

# 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

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## 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.

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## Experience

- 2020– Present **Adjunct Professor**, *University of Illinois*, Champaign, IL.  
Teach topics course in functional data analysis, serve of graduate committee, and engagement in the Statistics Department
- 2014– 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:
  - 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.

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## 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

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## Students

- Joel Upston - Ph.D. - UNM
- Trevor Harris - Ph.D. - UIUC

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## 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

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## Professional Memberships

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

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## References

*Available upon request*

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## Publications

### Journals

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

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

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.

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.

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.

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.

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. 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. 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

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. Canonical coordinates for detection and classification of underwater objects from sonar imagery. *Proc. of IEEE OCEANS 2007 Conference Europe*, pages 1–6, June 2007.

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.

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

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) Conferenc*, 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.

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.

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

- J. Ramirez, M. Orini, J. D. Tucker, E. Pueyo, and P. Lagunaby. An index for t-wave pointwise amplitude variability quantification. *Proc CinC*, September 2016.
- J. D. Tucker. Functional statistical process control using elastic methods. *Proc JSM*, August 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 N. Klausner. Compressive sensing for Gauss-Gauss detection. *IEEE SMC 2011 Conference*, pages 3335–3340, October 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 A. Srivastava. Statistical analysis and classification of acoustic color functions. *Proc SPIE*, 8017:O1–Q10, April 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. 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. D. Tucker and M. R. Azimi-Sadjadi. Neyman Pearson detection of K-distributed random variables. *Proc SPIE*, 7664:Q1–Q12, April 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.
- 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.

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.

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.

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.

J. D. Tucker, N. Klausner, and M. R. Azimi-Sadjadi. Target detection in disparate sonar platforms using multichannel hypothesis testing.

*Proc. of MTS/IEEE Oceans 2008 Conference*, pages 1–7, Sep. 2008.

#### 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.

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#### Invited Talks

- “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 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

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#### Contracts and Grants

- 10/18-9/20 - 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
- 04/16-9/18 - Event Correlation using Spatio-Temporal Point Processes - \$755,000 (PI), SNL Fellow Directed LDRD
- 10/16-9/18 - Doppler Assited Sensor Fusion - \$875,000, (Co-PI with R. M. Naething), OGA
- 09/08-09/11 - Coherence-based Target Detection for Multi-Platform Sonar Imagery - \$200,000 (Co-PI with M. R. Azimi), Office of Naval Research Code 32
- 09/10-09/12 - In-Situ Learning For CAD/CAC Sonar Imagery - \$200,000 (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+