Aubrey N. Beal, Ph.D.

Assistant Professor, Electrical Engineering

301 Sparkman Dr.
Huntsville, AL 35899
256.824.6307
aubrey.beal@uah.edu
fugo-ten.vercel.app/

EDUCATION

Aug 1, 2015	**Ph.D. Electrical Engineering** Auburn University *GPA: 4.0*
Aug 4, 2012	**M.S. Electrical Engineering** Auburn University *GPA: 4.0*
Dec 13, 2010	**B.E.E.** Auburn University *GPA: 3.78 Magna Cum Laude*

WORK EXPERIENCE - 12 YEARS

Assistant Professor Aug. 2019 – Present
Department of Electrical & Computer Engineering
The University of Alabama in Huntsville

- P.I. Nonlinear & Complex Systems Lab
- Teaching, Research & Service
- Senior Design Mentor
- Honor's Capstone Mentor
- HKN Faculty Advisor

Electronics Engineer May 2017- Aug. 2019
Charles M. Bowden Laboratory
U.S. Army Research, Dev. & Eng. Command

- Co - P.I. Nonlinear & Information Dynamics Group
- Author/COR for STTR/SBIR Topics
- Reviewed $>$ 100 proposals for STTR, SBIR, RIF
- External Funding: $280,000 (NASA/AMRDEC)

Postdoctoral Researcher Aug. 2015-May 2017
Oak Ridge Institute for Science and Education
U.S. Department of Energy

Analog Design, IO & Packaging Summer 2015
High Performance Computing
IBM Research

Research Assistant Fall 2009 - Spring 2015
Department of Electrical & Computer Engineering
Auburn University

Transmission Planning Summer 2009
Southern Company

Research statement: I build electronic circuits to study how systems facilitate the emergence of structure, complexity, and computation in their dynamics. I am particularly interested in new dynamical behaviors that catalyze engineering breakthroughs. This research space leads to mystery and conundrum with deep connections to information theory, communication, security and artificial intelligence.

Teaching statement: I love to learn, especially with students. I engage students through a spirit of collaboration and playful interpretation. My example-driven pedagogy builds from practical observations that progress towards complex challenges that motivate theoretical rigor. I hope to empower students with novel problem solving that transcends conventional boundaries.

RESEARCH INTERESTS

Nonlinear Systems	Chaos, Reservoir Computing, Dynamics, Control
Electronics	Nonlinear Circuits, IC Design, Microelectronics, TRNGs, PUFs, Hardware Security
Signal Processing	Asynchronous FPGAs, Machine Learning

PRODUCTS AS OF 03/2023

Experience:	12 yrs.
Journal Papers:	16
Book Chapters:	1
Patents:	14
Refereed Conference Papers:	23
Presentations & Symposia:	16
External Funding to Date (UAH):	$1.6 Million (Approx.)

JOURNAL PUBLICATIONS

16. **Beal**, A.N. (2023). Extracting Communication, Ranging and Test Waveforms with Regularized Timing from the Chaotic Lorenz System. Signals, 4(3), 507-523.

15. Cohen, S.D., Fendley, C., **Beal, A.N.** & Corron, N.J. (2023), Long-Range Pulse Interactions in Unclocked FPGAs. IEEE *Access*, vol. 11, pp. 41158-41166

14. Li, X., Shougat, M. R. E. U., Mollik, T., Dean, R. N., **Beal, A. N.** & Perkins, E. (2023) Field-programmable analog array (FPAA) based four-state adaptive oscillator for analog frequency analysis, Review of Scientific Instruments, 94(3).

13. Li, X., **Beal, A. N.**, Dean, R.N. and Perkins, E. (2023) Chaos in a pendulum adaptive frequency oscillator circuit experiment. Chaos Theory and Applications 5, no. 1 (2023): 11-19.

12. Syed, T.M., Pappu, C.S. and **Beal, A.N.** (2022), Drastically reduced sensor hardware for solvable chaos-based sonar. Electronics Letters, doi: 10.1049/ell2.12616

11. Pappu, C. S., **Beal, A. N.**, & Flores, B. C. (2021). Chaos Based Frequency Modulation for Joint Monostatic and Bistatic Radar-Communication Systems. Remote Sensing, 13(20), 4113.

10. Li, X., Shougat, M. R. E. U., Mollik, T., **Beal, A. N.**, Dean, R. N., & Perkins, E. (2021). Stochastic effects on a Hopf adaptive frequency oscillator. Journal of Applied Physics, 129(22), 224901.

9. Li, X., Shougat, M.R.E.U., Kennedy, S., Fendley, C.,**Beal, A. N.**, Dean, R.N., & Perkins, E. (2021). A Four-state Adaptive Hopf Oscillator. Plos one, 16(3), e0249131.

8. Rashid, M. I., Ferdaus, F., Talukder, B. B., Henny, P., **Beal, A. N.**, & Rahman, M. T. (2020). True Random Number Generation Using Latency Variations of FRAM. IEEE Transactions on Very Large Scale Integration (VLSI) Systems.

7. Corron N.J., Cohen, S.D., **Beal, A.N.** and Blakely, J.N. (2020). Exact analytic solution for a chaotic hybrid dynamical system and its electronic realization. Chaos: An Interdisciplinary Journal of Nonlinear Science, 30 (7), 073112

6. **Beal, A. N.**, Cohen, S. D., & Syed, T. M. (2020). Generating and Detecting Solvable Chaos at Radio Frequencies with Consideration to Multi-User Ranging. Sensors, 20(3), 774.

5. **Beal, A. N.**, Blakely, J. N., & Corron, N. J. (2018). Extended-Bandwidth Negative Impedance Converters by Nested Networks. IEEE Transactions on Circuits and Systems II: Express Briefs, 65(9), 1134-1138.

4. Milosavljevic, M. S., Blakely, J. N., **Beal, A. N.**, & Corron, N. J. (2017). Analytic solutions throughout a period doubling route to chaos. Physical Review E, 95(6), 062223.

3. Bailey, J. P., **Beal, A. N.**, Dean, R. N., & Hamilton, M. C. (2016). A digital matched filter for reverse time chaos. Chaos: An Interdisciplinary Journal of Nonlinear Science, 26(7), 073108.

2. **Beal, A. N.**, Tatarchuck, J., Stevens, C. B., Baginski, T. A., Hamilton, M. C., & Dean, R. N. (2015). Design Considerations of High-Current Density Capacitors Micromachined for Si Interposers. Journal of Microelectronics and Electronic Packaging, 12(3), 139-145.

1. Bailey, J. P., **Beal, A. N.**, Dean, R. N., Hamilton, M. C., & Tugnait, J. K. (2014). High-frequency reverse-time chaos generation using digital chaotic maps. Electronics Letters, 50(23), 1683-1685.

Journal	Publisher	Scopus CiteScore	Impact Factor
IEEE Access	IEEE	6.7 (2021)	3.476 (2021)
Remote Sensing	MDPI	6.6 (2020)	4.848 (2020)
PLOS One	PLOS	5.3 (2020)	3.240 (2020)
Transactions on Circuits & Systems II	IEEE	5.1 (2019)	2.814 (2019)
Sensors	MDPI	5.0 (2019)	3.275 (2019)
Transactions on VLSI	IEEE	4.9 (2019)	2.037 (2019)
Chaos	AIP	4.4 (2019)	2.832 (2019)
Physical Review E	APS	4.2 (2019)	2.296 (2019)
Journal of Applied Physics	AIP	4.2 (2019)	2.286 (2019)
Chaos Theory & Applications	Akif Akgul	3.9 (2023)	3.778 (2023)
Electronics Letters	IET	3.3 (2019)	1.316 (2019)
Review of Scientific Instruments	AIP	3.1 (2021)	1.843 (2021)

BOOK CHAPTERS

1. Blakely, J. N., Corron, N. J., **Beal, A. N.** & Milosavljevic, M. S. (2017). Chaos in Optimal Signals for Radar and Communications in Nonlinear Systems: Design, Applications and Analysis (395-448), Christos K. Volos (Editor), Nova Scientific Publishing

PATENTS GRANTED

4. Cohen, S.D. and **Beal, A.N.** (2023). Target ranging with subsampled noise correlation. U.S. Patent 11,733,364, Assignee: Kratos SRE Inc., University of Alabama in Huntsville, Filed: May, 21, 2021, Published: August 22, 2023.

3. *Multiple patents from* - Starkey, M.M. Riggs, L.S. and **Beal, A. N.** (2020). Waste receptacle configured to differentiate items. U.S. Patent 10,795,045, Assignee: EN Medical, LLC, Filed: January 31, 2018, Published: October 6, 2020. Summary of associated work:

   3.3. Awarded 2022: US Patent 11,402,535

   3.2. Awarded 2020: US Patent 10,795,045

   3.1. Awarded 2017: US Patent 9,556,599

2. Starkey, M.M. and McNeil, R.L. and Perez, J.C. and Riggs, L.S. and **Beal, A. N.** (2017). Detecting passing of unintended objects through throat of under-sink disposal. U.S. Patent 9,694,364, Publication No. US9694364 B2, Application No. US 14/896,435, Assignee: Samelin Innovations, LLC, Filed: May 22, 2015, Published: July 4, 2017. Also published as US9694364, WO2016190889A1

1. *Multiple patents from* - Starkey, M.M. and Riggs, L.S. and **Beal, A. N.** (2017). Waste receptacle. US Patent 9,637,309, Publication No. US9637309 B2, Application No. US 14/815,605, Assignee: Edison Nation Medical, LLC, Filed: Jul 31, 2015, Published: May 2, 2017. Summary of associated work:

   1.9. Awarded 2023: US Patent 11,551,538

   1.8. Awarded 2022: US Patent 11,380,188

   1.7. Awarded 2020: US Patent 10,815,053

   1.6. Awarded 2020: US Patent 10,777,069

   1.5. Awarded 2018: US Patent 10,121,354

   1.4. Awarded 2018: US Patent 10,077,153

   1.3. Awarded 2017: US Patent 9,840,369

   1.2. Awarded 2017: US Patent 9,842,484

   1.1. Awarded 2017: US Patent 9,637,309

REFEREED CONFERENCE PAPERS

23. Baker, D., **Beal, A. N.**, Joiner, L, Syed, T. M. (2023, April). A Low-Cost Modified Energy Detection-Based Spectrum Sensing Algorithm with GNU Radio for Cognitive Radio. In SoutheastCon 2023 (pp. 833-837). Orlando, FL. IEEE. *Accepted January 2023*

22. Carroll, R., Riggs, L. S., Waller, M. L., Hartline, M. B., **Beal, A. N.** (2023, March). Modeling and Measurement of the Isolation Effectiveness of Inductive Metal Screens. In 2023 International Applied Computational Electromagnetics Society Symposium (ACES) (pp. 1-2). Monterey, CA. IEEE.

21. Li, X., Shougat, M. R. E. U., Mollik, T., Dean, R. N., **Beal, A. N.** & Perkins, E., (2022 July) Stochastic Response of Hopf Adaptive Frequency Oscillator, ENOC 2020 (2022) 10th European Nonlinear Dynamics Conference, Lyon, France

20. Syed, T. M., Oh, D. R., & **Beal, A. N.** (2021, March). Synchronizing Solvable Chaotic Oscillators. In SoutheastCon 2021 (pp. 1-4). IEEE.

19. Syed,T.M., **Beal, A.N.** and Joiner, L. (2020, November). Solvable Chaos As a Tool for Evaluating Wideband Delay Cells in Matched Filters. IEEE International Conference on Electronics, Circuits and Systems (ICECS) 2020, Glasgow, Scotland.

18. **Beal, A. N.**, Erickson, C.J., Alim, M.E., & Nguyen, E. D. (2020, March). Stabilizing Long-period Orbits in Chaotic Oscillators with Open-source Hardware. In 2020 SoutheastCon (pp. 1-5). IEEE.

17. **Beal, A. N.**, Blakely, J. N., & Corron, N. J. (2019, April). Driven ring oscillators as FPGA entropy sources. In 2019 SoutheastCon (pp. 1-6). IEEE.

16. Stevens, C. B., Dean, R. N., Perkins, E., Li, C., **Beal, A. N.**, & Flowers, G. T. (2019, April). A Nonlinear MEMS Resonator for Generating AC Voltages Without Electronics. In 2019 SoutheastCon (pp. 1-7). IEEE.

15. **Beal, A. N.**, & Blakely, J.N. (2018). Szilard's information engine: Recent progress and a chaotic analog, IMAPS 14th International Conference and Exhibition of Device Packaging, Proceedings - Additional Conferences (Device Packaging, HiTEC, HiTEN, & CICMT); Fountain Hills, AZ, March 6-8, 2018

14. **Beal, A. N.**, & R.N. Dean. (2017). Using SPICE to model nonlinearities resulting from heterogeneous integration of complex systems, IMAPS 50th Anniversary International Symposium on Microelectronics; Vol. 2017, No. 1, pp. 274-279.; Raleigh, NC; October 2017

13. **Beal, A. N.** (2017, January). Modeling Nonlinear MEMS Beams and the Chaotic Duffing Oscillator in SPICE. In Additional Conferences (Device Packaging, HiTEC, HiTEN, & CICMT) (Vol. 2017, No. DPC, pp. 1-90). International Microelectronics Assembly and Packaging Society.

12. Rhea, B. K., Werner, F. T., Harrison, R. C., **Beal, A. N.**, & Dean, R. N. (2017, January). Electronic chaotic oscillator realization with potential uses in communication systems. In Additional Conferences (Device Packaging, HiTEC, HiTEN, & CICMT) (Vol. 2017, No. DPC, pp. 1-35). International Microelectronics Assembly and Packaging Society.

11. **Beal, A. N.**, Blakely, J. N., Corron, N. J., & Dean Jr, R. N. (2016, May). High frequency oscillators for chaotic radar. In Radar Sensor Technology XX (Vol. 9829, p. 98290H). International Society for Optics and Photonics. *Invited Talk*

10. **Beal, A. N.**, & Dean, R. N. (2016). A Survey of Nonlinear Phenomena and Chaos in Microsystems and Packaging. Additional Papers and Presentations, 2016(DPC), 001498-001542.

9. Werner, F. T., Rhea, B. K., **Beal, A. N.**, Abell, W. E., Bailey, J. P., Harrison, R. C., ... & Hamilton, M. C. (2016). A Matched Filter Developed for Chaotic Waveforms. Additional Papers and Presentations, 2016(DPC), 001613-001631.

8. **Beal, A. N.**, & Dean, R. N. (2015). A random stimulation source for evaluating MEMS devices using an exact solvable chaotic oscillator. Additional Papers and Presentations, 2015(DPC), 001594-001625.

7. Baginski T.A., Dean, R.N., Hamilton M.C., **Beal, A. N.**, Tatarchuk, J., & Stevens, C.B. (2014). Micromachined high density embedded capacitor technologies for energy storage applications. NDIA 57th Annual FUZE Conference, Newark, NJ, July 29-30, 2014

6. **Beal, A. N.**, Tatarchuk, J., Stevens, C., Baginski, T., Hamilton, M., & Dean, R. N. (2014). Design Considerations and Ring-down Characteristics of Micromachined, High Current Density Capacitors. Additional Papers and Presentations, 2014(DPC), 001380-001406.

5. **Beal, A. N.**, Stevens, C., Baginski, T., Hamilton, M., & Dean, R. (2013). Design, simulation and testing of high density, high current micro-machined embedded capacitors. Additional Papers and Presentations, 2013(DPC), 000515-000534.

4. **Beal, A. N.**, Bailey, J. P., Hale, S. A., Dean, R. N., Hamilton, M., Tugnait, J. K., ... & Corron, N. J. (2012, October). Design and simulation of a high frequency exact solvable chaotic oscillator. In MILCOM 2012-2012 IEEE Military Communications Conference (pp. 1-6). IEEE.

3. **Beal, A. N.**, Baginski, T., Dean, R., & Hamilton, M. (2012). Micromachined high density embedded capacitor technologies for silicon interposers. Additional Papers and Presentations, 2012(DPC), 001192-001222.

2. Ellis, C., **Beal, A. N.**, & Dean, R. (2011). Cu MEMS. Additional Papers and Presentations, 2011(DPC), 000952-000973.

1. Dean, R., Burch, N., Black, M., Beal, A. **Beal, A. N.**, & Flowers, G. (2011, April). Microfibrous metallic cloth for acoustic isolation of a MEMS gyroscope. In Industrial and Commercial Applications of Smart Structures Technologies 2011 (Vol. 7979, p. 797909). International Society for Optics and Photonics.

CONFERENCE PRESENTATIONS & SYMPOSIA

16. **Beal, A. N.** (2023). Hands-on student engagement via simple and/or solvable chaotic experiments. Dynamics Days 2023, Virtual, January 11, 2023 *Contributed Talk*

15. **Beal, A. N.** (2021). Introduction to Solvable Chaos. M.I.T. Lincoln Laboratory and U.S. Army DEVCOM CCDC AvMC, In-person at Redstone Arsenal, AL and Virtual, June 2, 2021 *Invited Talk*

14. **Beal, A. N.** (2021). Detecting Chaotic Waveforms for Communication. Department of Electrical Engineering Seminar, Union College, Schenectady, New York, (Virtual) May 2021 *Invited Talk*

13. **Beal, A. N.** (2021). Detecting Chaotic Waveforms for Communication. Department of Mechanical Engineering Seminar, North Carolina State University, Raleigh, North Carolina, (Virtual) April 2021 *Invited Talk*

12. **Beal, A. N.**, Blakely, J.N., & Corron, N.J. (2017). Naturally compressive noise radar using chaos. AMTA Atlanta 2017, Antenna Measurements Techniques Association, Atlanta, GA, October 2017 *Invited Talk*

11. **Beal, A. N.**, Blakely, J.N., & Corron, N.J. (2017). Naturally compressive noise radar using chaos. HEOS Speaker Series, Huntsville Electro-optical Society, University of Alabama in Huntsville, Huntsville, AL, May 18, 2017 *Invited Talk*

10. **Beal, A. N.**, Blakely, J.N., & Corron, N.J. (2017). Naturally compressive noise radar using chaos. Hardware-in-the-loop, AMTA/IEEE Regional Symposium Event, University of Alabama in Huntsville, Huntsville, AL, May 18, 2017 *Invited Talk*

9. **Beal, A. N.**. (2017). Engineering applications of solvable chaos. Alabama A&M University, Seminar for the College of Engineering, Technology, & Physical Sciences; Huntsville, AL, March 9, 2017 *Invited Talk*

8. **Beal, A. N.** (2016). Solvable chaos in Electrical Engineering applications. University of Alabama in Huntsville, Seminar for the Department of Electrical & Computer Engineering; Huntsville, AL, November 7, 2016

7. Rhea, B.K., **Beal, A. N.**, Werner, F.T. & Dean, R.N. (2016). Chaotic Oscillator Implementation Based on an Exactly Solvable Piecewise Linear Chaotic System Intended for Communication System Applications. IMAPS 12th International Conference and Exhibition of Device Packaging, Proceedings 2016; Fountain Hills, AZ, March 17-19, 2016

6. **Beal, A. N.**, Bailey, J.P., Dean, R.N. & Hamilton, M.C. (2015). Electronic Circuit Implementations of Exactly Solvable Chaos. SIAM Conference on Applications of Dynamical Systems, Snowbird, UT, May 17-21, 2015 *Invited Talk*

5. **Beal, A. N.** (2015). Order, Complexity and Chaos: Patterns in Art, Science and Engineering. Alabama Prison Arts + Education Project SPARKs Lecture Series, Staton Correction Facility, Elmore, AL April 23, 2015 *Invited Talk*

4. Olsen, D.A., & **Beal, A. N.** (2015). 3D Printing for Product Development in Construction. IMAPS 11th International Conference and Exhibition of Device Packaging, Proceedings 2015; Fountain Hills, AZ, March 17-19, 2015

3. Stevens, K., Wilson, A., Goodwin, D., & **Beal, A. N.** (2014). Bridging a curriculum gap in prisoner education. 2014 Outreach Scholarship Symposium: Advancing Transformative Engagement, Proceedings 2014; Auburn University, AL, February 10-11, 2014

2. **Beal, A. N.**, Bailey, J.P., Hale, S.A., Dean, R.N., Hamilton, M.C., Tugnait, J.K., Hahs, D.W., & Corron, N.J. (2013). Implementing an exactly solvable chaotic oscillator for chaos communications. Society of Industrial and Applied Mathematics (SIAM) Conference on Applications of Dynamical Systems, Snowbird, UT, May 19-23, 2013 *Invited Talk*

1. Hale, S.A., Bailey, J.P., **Beal, A. N.**, Dean, R.N., & Hamilton, M.C. (2013). Hardware implementation of cellular automata on coupled networks of exactly solvable chaotic oscillators. SIAM Conference on Applications of Dynamical Systems, Snowbird, UT, May 19-23, 2013

CONFERENCE POSTERS

4. **Beal, A. N.**, & Dean, R.N. (2014). Time-delay of an Exact Solvable Chaotic Signal for Electronic Communications. XXXIV Dynamic Days US 2014, Rice University, Houston, TX, January 9-11, 2015
3. **Beal, A. N.**, & Stevens, K. (2014). STEM Course Development in Alabama Prisons: Impact & Emergent Educational Communities. Graduate Engineering Research Showcase 2014, Auburn University, Auburn, AL, October 23, 2014
2. Hale, S.A., **Beal, A. N.**, & Bailey, J.P. (2014). Design considerations for a high-capacity chaotic communications channel. XXXIII Dynamic Days US 2014, Georgia Tech, Atlanta, GA, January 2-5, 2014
1. Aggas, J., Dean, R.N., Wilson, C.G., **Beal, A. N.** & Jenkins, L. (2013) Development of substrate embedded magnetics for DC-DC buck converters. IMAPS 9th International Conference and Exhibition of Device Packaging, Proceedings 2013; Scottsdale/Fountain Hills, AZ, March 11-14, 2013

FUNDING & PROPOSALS (AWARDED)

13. $110,000 **AWARDED** FPGA-Based Hardware Security Primitives. U.S. Army – Direct Funding via Kratos & Invariant PI: **Aubrey N. Beal Ph.D.** UAH Department of Electrical & Computer Engineering – PoP:08/03/2023 to 12/30/23 – Time Commitment: TBD%
12. $37,000 **AWARDED** Nonlinear Waveform Development. U.S. Army CCDC AvMC – Direct Funding PI: **Aubrey N. Beal Ph.D.** UAH Department of Electrical & Computer Engineering – PoP:08/03/23 to 12/30/23 – Time Commitment: TBD%
11. $160,000 **AWARDED** Novel RF Algorithms for Stimulated Brillouin Scattering Suppression. U.S. Army SMDC Direct Funding.PI: **Aubrey N. Beal Ph.D.** UAH Department of Electrical & Computer Engineering – PoP: 09/09/2022 - 09/08/2027 – Time Commitment: TBD%
10. $41,000 **AWARDED** Deep Reinforcement Learning (DRL) Enabled Warfighter Assistant. STTR Topic MDA22-T004. PI: Cameron McWilliams, NouSystems, CO-PI: **Aubrey N. Beal Ph.D.** UAH Department of Electrical & Computer Engineering, CO-PI: **Jacob D. Hauenstein Ph.D.** UAH Department of Computer Science – PoP: 12/22/22 - 05/22/2023 TBD – Time Commitment: TBD%
9. $180,000 **AWARDED** FPGA-Based Hardware Security Primitives. U.S. Army – Direct Funding via Kratos & Invariant PI: **Aubrey N. Beal Ph.D.** UAH Department of Electrical & Computer Engineering – PoP:11/03/2022 to 07/03/23 – Time Commitment: TBD%
8. $100,000 **AWARDED** Nonlinear Waveform Development. U.S. Army CCDC AvMC – Direct Funding PI: **Aubrey N. Beal Ph.D.** UAH Department of Electrical & Computer Engineering – PoP:08/03/22 to 08/03/23 – Time Commitment: TBD%
7. $10,000 **AWARDED** Handheld FMCW Fault Detection System. U.S. Army CCDC AvMC – Direct Funding PI: **Aubrey N. Beal Ph.D.** UAH Department of Electrical & Computer Engineering – PoP:11/30/21 to 11/28/22 – Time Commitment: TBD%
6. $37,000 **AWARDED** Nonlinear Waveform Development. U.S. Army CCDC AvMC – Direct Funding PI: **Aubrey N. Beal Ph.D.** UAH Department of Electrical & Computer Engineering – PoP:08/03/21 to 08/03/22 – Time Commitment: TBD%
5. $240,000 **AWARDED** Continuous-Time Digital Signal Processing (DSP) Using Reconfigurable Devices. U.S. Army CCDC AvMC – Small Business Innovation Research (SBIR) – A20-080. PI: Dane Phillips, IERUS Technologies Inc., CO-PIs:**Aubrey N. Beal Ph.D.** UAH Department of Electrical & Computer Engineering, Seth D. Cohen, Ph.D. Southern Research Institute – PoP: TBD – Time Commitment: TBD%
4. $400,000 **AWARDED** Advanced Data Association Algorithms to Address Emerging Threats - Phase II. PI: Mark Lambrecht, Ph.D., Archarithm, CO-PIs: **Aubrey N. Beal, Ph.D.** & Laurie Joiner, Ph.D. UAH Department of Electrical & Computer Engineering - Missile Defense Agency - Small Business Technology Transfer (STTR) – PoP: TBD – Time Commitment: TBD%
3. $50,000 **AWARDED** Continuous-Time Digital Signal Processing (DSP) Using Reconfigurable Devices. U.S. Army CCDC AvMC – Small Business Innovation Research (SBIR) – A20-080. PI: Dane Phillips, IERUS Technologies Inc., CO-PIs:**Aubrey N. Beal Ph.D.** UAH Department of Electrical & Computer Engineering, Seth D. Cohen, Ph.D. Southern Research Institute – PoP: 03/01/2020 – 12/31/2020. $23,000 – Time Commitment: 2%

2. $42,000 **AWARDED** Advanced Data Association Algorithms to Address Emerging Threats. PI: Mark Lambrecht, Ph.D., Archarithm, CO-PIs: **Aubrey N. Beal, Ph.D.** & Laurie Joiner, Ph.D. UAH Department of Electrical & Computer Engineering - Missile Defense Agency - Small Business Technology Transfer (STTR) – MDA19-T001 – PoP: 05/01/2020-10/31/2020. $42,000 – Time Commitment: 16%.

1. $10,000 **AWARDED** Naturally Compressive Noise Sonar using Solvable Chaos for Multi-User Applications. PI: **Aubrey N. Beal Ph.D.** UAH Department of Electrical & Computer Engineering - The University of Alabama in Huntsville – New Faculty Research (NFR) Award – PoP: 01/01/2020 – 12/31/2020. $10,000 – Time Commitment: 6%

FUNDING & PROPOSAL SUBMISSIONS (NOT AWARDED)

11. $41,000 *Not Funded* MDA22-T003: Surrogate Models to Accelerate High-Fidelity Physics Based Simulation PI: Cameron McWilliams, NouSystems, CO-PI: **Aubrey N. Beal Ph.D.** UAH Department of Electrical & Computer Engineering, CO-PI: **Jacob D. Hauenstein Ph.D.** UAH Department of Computer Science – PoP: 12/22/22 - 05/22/2023 TBD – Time Commitment: TBD%

10. $601,000 *Not Funded* 2022 NSF CAREER: Non-autonomous, Solvable Chaos for Authenticated Communication and Ranging Systems **Aubrey N. Beal Ph.D.** UAH Department of Electrical & Computer Engineering – PoP: TBD – Time Commitment: TBD%

9. $38,000 *Not Funded* Conformal and Integrated Sensors for On-demand PPE and Environmental Sensing. Southeastern Center for Electrical Engineering Education (SCEEE) - Grant, PI:**Aubrey N. Beal Ph.D.** UAH Department of Electrical & Computer Engineering. – PoP: 08/01/2020 – 08/01/2021. $38,000 – Time Commitment: 0.86 mo.

8. *$650,000 Not Funded* - Next Generation Lunar Landing: Innovation from High Precision Noise Radar and Robust Integrated Guidance and Control. NASA REDDI 2020 FoP: 80HQTR20NOA01-20FO_F1. NSPIRES Proposal No. N0-20FOF1-MAS-0066. PI: **Aubrey N. Beal Ph.D.**, Co-PI: Yuri Shtessel Ph.D., UAH Department of Electrical & Computer Engineering - The University of Alabama in Huntsville – PoP: 08/01/2020 – 01/31/2022. – Time Commitment: 10%

7. $52,000 *Not Funded* Millimeter-Wave MIMO and Micro-Doppler Radars for UAS Detection, Classification and Tracking. STTR Topic A21C-T009. PI: Michael Kranz, Ph.D., EngeniusMicro, LLC, CO-PI: **Aubrey N. Beal Ph.D.** UAH Department of Electrical & Computer Engineering – PoP: TBD – Time Commitment: TBD%

6. $79,000 *Not Funded* Nondestructive Concrete Characterization System. STTR Topic A21C-T012. PI: Michael Kranz, Ph.D., EngeniusMicro, LLC, CO-PI: **Aubrey N. Beal Ph.D.** UAH Department of Electrical & Computer Engineering – PoP: TBD – Time Commitment: TBD%

5. $35,000 *Not Funded* Intrinsic Localized Modes in Stochastic Adaptive Oscillator Arrays. ARO Broad Agency Announcement #W911NF-21-S-0008. PI: Edmon Perkins, Ph.D., Assistant Professor, North Carolina State University, CO-PI: **Aubrey N. Beal Ph.D.** UAH Department of Electrical & Computer Engineering – PoP: TBD – Time Commitment: TBD%

4. $640,000 *Not Funded* 2021 NSF CAREER: Non-autonomous, Solvable Chaos for Authenticated Communication and Ranging Systems **Aubrey N. Beal Ph.D.** UAH Department of Electrical & Computer Engineering – PoP: TBD – Time Commitment: TBD%

3. $41,000 *Not Funded* SBIR Topic #A214-004 Phase I: Low-Cost/Low Probability of Detection (LC/LPD) Waveform Radio - PI: Robert Bock, RDex Systems, Inc. CO-PIs:**Aubrey N. Beal Ph.D.** UAH Department of Electrical & Computer Engineering, Seth D. Cohen, Ph.D. Southern Research Institute – PoP: TBD – Time Commitment: TBD%

2. $30,000 *Not Funded* STTR/NGA20C-001: Algorithm Performance Evaluation with Low Sample Size - PI: Brent McCoy, Archarithm. CO-PIs:**Aubrey N. Beal Ph.D.** UAH Department of Electrical & Computer Engineering, – PoP: TBD – Time Commitment: TBD%

1. $37,500 *Not Funded* AF SBIR 212-0012 Rocket Landing on Irregular Surfaces - PI: Michael Root, Ph.D. Infinity Labs. CO-PIs:**Aubrey N. Beal Ph.D.** & Laurie Joiner, Ph.D., UAH Department of Electrical & Computer Engineering, – PoP: TBD – Time Commitment: TBD%

PROFESSIONAL MEMBERSHIPS

IEEE	Institute of Electrical and Electronics Engineers, Senior Member
SIAM	Society for Industrial and Applied Mathematics, (Inactive)
IMAPS	International Microelectronics Assembly and Packaging Society, (Inactive)
AUARC	Auburn University Amateur Radio Club K4RY (Personal Call Sign: KJ4TSF), (Inactive)

LEADERSHIP, HONORS & AWARDS

2022 – IEEE SSCS Platform for IC Design Outreach (PICO) Open-source Chipathon Participant
2021 – Elevated to IEEE Senior Member
2021 – UAH College of Engineering Outstanding Faculty Teaching Award
2021 – UAH Faculty Advisor for Eta Kappa Nu National Electrical & Computer Engineering Honor Society
2015 – Auburn University Graduate School's Presidential Award
2015 – Auburn University ECE Outstanding Ph.D. Student
2015 – IMAPS Microelectronics Foundation Prize
2014 – IMAPS Microelectronics Foundation Prize
2013 – IMAPS Microelectronics Foundation Prize
2013 – IMAPS Member Spotlight October-November
2012 – IMAPS Microelectronics Foundation Prize
2009 – Auburn University Dean's List Fall
Eta Kappa Nu National Electrical and Computer Engineering Honor Society
Tau Beta Pi National Engineering Honor Society

TEACHING

Introduction to Electronic Analysis & Design EE 315-01 *Fall 2023*
University of Alabama in Huntsville; Department of Electrical and Computer Engineering Huntsville, AL
Instructor; Undergraduate Level Course: 1 Section; 68 Students

Electric Circuits & Electronic Design Laboratory EE 316 *Fall 2023*
University of Alabama in Huntsville; Department of Electrical and Computer Engineering Huntsville, AL
Instructor of Record; Undergraduate Level Laboratory: 4 Sections; 38 Students

Electric Circuits & Electronic Design Laboratory EE 316 *Summer 2023*
University of Alabama in Huntsville; Department of Electrical and Computer Engineering Huntsville, AL
Instructor of Record; Undergraduate Level Laboratory: 2 Sections; 17 Students

Open Source IC Design EE 610-01 *Spring 2023*
University of Alabama in Huntsville; Department of Electrical and Computer Engineering Huntsville, AL
Instructor; Graduate Level Course: 1 Section; 14 Students

Electric Circuits & Electronic Design Laboratory EE 316 *Spring 2023*
University of Alabama in Huntsville; Department of Electrical and Computer Engineering Huntsville, AL
Instructor of Record; Undergraduate Level Laboratory: 8 Sections; 67 Students

Introduction to Electronic Analysis & Design EE 315 *Fall 2022*
University of Alabama in Huntsville; Department of Electrical and Computer Engineering Huntsville, AL
Instructor; Undergraduate Level Course: 1 Section; 79 Students

Electric Circuits & Electronic Design Laboratory EE 316 *Fall 2022*
University of Alabama in Huntsville; Department of Electrical and Computer Engineering Huntsville, AL
Instructor of Record; Undergraduate Level Laboratory: 5 Sections; 40 Students

Electric Circuits & Electronic Design Laboratory EE 316 *Summer 2022*
University of Alabama in Huntsville; Department of Electrical and Computer Engineering Huntsville, AL

Instructor of Record; Undergraduate Level Laboratory: 2 Sections

Special Topics: Nonlinear Dynamics & Chaos EE 410-02/510-02 *Spring 2022*
University of Alabama in Huntsville; Department of Electrical and Computer Engineering Huntsville, AL
Instructor; Graduate Level Course: 1 Section, Undergraduate Level Course: 1 Section

Electric Circuits & Electronic Design Laboratory EE 316 *Spring 2022*
University of Alabama in Huntsville; Department of Electrical and Computer Engineering Huntsville, AL
Instructor of Record; Undergraduate Level Laboratory: 8 Sections

Special Topics: Fundamentals of Radar Systems EE 410-02/510-02 *Fall 2021*
University of Alabama in Huntsville; Department of Electrical and Computer Engineering Huntsville, AL
Instructor; Graduate Level Course: 1 Section, Undergraduate Level Course: 1 Section

Analytical Methods for Multivariable and Discrete Time Systems EE 383 *Fall 2021*
University of Alabama in Huntsville; Department of Electrical and Computer Engineering Huntsville, AL
Instructor; Undergraduate Level Course: 1 Section

Electric Circuits & Electronic Design Laboratory EE 316 *Fall 2021*
University of Alabama in Huntsville; Department of Electrical and Computer Engineering Huntsville, AL
Instructor of Record; Undergraduate Level Laboratory: 5 Sections

Electric Circuits & Electronic Design Laboratory EE 316 *Summer 2021*
University of Alabama in Huntsville; Department of Electrical and Computer Engineering Huntsville, AL
Instructor of Record; Undergraduate Level Laboratory: 5 Sections

Special Topics: Nonlinear Dynamics & Chaos EE 410-02/510-02 *Spring 2021*
University of Alabama in Huntsville; Department of Electrical and Computer Engineering Huntsville, AL
Instructor; Graduate Level Course: 1 Section, Undergraduate Level Course: 1 Section

Electric Circuits & Electronic Design Laboratory EE 316 *Spring 2021*
University of Alabama in Huntsville; Department of Electrical and Computer Engineering Huntsville, AL
Instructor of Record; Undergraduate Level Laboratory: 7 Sections

Special Topics: Fundamentals of Radar Systems EE 410-02/510-02 *Fall 2020*
University of Alabama in Huntsville; Department of Electrical and Computer Engineering Huntsville, AL
Instructor; Graduate Level Course: 1 Section, Undergraduate Level Course: 1 Section

Analytical Methods for Multivariable and Discrete Time Systems EE 383 *Fall 2020*
University of Alabama in Huntsville; Department of Electrical and Computer Engineering Huntsville, AL
Instructor; Undergraduate Level Course: 1 Section

Analytical Methods for Multivariable and Discrete Time Systems EE 383 *Spring 2020*
University of Alabama in Huntsville; Department of Electrical and Computer Engineering Huntsville, AL
Instructor; Undergraduate Level Course: 1 Section

Analytical Methods for Multivariable and Discrete Time Systems EE 383 *Fall 2019*
University of Alabama in Huntsville; Department of Electrical and Computer Engineering Huntsville, AL
Instructor; Undergraduate Level Course: 1 Section

Wireless Design Laboratory ELEC 3060 *Fall 2014*
Auburn University; Department of Electrical and Computer Engineering Auburn, AL
Graduate Teaching Assistant; 2 Sections of Undergraduate Level Laboratory Courses

Analog Electronics ELEC 3700 *Summer 2014*
Auburn University; Department of Electrical and Computer Engineering Auburn, AL
Instructor; Undergraduate Level Course: 1 Section

Foundations and Concepts in the Physical Sciences *Summer 2014*
Alabama Prison Arts + Education Project; Staton Correctional Facility Elmore, AL

Instructor; Adult Continuing Education Full Course

Analog Electronics ELEC 3700 *Summer 2013*
Auburn University; Department of Electrical and Computer Engineering Auburn, AL
Instructor; Undergraduate Level Course: 1 Section

Introduction to Vocational Electronics *Summer 2013*
Alabama Prison Arts + Education Project; Easterling Correctional Facility Clio, AL
Instructor; Adult Continuing Education Full Course

Introduction to Electrical Engineering Laboratory ENGR 1110 *Spring 2009*
Auburn University; Department of Electrical and Computer Engineering Auburn, AL
Undergraduate Teaching Assistant to Dr. Thomas Denney; Undergraduate Level Laboratory Course

PAST GRADUATE STUDENTS

Micah Tseng - Master's in Electrical Engineering — Fall 2023
Topic: *TBD*

William Watson - Master's in Electrical Engineering — Summer 2022
Topic: *Future-proofing the MIT coffee can radar*

CURRENT GRADUATE STUDENTS

Ph.D. Students

5. Sean Mitchell — Spring 2021 - Present
   Topic: *Enhanced Reservoir Computing via Chaotic Maps*
4. Delores Baker — Spring 2021 - Present
   Topic: *Cognitive Energy Detection Methods Using Software Defined Radio*
3. Valdez Gant — Spring 2020 - Present
   Topic: *Nonlinear Dynamics and Chaotic Systems in Integrated Circuits*
2. Patrick Berry — Spring 2020 - Summer 2020
   Topic: *The Intersection of Information Theory and Dynamics*
1. Tamseel Mahmood Syed — Fall 2019 - Present
   Topic: *Synchronizing Solvable Chaos for Communication*

Master's Students

3. Micah Tseng — Fall 2022 - present
   Topic: *Information Theory and Measurement in Chaotic Dynamics*
2. Austin Davis — Fall 2021 - Present
   Topic: *First Order Choatic Oscillator Circuits*
1. Benjamin Shea — Fall 2020 - Fall 2021
   Topic: *Variable Coherence Radar Waveforms*
   Externally funded through Raytheon award

UNDERGRADUATE STUDENTS

Honor's College

3. Micah Tseng, Sara Mog, Michael Marsh & Lloyd Bickel — Fall 2021
   Topic: *Real-Time Audio Processing with Machine Learning*
2. Peter Sizemore — Spring 2021
   Topic: *Control Improvements to PCR Machines*
1. Austin Davis — Spring 2021
   Topic: *Comparing Noise Mechanisms & Entropy in Tent-map Circuits*

Research Assistants

4. Nathan Rotta, Electrical Engineering — Spring 2021 - Fall 2021
3. Tyler Norman, Electrical Engineering — Summer 2020
2. Phillip Wilkerson, Electrical Engineering — Fall 2019 - Fall 2020
1. Doo 'Dominic' ri Oh, Electrical Engineering — Fall 2019 - Spring 2021

DEFENSE COMMITTEES

4. Thomas Salverson, Master's in Electrical Engineering, UAH — October 1, 2021
   Topic: *Multi-robot SLAM*

3. Matchima Buddhanoy, Master's in Electrical Engineering, UAH — June 8, 2021
   Topic: *Experimental Evaluation of Data Retention Characteristics of NAND Flash Memories*

2. Md Imtiaz Rashid, Master's in Computer Engineering, UAH — June 12, 2020
   Topic: *Security Primitives With Emerging Memory Chips and Its Application in Wireless Communication*

1. Casey Fendley, Master's in Electrical Engineering, Auburn University — December 14, 2019
   Topic: *CMOS Exactly Solvable Chaotic Oscillator*

SENIOR DESIGN GROUP ADVISEMENT

10. *Solvable Chaotic Pendulum* (4 Students) UAH EE494 – Instructor: Dennis Hite — Fall 2022
    Matthew DeSanctis, Brett Kilgore, Cory Long, Kayla Cochran

9. *Audio Processing with Machine Learning* (4 Students) UAH EE494 – Instructor: Dennis Hite — Fall 2021
   Students: Micah Tseng, Sara Mog, Michael Marsh & Lloyd Bickel

8. *Open-source PCR Machine* (4 Students) UAH EE494 – Instructor: Dennis Hite — Spring 2021
   Funded by UAH OIT in collaboration with UAH Biology Department
   Students: Richard Compton, Hunter Hill, Ben Tran, Peter Sizemore

7. *RF Hardware for Alzheimer's Treatment* (3 Students) UAH EE494 – Instructor: Dennis Hite — Spring 2021
   Funded by UAH OIT
   Students: Steven Gallagher, Jaden Flint, Austin Mann

6. *Chaotic True Random Number Generator* (4 Students) UAH EE494 – Instructor: Dennis Hite — Fall 2020
   Students: Kenny Brainerd, Jonathan Kuhn, Austin Davis, Austin Handley

5. *Schlieren imaging* (3 Students) UAH EE412 – Instructor: Dr. Aubrey Beal — Spring 2020
   Students: Dryden Young, Amanda Stewart, Tara Crowe

4. *FMCW Radar Jamming* (4 Students) UAH EE494 – Instructor: Dennis Hite — Spring 2020
   Students: Wesley Weirich, Erin Bergman, Keene Manning, Jasmine Bone

3. *Controlling Chaos* (4 Students) UAH EE494 – Instructor: Dennis Hite — Spring 2020
   Students: Sean Mitchell, Tyler Norman, Jeff Cogin, Curt Sauer

2. *Controlling Chaos* (3 Students) UAH EE494 – Instructor: Dennis Hite — Fall 2019
   Externally funded $1,000 by GRA Inc.
   Students: Christian Erickson, Eric Nguyen, Einaam Alim

1. *Metal Detector Vest* (4 Students) Auburn University – Instructor: Dr. Lloyd Riggs — Fall 2017
   Personally donated $500 in materials
   Students: David Goldhagen, Riley Klages, Austin Lindsey, Napoleon Pleasant

TEACHING PHILOSOPHY

As an educator, my primary goal is to focus on student growth towards the high standards of university-level institutions. This takes work – reinforcing fundamentals and sharing a wonder for the material. I hope to create an environment that illustrates how to delight in this work. Engineering concepts are amazing. Topics often interconnect and deepen one another. Engineering turns the most satisfying results from mathematics and physics into the art of what is possible. If students earn these tools, they are empowered to build and analyze in new, better ways. For example, some students connect with the beauty of using an impulse response to turn a linear, time-invariant, differential equation problem into a convolution problem. Other students simply dislike differential equations to the point that any other alternative feels like a miracle. Both groups are empowered by solving LTI systems for an arbitrary input.

How do you get students to buy into this? I'm still learning. I try to seed an attitude and hope that is reflected. I try to give an example through my behavior. In my experience, generally, students tend to learn best by example. This tendency seems to hold not only for material in the classroom but also for developing excitement for learning, discipline for rigor, creativity for research and temperament for teamwork & mentorship.

However, sometimes I have more selfish goals if I'm being honest. Courses with roots showing subtle implications of fundamentals or sometimes slippery concepts give me longing. I think this is shared by Leonard Susskind. He states during an online lecture in Stanford's Statistical Mechanics offering, "The reason I teach it (stat. mech.) is not for you, its for me. I love teaching it. My life consists of learning and forgetting and learning and forgetting statistical mechanics."

Dr. Susskind's comment is in line with a concept that has been shared with me many times – education is what is left when someone forgets what they have learned. In short, I see great value in how much I learn when teaching and each time around I hope to forget a little less while making new observations. As Georgia O'Keeffe painted the slightly different perspective of her same patio door more than 20 individual times, I hope to appreciate the perspectives of my courses as I repeat and relearn the material throughout my career.

I am still growing as an educator. I value feedback and self-reflection to progress my teaching philosophy. Each time I update my teaching statement, I feel a bit embarrassed at what was written before. I interpret this as evidence of my growth. My outlook is influenced by many great teachers and mentors. They have shown me examples of patience, compassion, rigor, curiosity, work-life balance and style. My mentors have been so generous. It took time to realize the monumental energy associated with their level of composure and openhandedness. Currently, my job is to find that energy on demand as needed by my students.

TEACHING METHODS

My teaching methods are largely traditional in the sense of providing lectures followed by homework, quizzes and tests. The goal is to suit student needs in a format that is comfortable and familiar. I add as much transparency as possible regarding supplemental material that I consume to prepare material. Often times, the best discussions come from the shared supplemental material.

Delivery of my course has evolved to include a DIY lightboard and make-shift studio in my garage. Students have responded very well to this. I pre-record mandatory lectures for the week and provide them on Canvas. The in-person component is flipped and recorded synchronously. I'm interested in how technology can improve the pieces that work so well in a traditional classroom. Discussion boards, multimedia supplements and video lectures/recitations with speed control are all working well at the moment.

A typical lecture in my course is modeled after a particularly talented math teacher named David Cope and share similarity to lectures by Dr. Gilbert Strang. I try to think about students' perspectives. A seemingly familiar example is introduced but with a small change. This change creates an issue that the students are not equipped to handle. The lecture is about developing the tools to resolve any dilemmas we have created by changing our familiar problem. Finally, we formalize the results.

Not all lectures work out this way, but it is nice when they do. Regardless, I try to give students a challenge that shows value. Sometimes value comes from realizing that the currently equipped techniques have limits. Other times that value is evident through analogy, allegory or real-world engineering problems. None of this works without many example problems. When working examples live, I inevitably get stuck for a moment from

time to time. I have found that encouraging student participation to think through these difficulties works well. Students often rise to the challenge of figuring out my mistake before I do and can be satisfying for all parties.

Summary of Teaching Progress

This academic year, I have evaluated our ECE department's electronics course track with a focus on EE315 Introduction to Electronics Design & Analysis and its loosely associated lab EE316. I reorganized some of the topics of EE316 to fit the scheduling of topics in our EE315 textbook by Sedra & Smith. I have also began developing a hands-on course to develop world-class integrated circuits in line with the concepts in our Sedra & Smith textbook. I have also continued to develop notes for a new, advanced nonlinear dynamics course that will help prepare my graduate students for emerging topics that include data-driven control/signal processing, true random number generation, physically unclonable functions, machine learning and chaos circuit design.