006 - Present

References

Available upon request

Publications

Journals

X. Zhang, S. Kurtek, O. Chkrebtii, and J. D. Tucker. Elastic k-means clustering of functional data for posterior exploration, with an application to inference on acute respiratory infection dynamics. *Computational Statistics and Data Analysis*, submitted 2021.

J. D. Tucker, L. Shand, and K. C. ". Multimodal bayesian registration of noisy functions using hamiltonian monte carlo. *Computational Statistics and Data Analysis*, pages 1–27, 2021.

D. Ries, A. Zhang, J. D. Tucker, K. Shuler, and M. Ausdemore. A framework for inverse prediction using functional response data. *JCISE*, submitted 2021.

L. Patel, L. Shand, J. D. Tucker, , and G. Huerta. Spatio-temporal extreme event modeling of terror insurgencies. *PNAS*, submitted 2021.

C. King, N. Martin, and J. D. Tucker. Bounding uncertainty in functional data: A case study in reliability. *Quality Engineering*, 1(33), 2021.

T. Harris, B. Li, and J. D. Tucker. Scalable multiple changepoint detection for functional data sequences. *Envirometrics*, pages 1–32, 2021.

A. H. Foss, R. B. Lehoucq, W. Z. Stuart, J. D. Tucker, and J. W. Berry. A deterministic hitting-time moment approach to seed-set expansion over a graph. *Journal of Applied Statistics*, submitted 2021.

T. Harris, J. D. Tucker, B. Li, and L. Shand. Elastic depths for detecting shape anomalies in functional data. *Technometrics*, 2020.

T. Harris, B. Li, N. J. Steiger, J. E. Smerdon, N. Narisetty, and J. D. Tucker. Testing the exchangeability of two ensembles of spatial processes - evaluating proxy influence in assimilated paleoclimate reconstructions. *Journal of the American Statistical Association*, 2020.

M. Ahn, J. D. Tucker, W. Wu, and A. Srivastava. Regression models using shapes of functions as predictors. *Computational Statistics and Data Analysis*, pages 1–30, 2020.

J. D. Tucker, L. Shand, and J. R. Lewis. Handling missing data in self-exciting point process model. *Spatial Statistics*, 29:160–176, March 2019.

J. D. Tucker, J. R. Lewis, and A. Srivastava. Elastic functional principal component regression. *Statistical Analysis and Data Mining*, 12(2):101–115, April 2019.

J. D. Tucker, J. R. Lewis, C. King, and S. Kurtek. A geometric approach for computing tolerance bounds for elastic functional data. *Journal of Applied Statistics*, 47(3):481–505, 2019.

Y. Guan, C. Sampson, J. D. Tucker, W. Chang, A. Mondal, M. Haran, and D. Sulsky. Computer model calibration based on image warping metrics: An application for sea ice deformation. *JABES*, 41:444—463, 2019.

J. Ramirez, M. Orini, J. D. Tucker, P. Laguna, and E. Pueyo. Variability of ventricular repolarization dispersion quantified by time-warping the morphology of the t-waves. *IEEE Transactions on Biomedical Engineering*, 64(7):1619–1630, July 2017.

T. G-Michael, B. Marchand, J. D. Tucker, D. D. Sternlicht, T. M. Marston, and M. R. Azimi-Sadjadi. Image-based automated change detection for synthetic aperture sonar. *IEEE Journal of Oceanic Engineering*, 41(3):592–612, July 2016.

D. Bryner, F. Huffer, J. D. Tucker, and A. Srivastava. Underwater mine detection in clutter data using spatial point process models. *IEEE Journal of Oceanic Engineering*, 41(3):670–681, July 2016.

D. Bryner, F. Huffer, M. M. Rosenthal, J. D. Tucker, and A. Srivastava. Linear minelayer trajectory estimation using cluttered point cloud data. *Computational Statistics and Data Analysis*, 102:1–22, October 2016.

J. D. Tucker, W. Wu, and A. Srivastava. Analysis of signals under compositional noise with applications to sonar data. *IEEE Journal of Oceanic Engineering*, 39(2):318–330, 2014.

J. D. Tucker, W. Wu, and A. Srivastava. Analysis of proteomics data: phase amplitude separation using an extended fisher-rao metric. *Electronic Journal of Statistics*, 8(2):1724–1733, 2014.

J. D. Tucker, W. Wu, and A. Srivastava. Generative models for functional data using phase and amplitude separation. *Computational Statistics and Data Analysis*, 61:50–66, 2013.

J. D. Tucker and M. R. Azimi-Sadjadi. Coherence-based underwater target detection from multiple sonar platforms. *IEEE Journal of Oceanic Engineering*, 36(1):37–51, Jan 2011.

Conferences

C. Ting, N. Johson, U. Onunkwo, and J. D. Tucker. Faster classification using compression analytics. *IEEE ICDM Workshop on Data Mining and Machine Learning for Cybersecurity*, October 2021.

S. Reza, N. Martin, T. Bucheit, and J. D. Tucker. Tolerance bound calculation for compact model calibration using functional data analysis. *Proc of 4th IEEE Electron Devices Technology and Manufacturing (EDTM) Conference*, 2020.

L. Patel, L. Shand, J. D. Tucker, and G. Huerta. Assessing extreme value analysis to predict rare events from the global terrorism database. *Proc JSM*, August 2020.

N. Martin and J. D. Tucker. Estimation of physical tolerance bounds for functional data. *Proc of SIAM Conference on Uncertainty Quantification*, 2020.

T. Harris, B. Li, N. Steiger, J. Smerdon, and J. D. Tucker. Evaluating proxy influence in data assimilation based climate field reconstructions. *Proc JSM*, August 2018.

T. Harris, B. Li, N. Steiger, J. Smerdon, and J. D. Tucker. Evaluating proxy influence in data assimilation. *Proc Climate Informatics Workshop*, Sept. 2018.

M. K. Ahn, J. D. Tucker, W. Wu, and A. Srivastava. Elastic handling of predictor phase in functional regression models. *International Workshop on DIFF-CVML:*

Differential Geometry in Computer Vision and Machine Learning, IEEE Conference on Computer Vision and Pattern Recognition (CVPR) Workshop, June 2018.

J. D. Tucker. Functional statistical process control using elastic methods. *Proc JSM*, August 2016.

J. Ramirez, M. Orini, J. D. Tucker, E. Pueyo, and P. Lagunaby. An index for t-wave poinwtwise amplitude variability quantification. *Proc CinC*, September 2016.

T. G-Michael, J. D. Tucker, and R. R. Roberts. Statistically normalized coherent change detection for synthetic aperture sonar imagery. *Proc SPIE*, April 2016.

T. G-Michael, B. Marchand, J. D. Tucker, D. D. Sternlicht, and T. M. Marston. Automated change detection for synthetic aperture sonar. *Proc SPIE*, 9072:O1–Q10, April 2014.

J. D. Tucker, W. Wu, and A. Srivastava. Analysis of signals under compositional noise with application to sonar data. *Proc. of MTS/IEEE Oceans 2012 Conference*, pages 1–6, October 2012.

J. D. Tucker and A. Srivastava. Statistical analysis and classification of acoustic color functions. *Proc SPIE*, 8017:O1–Q10, April 2011.

J. D. Tucker and N. Klausner. Compressive sensing for Gauss-Gauss detection. *IEEE SMC 2011 Conference*, pages 3335–3340, October 2011.

J. D. Tucker, J. T. Cobb, and M. R. Azimi-Sadjadi. Signal diffusion features for automatic target recognition in synthetic aperture sonar. *IEEE DSP/SPE 2011 Workshop*, pages 461–465, Jan 2011.

J. C. Isaacs and J. D. Tucker. Generalized likelihood ratio test for finite mixture model of K-distributed random variables. *IEEE DSP/SPE 2011 Workshop*, pages 443–448, Jan 2011.

J. C. Isaacs and J. D. Tucker. Diffusion features for target specific recognition with synthetic aperture sonar raw signals and acoustic color. *Computer Vision and Pattern Recognition Workshops (CVPRW), 2011 IEEE Computer Society Conference on*, pages 27–32, June 2011.

J. D. Tucker and M. R. Azimi-Sadjadi. Neyman Pearson detection of K-distributed random variables. *Proc SPIE*, 7664:Q1–Q12, April 2010.

N. Klausner, M. R. Azimi-Sadjadi, and J. D. Tucker. Multi-sonar target detection using multi-channel coherence analysis.
Proc. of MTS/IEEE Oceans 2010 Conference, pages 1–7, Sept. 2010.

M. Kabatek, M. R. Azimi-Sadjadi, and J. D. Tucker. An underwater target detection system for electro-optical imagery data. *Proc. of MTS/IEEE Oceans 2010 Conference*, pages 1–8, Sept. 2010.

T. G-Michael and J. D. Tucker. Canonical correlation analysis for coherent change detection in synthetic aperture sonar imagery. *IEEE SAR/SAS 2010 Conference*, 32(4):117–122, Sept. 2010.

N. Klausner, J. D. Tucker, and M. R. Azimi-Sadjadi. Multi-platform target detection using multi-channel coherence analysis and robustness to the effects of disparity. *Proc. of MTS/IEEE Oceans 2009 Conference*, pages 1–7, October 2009.

N. Klausner, M. R. Azimi-Sadjadi, and J. D. Tucker. Underwater target detection from multi-platform sonar imagery using multi-channel coherence analysis. *IEEE SMC 2009 Conference*, pages 2728–2733, 2009.

J. D. Tucker, N. Klausner, and M. R. Azimi-Sadjadi. Target detection in m-disparate sonar platforms using multichannel hypothesis testing. *Proc. of MTS/IEEE Oceans 2008 Conference*, pages 1–7, Sep. 2008.

M. R. Azimi-Sadjadi and J. D. Tucker. Target detection from dual disparate sonar platforms using canonical correlations. *Proc. SPIE*, 6953:J1 – J10, March 2008.

J. D. Tucker, M. R. Azimi-Sadjadi, and G. J. Dobeck. Coherent-based method for detection of underwater objects from sonar imagery. *Proc. SPIE*, 6553:U1–U8, April 2007.

J. D. Tucker, M. R. Azimi-Sadjadi, and G. J. Dobeck. Canonical coordinates for detection and classification of underwater objects from sonar imagery. *Proc. of IEEE OCEANS 2007 Conference Europe*, pages 1–6, June 2007.

Magazines

J. D. Tucker and M. R. Azimi-Sadjadi. Coherence-based underwater target detection and classification for side-scan sonar imagery. *Sea Technology Magazine*, 12:10–14, December 2008.

Invited Talks

- "Elastic Functional Tolerance Bounds", LANL Statistical Colloquium, December 16, 2020 (Organizer: Emily Castleton)
- "Using FDA for Nueral Network Explanibility", FSU Industry Engagement Symposium, October 2, 2020 (Organizer: Elizabeth Slate)
- "Elastic Functional Data Analysis", BYU Statistical Colloquium, December 4, 2019 (Organizer: William Christensen)
- "Sandia Applications of Functional Data Analysis", UIUC Statistical Colloquium, November 22, 2019 (Organizer: Trevor Harris)

- "Elastic Depth Analysis", FSU Statsistical Collquium, April 8, 2019 (Organizer: Xufeng Nu)
- "Elastic Functional Data Analysis", ANU Statistical Colloquium, July 19, 2018 (Organizer: Janice Scealy)
- "Elastic Functional Data Analysis", UNM Statistical Colloquium, February 15, 2018 (Organizer: Li Li)
- "Event Correlation using Spatio-Temporal Point Processes", SNL DSRC Colloquium, September 29, 2016 (Organizer: K. Simonson)
- "Doppler Multi-INT Detection and Tracking", NSWC-PCD Invited Lecture, October 1, 2015 (Organizer: J. T. Cobb)
- "Statistical Analysis and Modeling of Elastic Functions", Department of Mathematical and Statistical Sciences, University of Alberta, Aug 23, 2011. (Organizer: Yau Shu Wong)
- "Alignment and Analysis of Proteomics Data using Square Root Slope Function Framework", CTW: Statistics of Time Warpings and Phase Variations 2012, OSU MBI, Nov 7, 2012

Patents

- "Automated Change Detection Technique for Synthetic Aperture Sonar" US Patent No. US10049295B2

Contracts and Grants

- 10/18-7/21 - Statistical Enhancement of Nuclear Forensics - $600K (PI), NTNFC
- 10/18-9/20 - Data Enrichment for Improved Intelligence Value and Situational Awareness - $1,059K (PI), SNL LDRD
- 10/18-9/19 - Statistical Uncertainty Quantification for Multivariate Physical Parameter Estimation with Multivariate Outputs - $500K (CO-PI), SNL LDRD
- 04/16-9/18 - Event Correlation using Spatio-Temporal Point Processes - $755K (PI), SNL Fellow Directed LDRD
- 10/16-9/18 - Doppler Assited Sensor Fusion - $875K, (Co-PI with R. M. Naething), OGA
- 09/08-09/11 - Coherence-based Target Detection for Multi-Platform Sonar Imagery - $200K (Co-PI with M. R. Azimi), Office of Naval Research Code 32
- 09/10-09/12 - In-Situ Learning For CAD/CAC Sonar Imagery - $200K (Co-PI with M. R. Azimi and N. Wachowski), Office of Naval Research Code 32

Computer skills

Programming Languages	Julia, Python, R, MATLAB, Mathcad, C, C++, Mathematica, Java, HTML, Labview
Assembly Languages	68HC12

Operating Systems	Linux, Mac OS, Windows
Software	Autocad, P-Spice, Logic Works, Adobe Suite, Microsoft Office, Agilent VEE, Macromedia Suite, P-CAD, Inventor
Certifications	Security+, Linux+

Brief Biography

J. Derek Tucker received his B.S. in Electrical Engineering Cum Laude and M.S. in Electrical Engineering from Colorado State University in 2007 and 2009, respectively. Upon completion of these degrees, he began working as a Research Scientist at the Naval Surface Warfare Center Panama City Division in Panama City, FL. In 2014 he received the Ph.D. degree in Statistics from Florida State University In Tallahassee, FL under the co-advisement of Dr. Anuj Srivastava and Dr. Wei Wu. While at NSWC-PCD he led various development efforts in automatic target recognition algorithms for synthetic aperture sonar imagery. In the summer of 2014 he joined Sandia National Laboratories and is currently in the Statistical Sciences department. He currently is leading research projects in the area of satellite image registration and point processes modeling for monitoring applications. His research is focused on pattern theoretic approaches to problems in image analysis, computer vision, signal processing, and functional data analysis. In 2017, he received the Director of National Intelligence Team Award for his contributions to the Signal Location in Complex Environments (SLiCE) team.