

# JOHN BREVARD SIGMAN

Raleigh/Durham, NC

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## EDUCATION

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### **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

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### **Infinia ML**

April 2019-Present

*Principal Data Scientist*

*Senior Data Scientist*

*Data Scientist*

*Durham, NC*

- Leading Appeal Letter Generation team, a production LLM application.
- Led Medical Record Extraction team who developed Retrieval-Augmented Generation (RAG) product for Question Answering over medical documents by clinical validators.
- Led 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](#)
- During consulting phase of Infinia's business, led client projects worth multiple \$M in revenue, some of which are highlighted below.
- 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

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**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

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**US Army Corps of Engineers - Cold Regions Research and Engineering Laboratory** Summer 2016  
*ORISE Fellow - Signature Physics Branch* *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 &amp; 2009

*Syracuse, NY*

- Engineer at Lockheed Martin MS2 for two summers.

**TEACHING**

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**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

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

## BOARD EXPERIENCE AND VOLUNTEERING

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Scientific Advisory Board Member, Moosh Systems	2019-Present
<ul style="list-style-type: none"> <li>• <a href="https://mooshsystems.com/">https://mooshsystems.com/</a></li> </ul>	
Scientific Advisor, The Data Bull	2023-2024
<ul style="list-style-type: none"> <li>• <a href="https://thedatabull.com/">https://thedatabull.com/</a></li> </ul>	

## AWARDS AND HONORS

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Oak Ridge Institute for Science and Education (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
- Jordanian Journal of Computers and Information Technology

- 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–IO. 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.