

# Aubrey N. Beal, Ph.D.

## *Assistant Professor, Electrical Engineering*

### EDUCATION

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- 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

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

- P.I. Nonlinear Signals & Systems Lab

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

- P.I. Nonlinear & Information Dynamics Group
- Author/COR for STTR/SBIR Topics
- Reviewed > 100 proposals for STTR, SBIR, RIF

**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

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### RESEARCH STATEMENT

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Dr. Beal's research focuses on the intersection of nonlinear dynamics and electrical engineering. He is currently developing low-cost ranging sensors with unique advantages due to solvable chaos. Applications of these systems include multi-user, spread spectrum ranging, collision avoidance, disaster relief and medical imaging.

### RESEARCH INTERESTS

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NONLINEAR SYSTEMS	Chaos, Reservoir Computing, Dynamics, Control
ELECTRONICS	Nonlinear Circuits, IC Design, Microelectronics
SIGNAL PROCESSING	Asynchronous FPGAs, Machine Learning
SENSORS	Radar, Sonar, Remote Sensing, Acoustic Ranging

### PRODUCTIVITY SUMMARY (03/2021)

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JOURNAL PAPERS:	9
BOOK CHAPTERS:	1
PATENTS:	9
REFEREED CONFERENCE PAPERS:	20
PRESENTATIONS & SYMPOSIA:	13

## PUBLICATIONS IN PREPARATION

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2. **Beal, A.N.**, Corron, N.J. & Blakely, J.N. (2021) High Frequency Compensation of an Exactly Solvable Chaotic Oscillator. Proceedings of the Royal Society A - Special Edition on Chaos Applications *Invited by Dr. Hai Peng Ren – In Preparation*
1. Cohen, S.D. & **Beal, A.N.**, Noise Radar Backend Components U.S. Provisional Patent App. No. 63028389, **FILED** 05/21/2020

## JOURNAL PUBLICATIONS

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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 **Accepted**
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
PLOS One	PLOS	5.2 (2019)	2.740 (2019)
Transactions on Circuits & Systems II	IEEE	5.1 (2019)	2.814 (2019)
Sensors	MDPI	5.0 (2019)	3.275 (2019)
Proceedings of the Royal Society A	Royal Society	5.0 (2019)	2.741 (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)
Electronics Letters	IET	3.3 (2019)	1.316 (2019)

## BOOK CHAPTERS

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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

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3. 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.

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:
  - 1.7. 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

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20. Syed, T.M., Oh, D.R., **Beal, A. N.** (2021, March). Synchronizing Solvable Chaotic Oscillators. In 2021 SoutheastCon (pp. 1-5). IEEE. **ACCEPTED**
19. Syed, T.M., **Beal, A.N.** and Joiner, L. (2020, November). Solvable Chaos As a Tool for Evaluating Wide-band 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). Micro-machined 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

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

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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

## LEADERSHIP, HONORS & AWARDS

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UAH Faculty Advisor for Eta Kappa Nu National Electrical & Computer Engineering Honor Society 2021  
 Auburn University Graduate School's Presidential Award 2015  
 Auburn University ECE Outstanding Ph.D. Student 2015  
 IMAPS Microelectronics Foundation Prize 2012-2015  
 IMAPS Member Spotlight October-November 2013  
 Eta Kappa Nu National Electrical and Computer Engineering Honor Society  
 Tau Beta Pi National Engineering Honor Society  
 Phi Kappa Phi National Honor Society  
 Auburn University Dean's List Fall 2009

## PROFESSIONAL MEMBERSHIPS

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

## TEACHING

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

*Spring 2021*  
 Huntsville, AL

<b>Electric Circuits &amp; Electronic Design Laboratory</b> EE 316 University of Alabama in Huntsville; Department of Electrical and Computer Engineering Instructor of Record; Undergraduate Level Laboratory: 7 Sections	<i>Spring 2021</i> Huntsville, AL
<b>Special Topics: Fundamentals of Radar Systems</b> EE 410-02/510-02 University of Alabama in Huntsville; Department of Electrical and Computer Engineering Instructor; Graduate Level Course: 1 Section, Undergraduate Level Course: 1 Section	<i>Fall 2020</i> Huntsville, AL
<b>Analytical Methods for Multivariable and Discrete Time Systems</b> EE 383 University of Alabama in Huntsville; Department of Electrical and Computer Engineering Instructor; Undergraduate Level Course: 1 Section	<i>Fall 2020</i> Huntsville, AL
<b>Analytical Methods for Multivariable and Discrete Time Systems</b> EE 383 University of Alabama in Huntsville; Department of Electrical and Computer Engineering Instructor; Undergraduate Level Course: 1 Section	<i>Spring 2020</i> Huntsville, AL
<b>Analytical Methods for Multivariable and Discrete Time Systems</b> EE 383 University of Alabama in Huntsville; Department of Electrical and Computer Engineering Instructor; Undergraduate Level Course: 1 Section	<i>Fall 2019</i> Huntsville, AL
<b>Wireless Design Laboratory</b> ELEC 3060 Auburn University; Department of Electrical and Computer Engineering Graduate Teaching Assistant; 2 Sections of Undergraduate Level Laboratory Courses	<i>Fall 2014</i> Auburn, AL
<b>Analog Electronics</b> ELEC 3700 Auburn University; Department of Electrical and Computer Engineering Instructor; Undergraduate Level Course: 1 Section	<i>Summer 2014</i> Auburn, AL
<b>Foundations and Concepts in the Physical Sciences</b> Alabama Prison Arts + Education Project; Staton Correctional Facility Instructor; Adult Continuing Education Full Course	<i>Summer 2014</i> Elmore, AL
<b>Analog Electronics</b> ELEC 3700 Auburn University; Department of Electrical and Computer Engineering Instructor; Undergraduate Level Course: 1 Section	<i>Summer 2013</i> Auburn, AL
<b>Introduction to Vocational Electronics</b> Alabama Prison Arts + Education Project; Easterling Correctional Facility Instructor; Adult Continuing Education Full Course	<i>Summer 2013</i> Clio, AL
<b>Introduction to Electrical Engineering Laboratory</b> ENGR 1110 Auburn University; Department of Electrical and Computer Engineering Undergraduate Teaching Assistant to Dr. Thomas Denney; Undergraduate Level Laboratory Course	<i>Spring 2009</i> Auburn, AL