

JOHN BREVARD SIGMAN

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EDUCATION

Duke University

Postdoctoral Work and Lecturing, Pratt School of Engineering

2017-2019

Durham, NC

Dartmouth College

Ph.D., Electrical Engineering, Thayer School of Engineering

August 2017

Hanover, NH

University of Virginia

B.S., Electrical Engineering

May 2010

Charlottesville, VA

Thomas Jefferson High School for Science and Technology

High School Diploma

June 2006

Alexandria, VA

RECENT WORK EXPERIENCE

Infinia ML

Principal Data Scientist

Senior Data Scientist

Data Scientist

April 2019-Present

Durham, NC

- Leading internal Healthcare technology team (6 other technical members). [Link to Announcement](#)
 - Developing technology for heavily integrated and production-ready use with OpenAI's Large Language Models, such as GPT-3.
- Led Internal Legal technology team (6 other technical members). [Link to Announcement](#)
- Led client projects worth multiple \$M in revenue.
- Led engagement with RX reconciliation business, built entities and cost extraction model for automated remittance processing.
- Led engagement with Fortune 500 Subsidiary. Led scientific development of a time-series forecasting solution for energy storage problems. Resulted in 35% year-over-year cost reduction for the client.
- Co-Led project for predicting multiple insurance coverage from claims data.
- Led development of a deep convolutional approach for particle detection and sample characterization for a Biopharmaceutical client.
- Led internal research project building Named Entity Recognition (NER) models using document-based Transformer feature extractors.
- Integral part of the team which built the first 3D convolutional threat detection algorithm for the Transportation Security Administration.
- Co-led development and deployment of NLP entity matching model for NSF grant.
- Built customer contact recommendation system from transaction and sales communication history for a Tier One Global Investment Bank.

RESEARCH

Duke University

Postdoctoral Associate

September 2017-July 2019

Durham, NC

Research Areas

Deep Learning, Machine Learning, Computer Vision,
Object Detection, Domain Adaptation, Semi-Supervised Learning

Object Detection for Threats in Baggage

2017-2018

- Working in the Lawrence Carin research group of the Duke Electrical and Computer Engineering department, adapting state-of-the-art deep models for object detection to labeled X-ray data.
- Led a team of Duke researchers in collaboration with multidisciplinary researchers and scientists in development of real-world application of cutting-edge custom machine learning techniques.
- Successfully led this project to completion and interfaced with Government sponsors and industry collaborators.
- [Link to Announcement.](#)
- Focus: improving object detection by semi-supervised learning using techniques such as autoencoding and adversarial domain adaptation.

Dartmouth College

Graduate Research Assistant

September 2012-August 2017

Hanover, NH

Research Areas

Computational Electromagnetics, Numerical Methods,
Electromagnetic Sensing, Inverse Problems in Electromagnetics

High Frequency Electromagnetic Induction Sensing

2013-present

- Built new advanced electromagnetic induction sensor to work at high induction frequencies (100 kHz-15 MHz) for detection of carbon fiber and other intermediate-conductivity materials.
- This approach was the first ever to use electromagnetic induction for detection of exotic materials, and required electromagnetic theory, modeling of Maxwell's equations via numerical techniques, and comparison of theory and experiment.

Unexploded Ordnance ROC Analysis

2015-2016

- Bayesian inference for estimating unexploded ordnance remaining at a site from history of false positives.
- Monte Carlo methods and nonlinear optimization.

Drone-Operated Ground Resistivity Meter

2016

- Built a proof-of-concept instrument for an Unmanned Aerial Vehicle (UAV) to probe ground resistivity for permafrost detection.
- Conducted exploratory experiments, wrote signal processing code, compared data to analytical solutions.

Automatic Classification of Unexploded Ordnance

2012-2014

- Designed and programmed semi-supervised learning algorithm using live-site electromagnetic data.
- Naive Bayes, Gaussian Mixture Model, Weighted Pair Group Method with Averaging.

University of Virginia

Undergraduate Research Thesis

2009-2010

Charlottesville, VA

- Ultraviolet free-space optical communication modeling and hardware.

PREVIOUS WORK EXPERIENCE

US Army Corps of Engineers - Cold Regions Research and Engineering Laboratory

ORISE Fellow - Signature Physics Branch

Summer 2016

Hanover, NH

- Performed computational electromagnetics research for five-month internship during doctoral studies.
- Used the Finite-Difference Time Domain (FDTD) method to characterize complex resonances for tunnel structures in weakly-conducting and dielectric soils.

Fannie Mae

Software Contractor

April 2012-2015

Washington, DC

- Worked summer 2012 full time, after September 2012 in a limited advisory capacity (10 hrs/week).
- Developed all frontend code of four different enterprise iPad/iPhone applications for Fannie Mae Financial Engineering research group.

- Applications are still used by field inspectors to read and collect data on foreclosed homes.

Alarm.com

Associate Engineering Program Manager

June 2010-April 2012

Washington, DC

- Device Engineering, Hardware Engineering, and Firmware Development.
- Reported directly to CTO and Founder.
- Primarily worked on a battery-powered PIR motion detector and camera, the Alarm.com *Image Sensor*.
- Wrote all firmware related to camera sensor, JPEG encoder, and accelerometer.
- Envisioned and developed embedded image processing engine using raw JPEG DCT data.
- Designed circuits for ambient light sensor, combined with firmware for faster camera acquisition time.
- Tested and analyzed different image sensor hardware for cost, speed, and quality.
- Wrote firmware for UART test and initialization of devices, wrote sections of the corresponding test and database application for the manufacturer in VB6.
- Developed software feedback system to guarantee quality of lens focus before shipment by human manufacturers.
- Ran internal alpha testing of device, later ran alpha testing and optimization of image processing engine.
- Responsible for PIR performance related to successfully obtaining UL 639 compliance.

Lockheed Martin

Hardware Engineering Intern

Summers 2008 & 2009

Syracuse, NY

- Engineer at Lockheed Martin MS2 for two summers.

TEACHING

Duke +DataScience Initiative

2018-2019

- Working on a team of Machine Learning/Artificial Intelligence experts at Duke to bring Data Science to students and researchers across all backgrounds.
- Website: <https://plus.datascience.duke.edu/>.
- Lectures on:
 - *Tensorflow for Deep Learning Analysis of Images.*
 - *Deep Learning for Object Recognition in Images.*

Duke Machine Learning Winter School

Featured Lecturer

Winter 2019
Durham, NC

- - *Tensorflow for Deep Learning Analysis of Images.*
- Announcement: <https://strategicplan.duke.edu/initiatives/machine-learning-winter-school/>.

Duke Machine Learning Summer School

Featured Lecturer

Summer 2019
Durham, NC

- - *Tensorflow for Deep Learning Analysis of Images.*

Duke/Duke-NUS Plus Data Science Workshop 2019

Featured Lecturer

July 2019
Singapore

- Lectured:
 - *Introduction to Tensorflow.*
 - *Tensorflow for Deep Learning Analysis of Images.*
 - *Introduction to Convolutional Object Detection.*

TA, ENGS 31, Introduction Digital Logic (2014)

TA and Guest Lecturer, ENGS 110, Signal Processing (2015)

TA, ENGS 64, Engineering Electromagnetics (2016)

TECHNICAL STRENGTHS

Computer Languages	Python, MATLAB, C, C++, Objective-C, Fortran, Visual Basic, VHDL, MIPS assembly, Scheme, emacs lisp, bash scripting
Protocols & APIs	Pytorch, Tensorflow, iOS, OpenMPI, L ^A T _E X, Docker
Software	git, AWS EC2, Github, Eagle Layout, Mentor Graphics PADS, XCode, Cadence, MIT meep
Areas of Interest	Deep Learning, Computer Vision, Natural Language Processing, Mobile Computing, Embedded Computing, Signal Processing, Electromagnetic Sensing, Computational Electromagnetics
Open Source	https://github.com/jsigman
Portfolio Website and Blog	https://www.johnsigman.com

BOARD EXPERIENCE AND VOLUNTEERING

Scientific Advisory Board Member, Moosh Systems

- <https://mooshsystems.com/>

AWARDS AND HONORS

ORISE Fellowship

Thayer Fellowship

Member, SPIE – Session Chair, Electromagnetic Induction (2013 & 2014)

Member, SAGEEP

Phi Eta Sigma Honor Society at University of Virginia

The Fraternity of Phi Gamma Delta, Pledge Class President

Habitat for Humanity, 2004-2010. High School Chapter Treasurer 2005-2006

Journal Reviewer:

- IEEE Winter Conference on Applications of Computer Vision (WACV)
- IEEE Transactions on Industrial Electronics
- IEEE Transactions on Industrial Informatics
- Knowledge-Based Systems

Standardized Test Scores:

- SAT (2005): Math - 800/800, Verbal - 650/800, Writing - 680/800
- SAT II (2005): Math 2C - 800/800, Chemistry - 800/800
- GRE (2011): Math - 170/170, Verbal - 161/170

Publications

- [1] John B Sigman, Gregory P Spell, Kevin J Liang, and Lawrence Carin. “Background Adaptive Faster R-CNN for Semi-Supervised Convolutional Object Detection of Threats in X-Ray Images”. In: *Proc.SPIE*. 2020.
- [2] Kevin J Liang, John B Sigman, Gregory P Spell, Dan Strellis, William Chang, Felix Liu, Tejas Mehta, and Lawrence Carin. “Toward Automatic Threat Recognition for Airport X-ray Baggage Screening with Deep Convolutional Object Detection”. In: *Advances in X-ray Analysis, Volume 64, proceedings of the 2020 Denver X-ray Conference* (2019).
- [3] Kevin J Liang, Geert Heilmann, Christopher Gregory, Souleymane O Diallo, David Carlson, Gregory P Spell, John B Sigman, Kris Roe, and Lawrence Carin. “Automatic threat recognition of prohibited items at aviation checkpoint with x-ray imaging: a deep learning approach”. In: *Proc.SPIE – Invited Paper*. Vol. 10632. 2018, pp. 10632 –10632 –II. DOI: [10.1117/12.2309484](https://doi.org/10.1117/12.2309484). URL: <https://doi.org/10.1117/12.2309484>.
- [4] Fridon Shubitidze, Benjamin E Barrowes, Irma Shamatava, John Sigman, and Kevin A O’Neill. “Accounting for the influence of salt water in the physics required for processing underwater UXO EMI signals”. In: *Proc.SPIE*. Vol. 10628. 2018, pp. 10628 –10628 –IO. DOI: [10.1117/12.2305161](https://doi.org/10.1117/12.2305161). URL: <https://doi.org/10.1117/12.2305161>.
- [5] John Brevard Sigman, Benjamin Barrowes, Kevin O’Neill, Janet Simms, Jay Bennett, Don Yule, and Fridon Shubitidze. “High-frequency electromagnetic induction sensing of non-metallic materials”. In: *IEEE Transactions on Geoscience and Remote Sensing* (2017).
- [6] Janet E Simms, John B Sigman, Benjamin E Barrowes, Hollis H Bennett Jr, Donald E Yule, Kevin O’Neill, and Fridon Shubitidze. “Initial Development of a High-frequency EMI Sensor for Detection of Subsurface Intermediate Electrically Conductive (IEC) Targets”. In: *Journal of Environmental and Engineering Geophysics* 22.2 (2017), pp. 111–120.
- [7] John B. Sigman, Benjamin E. Barrowes, Kevin O’Neill, Yinlin Wang, Hollis J. Bennett, Janet E. Simms, and Fridon Yule Donald E.and Shubitidze. “A hybrid coil system for high frequency electromagnetic induction sensing”. In: *Proc. SPIE*. 2017.
- [8] Benjamin E. Barrowes, Fridon Shubitidze, John B. Sigman, Jay Bennet, Janet E. Simms, Don Yule, and Kevin O’Neill. “Void and landmine detection using the HFEMI sensor”. In: *Proc. SPIE*. 2017.
- [9] Fridon Shubitidze, Benjamin E. Barrowes, John B. Sigman, and Kevin O’Neill. “Ultra-wideband EMI sensing for subsurface DU detection”. In: *Proc. SPIE*. 2017.
- [10] B. E. Barrowes, J. B. Sigman, K. O’Neill, J. E. Simms, H. J. Bennett, D. E. Yule, and F. Shubitidze. “Detection of Conductivity Voids and Landmines using High Frequency Electromagnetic Induction”. In: *Direct and Inverse Problems of Electromagnetic and Acoustic Wave Theory (DIPED), 2016 XXIst International Seminar/Workshop on*. 2016.
- [11] F. Shubitidze, B. E. Barrowes, J. B. Sigman, K. O’Neill, and I. Shamatava. “UXO Classification Procedures Applied to Advanced EMI Sensors and Models”. In: *Direct and Inverse Problems of Electromagnetic and Acoustic Wave Theory (DIPED), 2016 XXIst International Seminar/Workshop on*. 2016.
- [12] Benjamin E. Barrowes, John B. Sigman, YinLin Wang, Kevin A. O’Neill, Fridon Shubitidze, Janet Simms, Hollis J. Bennett, and Donald E. Yule. “Carbon fiber and void detection using high-frequency electromagnetic induction techniques”. In: *Proc. SPIE*. Vol. 9823. 2016, pp. 98230D–98230D–10. DOI: [10.1117/12.2224584](https://doi.org/10.1117/12.2224584). URL: <http://dx.doi.org/10.1117/12.2224584>.
- [13] Irma Shamatava, Benjamin Barrowes, John Sigman, and Fridon Shubitidze. “West Mesa Metal Mapper Data Inversion and Classification”. In: *Direct and Inverse Problems of Electromagnetic and Acoustic Wave Theory (DIPED), 2014 XIXth International Seminar/Workshop on*. 2014.
- [14] F. Shubitidze, B. E. Barrowes, J. B. Sigman, Yinlin Wang, Irma Shamatava, and K. O’Neill. “Detecting and classifying small and deep targets using improved EMI hardware and data processing approach”. In: *Proc. SPIE*. Vol. 9072. 2014, pp. 90720I–90720I–8. DOI: [10.1117/12.2050893](https://doi.org/10.1117/12.2050893). URL: <http://dx.doi.org/10.1117/12.2050893>.
- [15] F. Shubitidze, B. E. Barrowes, Yinlin Wang, Irma Shamatava, J. B. Sigman, K. O’Neil, and Daniel A. Steinhurst. “A high power EMI sensor for detecting and classifying small and deep targets”. In: *Proc. SPIE*. Vol. 9823. 2016, pp. 982308–982308–II. DOI: [10.1117/12.2224407](https://doi.org/10.1117/12.2224407). URL: <http://dx.doi.org/10.1117/12.2224407>.
- [16] F. Shubitidze, B. E. Barrowes, Yinlin Wang, Irma Shamatava, J. B. Sigman, and K. O’Neill. “Advanced EMI models for survey data processing: targets detection and classification”. In: *Proc. SPIE*. Vol. 9823. 2016, 98230O–98230O–12. DOI: [10.1117/12.2224420](https://doi.org/10.1117/12.2224420). URL: <http://dx.doi.org/10.1117/12.2224420>.

- [17] F. Shubitidze, J. Sigman, K. O’Neill, I. Shamatava, and B. Barrowes. “High frequency electromagnetic induction sensing for non-metallic ordnances detection”. In: *Direct and Inverse Problems of Electromagnetic and Acoustic Wave Theory (DIPED), 2014 XIXth International Seminar/Workshop on*. 2014, pp. 180–182. DOI: [10.1109/DIPED.2014.6958363](https://doi.org/10.1109/DIPED.2014.6958363).
- [18] F. Shubitidze, J. B. Sigman, Yinlin Wang, J. Miller, J. Keranen, I. Shamatava, B. E. Barrowes, and K. O’Neill. “Advanced EMI models for survey data processing: targets detection and classification”. In: *Proc. SPIE*. Vol. 9072. 2014, 90720J–90720J–9. DOI: [10.1117/12.2050897](https://doi.org/10.1117/12.2050897). URL: <http://dx.doi.org/10.1117/12.2050897>.
- [19] John B. Sigman, Benjamin E. Barrowes, Kevin O’Neill, and Fridon Shubitidze. “Automatic classification of unexploded ordnance applied to Spencer Range live site for 5x5 TEMTADS sensor”. In: *Proc. SPIE*. Vol. 8709. 2013, pp. 870904–870904–8. DOI: [10.1117/12.2016118](https://doi.org/10.1117/12.2016118). URL: <http://dx.doi.org/10.1117/12.2016118>.
- [20] John B. Sigman, Benjamin E. Barrowes, Yinlin Wang, Hollis J. Bennett, Janet E. Simms, Donald E. Yule, Kevin O’Neill, and Fridon Shubitidze. “Coil design considerations for a high-frequency electromagnetic induction sensing instrument”. In: *Proc. SPIE*. Vol. 9823. 2016, pp. 982302–982302–6. DOI: [10.1117/12.2223988](https://doi.org/10.1117/12.2223988). URL: <http://dx.doi.org/10.1117/12.2223988>.
- [21] John Brevard Sigman, Kevin O’Neill, Benjamin Barrowes, Yinlin Wang, and Fridon Shubitidze. “Automatic classification of unexploded ordnance applied to live sites for MetalMapper sensor”. In: *Proc. SPIE*. Vol. 9072. 2014, 90720F–90720F–7. DOI: [10.1117/12.2050784](https://doi.org/10.1117/12.2050784). URL: <http://dx.doi.org/10.1117/12.2050784>.
- [22] John B. Sigman, Yinlin Wang, Kevin O’Neill, Benjamin E. Barrowes, and Fridon Shubitidze. “An expert-free technique for live site uxo target classification”. In: ISSN 1554-8015. Symposium on the Application of Geophysics to Engineering and Environmental Problems (SAGEEP). Environmental and Engineering Geophysical Society, 2014.
- [23] Y. Wang, J.B. Sigman, B.E. Barrowes, K.A. O’Neill, and F. Shubitidze. “A Combined Joint Diagonalization-Music Algorithm For Estimating Locations Of Subsurface Targets”. In: Symposium on the Application of Geophysics to Engineering and Environmental Problems (SAGEEP). Environmental and Engineering Geophysical Society, 2014.
- [24] Yinlin Wang, John B. Sigman, Benjamin E. Barrowes, Kevin O’Neill, and Fridon Shubitidze. “A combined joint diagonalization-MUSIC algorithm for subsurface targets localization”. In: *Proc. SPIE*. Vol. 9072. 2014, 90720G–90720G–10. DOI: [10.1117/12.2050787](https://doi.org/10.1117/12.2050787). URL: <http://dx.doi.org/10.1117/12.2050787>.

Patents

- [1] N.P. Den Herder, J.B. Sigman, N. Lande, and E. Rosenblatt. *Photograph initiated appraisal process and application*. US Patent App. 13/614,705. 2014. URL: <https://www.google.com/patents/US20140074733>.
- [2] N.P. Den Herder, J.B. Sigman, N. Lande, and E. Rosenblatt. *Location driven appraisal data extraction, past appraisal and value comparison and comparable property finder*. US Patent App. 13/614,686. 2014. URL: <https://www.google.com/patents/US20140074732>.

Government Reports

- [1] John Sigman, Benjamin Barrowes, Fridon Shubitidze, Kevin O’Neill, and Sergey Vecherin. *Resonant Tunnel Detection*. Tech. rep. Hanover, NH: US Army Corps of Engineers, Engineer Research and Development Center, 2016.
- [2] Fridon Shubitidze, John Sigman, Yinlin Wang, Irma Shamatava, Juan Pablo Fernandez, Alex Bijamov, and D Karkashadze. *Resolving and Discriminating Overlapping Anomalies from Multiple Objects in Cluttered Environments*. Tech. rep. Dartmouth College Hanover United States, 2015.