

# Alex Duda

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## Summary

- Activities** Fundamental research, applied research, tech strategy research, customer relationship building, prototypes, tech volume of proposals, trade studies, and tech development
- Specialties** Spiking Neural Networks, Neural Cognitive Machine Intelligence, Synthetic Data Generation, Machine Learning, and Natural Language Processing
- Roles** Experienced, committed, and enthusiastic - lifelong learner, communicator, creator, mentor, research and development engineer scientist, individual contributor, and tech lead

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## Education

- 2015 **PhD, Electrical and Computer Engineering**, University of Illinois at Urbana-Champaign  
Specialty - Signal Processing and Machine Intelligence
- 2009 **MS, Applied Mathematics**, University of Illinois at Urbana-Champaign  
Specialty - Optimization and Algorithms
- 2006 **BS, Engineering Physics**, University of Illinois at Urbana-Champaign

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## Selected Research Interests

- Sci/Math** Cognitive Systems, Complex Systems, Computational Systems Neuroscience, Creativity, Networks, Nonlinear Dynamics, Sensor Resource Management, Signal Processing, Swarms, Systems Science
- Engr/Tech** Adversarial/Secure Machine Learning, {Biological, Cognitive, Heuristic, Neural}-Inspired Computing, Cognitive Robotics, Computational Intelligence, Data Science, Developmental Embodied Systems, Ensemble Methods, Event-Based Processing, Event-Based Sensing, Human-Machine Integration/ Interaction, Machine {Creativity, Curiosity, Emotion, Imagination, Improvisation, Learning, Originality, Play}, Natural Language Processing, Neuromorphics, Neurorobotics, Reinforcement Learning, Soft Computing, Spiking (Biological, Neurological) Neural Networks, Swarm Intelligence, Synthetic Data Generation
- Organizational** Developing/Nurturing Collaborative, Creative, Ecosystems

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## Selected Computer Skills

- Languages** Python, C, C++, Tcl
- Python Packages** argparse, Augmentor, csv, datetime, glob, json, keras, logging, math, matplotlib, multiprocessing, NetworkX, numpy, operator, os, pandas, pickle, pillow (PIL), PyTorch, random, re, scikit-learn, seaborn, string, tensorflow, tensorflow\_datasets, tensorflow\_hub, time, torch, torchvision, warnings
- Applications** Inkscape, Java tool for Address-Event Representation (jAER), Jupyter Notebook, L<sup>A</sup>T<sub>E</sub>X, LMMS, Mathematica, MATLAB, Microsoft Office, Open Office, NeuroXyce, Pro Tools, Reason, ROS, Simulink, STELLA, VCV Rack
- OS** Linux, macOS, Windows
- Cloud** EC2 (AWS Elastic Compute Cloud), AMI (Amazon Machine Images)

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## Selected Awards and Honors

- 20(20-21) Artificial Intelligence Advanced Academy at Northrop Grumman Corporation
- 20(17 - 18) Mentoring the Technical Professional (MTP) Program at Northrop Grumman Corporation
- 20(14 - 17) Future Technical Leaders (FTL) Program at Northrop Grumman Corporation
- 2013 F - Eta Kappa Nu (HKN) Electrical and Computer Engineering Honor Society, Alpha Chapter
- 2011 Su International Conference on Complex Systems Best Poster Award Winner
- 2010 W IEEE International Conference on Machine Learning and Applications Best Poster Award Nominee
- 20(09, 10) F List of Teachers Ranked as Excellent by their Students
- 2010 Su New England Complex Systems Institute Summer School Scholarship Recipient

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## Security Clearances

Active clearance. Details available upon request.

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## Selected Leadership Experience

### Mentor

- 2020 New-hires (2 PhD FTLs, 1 PhD senior engineer, 1 junior engineer), 1 PhD FTL, NGMS
- 2019 1 senior engineer, NGMS
- 2018 3 junior engineers, NGMS
- 2017 1 undergraduate summer intern, 1 junior engineer, NGES
- 2016 1 PhD student research intern, 1 junior engineer, NGAS
- 2015 1 PhD student summer research intern, 1 PhD senior engineer, NGIS
- 2014 Multiple junior engineers, NGIS
- 20(13 Su - 13 S) UIUC CS Senior Thesis: *Controlling an Autonomous Car with a Spiking Neural Network*
- 20(10 F - 11 S) UIUC ECE Senior Thesis: *Analysis of an AB Initio Multi-Scale Model of Associative Memory*

### Founder

- 2021 - Big Ideas Meeting (Monthly); members from across academia, industry, and government
- 2019 - FTL/UIUC Meeting (Quarterly)
- 2016 Su *NG/Next* All Minds Meeting
- 20(15 -16) S Cyber Analytics & Research Department Webinar Series at NGC (Monthly)
- 20(13 Su - 14 F) Big Ideas Meeting at UIUC (Weekly); members from across fields

### Reviewer

- 20(14, 15) Complex Adaptive Systems Conference, Procedia Computer Science

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## Selected Work Experience

- 2019 - **Research and Development Engineer Scientist**  
*Northrop Grumman Mission Systems, Baltimore, MD*
  - Led six+ person team designing, implementing, and applying a synthetic data generator to improve performance of deep artificial neural network object detectors for multiple programs
  - Served as subject matter expert for IR&D focused on applications of spiking neural networks that led to customer-delivered whitepaper and publication
  - Served as subject matter expert on cognitive systems-enabled technology for winning DARPA proposal
  - Served as subject matter expert for mission-level applications for novel neuromorphic sensor for DARPA proposal still under review
- 2018 **Research and Development Engineer Scientist**  
*Northrop Grumman Mission Systems, Baltimore, MD*
  - Supported architecture, algorithm, design for multiple IR&Ds (03/28/18 - 12/31/18)
  - Reviewed and evaluated techniques for supervised and unsupervised machine learning
  - Reviewed and evaluated neuromorphic hardware options optimized for spiking neural networks, as well as artificial neural networks
  - Investigated next-generation hardware options for next-generation machine learning
- 20(17 - 18) **Research and Development Engineer Scientist**  
*Northrop Grumman Mission Systems, Baltimore, MD*
  - Completed first post-FTL position (06/19/17 - 03/28/18)
  - Served as *Tech Lead* of six person IR&D team
  - Led architecture and algorithm design efforts for component focused on contextualized, holistic, situational awareness driven sensor resource management
  - Applied work from combinatorial optimization, reinforcement learning, decision theory, and cognitive models for multiple time scale adaptive closed-loop learning and control
- 2016 - **Future Technical Leaders Program - Alumni Recruiter at UIUC**  
*Northrop Grumman Corporation, Baltimore, MD*
  - Lead recruiter from 2019 to present

- Assistant recruiter from 2016 to 2018
  - Establish and nurture relationships with contacts across university
  - Market, present, coordinate 6+ person team for information sessions
  - Interview, evaluate, select high potential (graduate degree and post-doc) candidates
  - Present candidates to FTL program office decision committees
  - Provide ongoing guidance to candidates
  - Present detailed recruiting retrospective to help improve process
- 20(16 - 17) **Future Technical Leaders Program - Rotation #3**  
*Northrop Grumman Electronic Systems, Linthicum, MD*
- Completed third FTL rotation (08/08/16 - 06/16/17) in Advanced Concepts & Technologies Division
  - Primarily supported shaping, capture, proposal, on multiple DARPA efforts
  - Technical areas focused on next-generation machine learning, stochastic computing, cognitive frameworks, and context-sensitive adaptive edge perception/computation/control
- 20(15 - 16) **Future Technical Leaders Program - Rotation #2**  
*Northrop Grumman Aerospace Systems, Space Park, CA.*
- Completed second FTL rotation (07/20/15 - 07/29/16) in *NG/Next* Basic Research supporting the Biologically-Inspired Processing and Sensing (BIPS) group
  - Contributed to founding whitepaper for BIPS group
  - Provided tours/demos for *NG/Next* Lab to various NGC personnel, across a wide range of backgrounds including corporate directors, engineers, executives, and R&D managers
  - Conducted neurorobotics basic research that included cellular (dynamical) spiking neural networks with plastic synapses
  - Developed and nurtured academic collaborations
  - Helped to propose and supported topic area at Telluride Neuromorphic Cognition Engr. Workshop
  - Represented *NG/Next* BIPS group at Design & Emergent Systems Sidebar at *NGC* TechExpo
- 20(14 - 15) **Future Technical Leaders Program - Rotation #1**  
*Northrop Grumman Information Systems, Annapolis Junction, MD*
- Conducted tech strategy research on potentially disruptive low-TRL hardware trends for big data processing systems
  - Completed state-of-the-art trade study on streaming and in-memory engines
  - Attended and documented 2014 IEEE Big Data Conference in Washington DC, 2015 Solid Conference (HW, SW, and IoT) in San Francisco, 2015 In-Memory Computing Summit in San Francisco.
  - Provided technical writing support and innovation ideas for business proposal tech volume
- 20(11 - 14) **Graduate Researcher**  
*Beckman Institute for Advanced Science and Technology, UIUC, Urbana, IL*
- Worked on Sandia National Labs funded *Computational Models of Neural Population Dynamics*
  - Designed canonical cellular-resolution spiking neural network
  - Incorporated adaptive synapses with plasticity
  - Empirically studied extent to which summary statistics were information-preserving
  - Explored techniques to establish similarity measures between phase portraits
  - Used emergent dynamics of spiking neural networks as basis of multi-sensory associative memory
  - Examined methods of processing high-throughput data with finite resources
  - Employed visualization techniques for high-dimensional systems
- 2012 Su **Graduate Research Intern**  
*Computer Science Research Institute, Sandia National Laboratories, Albuquerque, NM*
- Worked on PhD dissertation, which included NeuroXyce development
  - Identified important features in conductance-based adaptation-enabled synapse model

- Adapted spike-timing dependent plasticity (STDP) model for NeuroXyce synapse device
  - Simulated, tuned, and debugged NeuroXyce synapse device
- 20(10 - 11) **Graduate Researcher**  
*Beckman Institute for Advanced Science and Technology, UIUC, Urbana, IL*
- Worked on Navy Research Lab funded *The Role of Sensorimotor Function, Associative Memory, and Reinforcement Learning in Automatic Acquisition of Spoken Language by an Autonomous Robot*
  - Conducted scholarly research on use of spiking neural networks for sensory integration
  - Determined minimal required features of canonical cellular-resolution spiking neural network
  - Explored ways to use dynamics of spiking neural networks as basis for associative memory
- 2010 Su **Graduate Researcher**  
*NECSI Summer School, MIT, Cambridge, MA*
- CX 201: Complex Physics, Biological, and Social Systems
  - CX 102: Computer Programming and Complex Systems
  - CX 202: Complex Systems Modeling and Networks
  - Completed exploratory computational project in Python
  - Focused on the Kuramoto Model for synchronization behavior of coupled oscillators
- 2010 S - Su **Graduate Researcher**  
*Beckman Institute for Advanced Science and Technology, UIUC, Urbana, IL*
- Worked on Sandia National Laboratories funded *Mathematical Models of Neocortical Circuits*
  - Numerically integrated Hodgkin-Huxley neuron model; explored variety of nonlinear behaviors
  - Investigated statistical methods to create reduced-order models of spiking neural networks
  - Implemented small-scale spiking neural network (25+ neurons, 120+ synapses)
- 20(09 - 10) S **Graduate Researcher**  
*Beckman Institute for Advanced Science and Technology, UIUC, Urbana, IL*
- Investigated recurrent artificial neural networks for associative learning
  - Analyzed state transition dynamics and emergence of basins of attraction
  - Explored attractor topology
  - Compared behavior to that predicted by presence of feedback cycles (number, type)
- 20(07 - 08) F **Graduate Researcher**  
*Siebel Center for Computer Science, UIUC, Urbana, IL*
- Investigated variants of Kauffman's NK model
  - Reviewed analytical and simulation results
  - Simulated deterministic and stochastic variants
  - Analyzed N, K value impact on fitness landscape
  - Evaluated effectiveness of different search algorithms to approach optima
- 2007 F **Graduate Researcher**  
*Siebel Center for Computer Science, UIUC, Urbana, IL*
- Optimal path planning through probabilistic digraph
  - Investigated analytical and computational approaches
  - Compared shortest path algorithms
- 2006 Su **Undergraduate Researcher**  
*Loomis Laboratory of Physics, UIUC, Urbana, IL*
- Experimental biophysics
  - Prepared DNA samples for use in single-molecule optical experiments
  - Applied specialized optical techniques, such as FIONA (Fluorescence Imaging with One-Nanometer Accuracy), to study DNA molecules
  - Developed program for tracking microtubules that enabled automated analysis of collected frame-data and increased precision in molecular dynamics studies

- 2005 F **Undergraduate Researcher**  
*Loomis Laboratory of Physics, UIUC, Urbana, IL*
- Computational biophysics
  - Programmed simulations of enzymes using Tcl scripting language
  - Generated simulation visualizations using VMD (Visual Molecular Dynamics) software
  - Examined thermodynamic behavior of enzymes during equilibration
  - Prepared statistical analysis of enzyme's behavior during simulation
- 2005 S **Undergraduate Researcher**  
*Altgeld Hall, UIUC, Urbana, IL*
- Applied linear algebra
  - Investigated information retrieval, population migration, and computer graphics
  - Determined coding matrices using Mathematica

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## Selected Tech Reports

### Machine Learning

- [3] A. Duda, "Some Brief Notes on Ensemble Methods: AdaBoost, Random Forest, and Gradient Boosting", Tech. Rep., 2020, p. 1 - 6. [PDF]
- [2] A. Duda, "Ensemble Methods for High Dimensional Data: Primary Considerations for a Principled, Advanced, Approach", NGMS, Baltimore, MD, Tech. Rep., 2019, pp. 1 - 4.
- [1] A. Duda, "DARPA SAGA - Recommendations and Insights", NGES, Linthicum, MD, Tech. Rep., 2017, pp. 1 - 7.

### Natural Language Processing

- [3] A. Duda, "HMM as Building Block in Models of Brain, Language, and Mind", Beckman Institute, Urbana, IL, Tech. Rep., 2013, pp. 1 - 6. [PDF]
- [2] A. Duda, "The Importance of Being Parsed", Beckman Institute, Urbana, IL, Tech. Rep., 2013, pp. 1 - 14. [PDF]
- [1] A. Duda, "Symbols  $\Leftrightarrow$  Models", Beckman Institute, Urbana, IL, Tech. Rep., 2013, pp. 1 - 45. [PDF]

### Neural Cognitive Machine Intelligence

- [3] A. Duda, "From Natural Intelligence to Machine Intelligence: Augmented Cattell-Horn-Carroll (CHC) Theory of Cognitive Abilities as Framework for Progress", NGMS, Baltimore, MD, Tech. Rep., 2019, pp. 1 - 12.
- [2] A. Duda, "Towards A More Natural Machine Intelligence: For Those Looking to Enhance Machines with Neuroscience", NGMS, Baltimore, MD, Tech. Rep., 2019, pp. 1 - 22.
- [1] A. Cobb, A. Duda, S. Kelly, J. Shepanski, and G. Tseng, "Biologically Inspired Processing and Sensing (BIPS) Group Founding Whitepaper ", NGAS, Space Park, CA, Tech. Rep., 2015, pp. 1 - 75.

### Next-Generation Hardware for Big Data Processing, Machine Intelligence, etc.

- [3] A. Duda, "Towards a Streaming Analytics Platform: Hardware Considerations, Predictions, and Recommendations", NGIS, Annapolis Junction, MD, Tech. Rep., 2015, pp. 1 - 23.
- [2] A. Duda, "Memristors in Big Data", NGIS, Annapolis Junction, MD, Tech. Rep., 2015, pp. 1 - 35.
- [1] A. Duda, "Important Opportunities for M2M/IoT in 2020", NGIS, Annapolis Junction, MD, Tech. Rep., 2014, pp. 1 - 3.

### Sensor Resource Management

- [3] A. Duda, "SRM Technology Readiness Demo Assessment and Recommendations", NGMS, Baltimore, MD, Tech. Rep., 2018, pp. 1 - 6.
- [2] A. Duda and C. Lefler, "Interest-Level Assessor: A Holistic, Contextual, Approach", NGMS, Baltimore, MD, Tech. Rep., 2018, pp. 1 - 18.
- [1] A. Duda and C. Lefler, "Command Selection for Real Benefit: Short Time-Horizon Capability Command Down-Selector", NGMS, Baltimore, MD, Tech. Rep., 2018, pp. 1 - 12.

## Signal Processing

- [1] A. Duda, "Over the channel and through the noise: A Study in Adaptive Filter Design with DFE", Beckman Institute, Urbana, IL, Tech. Rep., 2011, pp. 1 - 6. [PDF]

## Spiking Neural Networks

- [6] A. Duda, "Embodied Adaptive Spiking Neural Networks: Emergent Weighted Directed Graph Structure and its Applicability to Novelty Detection", NGAS, Space Park, CA, Tech. Rep., 2016, pp. 1 - 34.
- [5] A. Duda, "Desirable Features of a Neocortically-Inspired Ab Initio Model of Associative Memory", Beckman Institute, Urbana, IL, Tech. Rep., 2012, pp. 1 - 86. [PDF]
- [4] A. Duda, "NeuroXyce Synapse Device with STDP and Stochastic Transmission Reliability", Beckman Institute, Urbana, IL, Tech. Rep., 2012, pp. 1 - 11. [PDF]
- [3] R. Schiek, C. Warrender, C. Teeter, J. Aimone, H. Thornquist, T. Mei, and A. Duda, "Simulating neural systems with Xyce", Sandia National Laboratories, Albuquerque, NM, Tech. Rep., 2012, pp. 1 - 78, doi: 10.2172/1096952.
- [2] A. Duda, "Multimodal Memory Encoding with Large Populations of Spiking Neurons", Beckman Institute, Urbana, IL, Tech. Rep., 2010, pp. 1 - 76. [PDF]
- [1] A. Duda, "Simulink Implementation of Hodgkin-Huxley Spiking Neuron Model", Beckman Institute, Urbana, IL, Tech. Rep., 2010, pp. 1 - 15. [PDF]

## Synthetic Data Generation

- [1] A. Duda, "Synthetic Data Generator (sdg) for Improved Deep Learning Based Object Detectors", NGMS, Baltimore, MD, Tech. Rep., 2020, pp. 1 - 10.

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## Selected Publications

### Spiking Neural Networks

- [7] P. Tschirhart, A. Duda, and K. Segall, "Architecture Considerations for Superconducting Neuromorphic Systems: Programmability, Scalability, Area, and Latency", 2020 29th Applied Superconductivity Conference (Special Session on Novel Computing – Reversible and Neuromorphic), 2020, pp. 1 - 21.
- [6] A. Duda, "Towards a Neocortically-Inspired Ab Initio Cellular Model of Associative Memory", PhD dissertation, Department of Electrical and Computer Engineering, University of Illinois at Urbana-Champaign, Urbana-Champaign, IL, 2015, URI: <http://hdl.handle.net/2142/78735>.
- [5] A. M. Duda and S. E. Levinson, "Information-Preserving Transforms: Two Graph Metrics for Simulated Spiking Neural Networks", Procedia Computer Science, vol. 20, 2013, pp. 14 - 21, doi: 10.1016/j.procs.2013.09.232.
- [4] A. M. Duda and S. E. Levinson, "Complex Networks of Spiking Neurons: Collective Behavior Characterization", 2011 Eighth International Conference on Complex Systems, Quincy, MA, 2011, pp. 1627 - 1629, doi: 10.1.1.409.5105, (Best Poster Award Winner).
- [3] A. M. Duda and S. E. Levinson, "Characterizing Populations of Spiking Neurons", 2011 Fifteenth International Conference on Cognitive and Neural Systems, Boston, MA, 2011, pp. 87, doi:10.1.1.409.5105.
- [2] A. M. Duda and S. E. Levinson, "Nonlinear Dynamical Multi-Scale Model of Associative Memory", 2010 Ninth International Conference on Machine Learning and Applications, Washington, DC, 2010, pp. 867 - 872, doi: 10.1109/ICMLA.2010.135, (Best Poster Award Nominee).
- [1] L. Majure, L. Niehaus, A. Duda, A. Silver, L. Wendt, and S. Levinson, "Integrating Language and Motor Function on a Humanoid Robot", 2010 Twenty Third IEEE/RSJ International Conference on Intelligent Robots and Systems, RobotCub Workshop, 2010, pp. 1 - 5, doi: 10.1.1.409.9064.

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## Selected Presentations

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| 2019-04-11 | Towards A More Natural Machine Intelligence: For Those Looking to Enhance Machines with Neuroscience, NGMS, Linthicum, MD |
| 2016-07-14 | NG/Next BIPS Group Demo, Telluride Neuromorphic Cognition Engr. Workshop, Telluride, CO                                   |

- 2016-06-24 *NG/Next* All Minds Meeting, NGAS, Manhattan Beach, CA
- 2016-06-(7,8) *NG/Next* Basic Research BIPS group Demo/Talk, NGC TechExpo, McLean, VA
- 2016-03-21 Embodied Adaptive Spiking Neural Networks: Emergent Weighted Directed Graph Structure and its Applicability to Novelty Detection, *NG/Next* Basic Research Series, Redondo Beach, CA
- 2016-03-10 MUNDANE: Multisensory Adaptive Data Experience Technology, NGC FTL/SEA Spring Learning Forum, Baltimore, MD
- 2015-06-16 Memristors in Big Data, NGIS Cyber Division Operations Webinar Series, AJ, MD
- 2015-06-(9,10) NGC IR&D Big Data 2020 Demo/Talk, NGC TechExpo, McLean, VA
- 2015-04-23 Towards a Streaming Analytics Platform: Hardware Focus, NGIS, AJ, MD
- 2015-02-20 IEEE Big Data Conference 2014 Overview, NGIS Cyber Analytics & Research Department Webinar Series, AJ, MD
- 2014-09-05 PhD Final Examination, Urbana, IL
- 2013-12-02 Unsupervised Machine Learning with Spiking Neural Networks, MIT Lincoln Lab, Lexington, MA
- 2013-11-21 Graduate School Advice Talk, HKN ECE Honor Society, Urbana, IL
- 2013-11-13 Information-Preserving Transforms: Two Graph Metrics for Simulated Spiking Neural Networks, Complex Adaptive Systems Conference, Baltimore, MD
- 2013-03-08 Language Acquisition and Robotics Group Demo/Talk, Beckman Institute Open House, Urbana, IL
- 2013-03-07 PhD Preliminary Examination, Urbana, IL
- 2012-02-09 Desirable Features of a Neocortically-Inspired Ab Initio Model of Associative Memory, Language Acquisition and Robotics Group Research Meeting, Beckman Institute, Urbana, IL
- 2011-06-30 Complex Networks of Spiking Neurons: Collective Behavior Characterization, International Conference on Complex Systems, Boston, MA
- 2011-05-14 Characterizing Populations of Spiking Neurons, International Conference on Cognitive and Neural Systems, Boston, MA
- 2011-03-11 Language Acquisition and Robotics Group Demo/Talk, Beckman Institute Open House, Urbana, IL
- 2010-12-12 Nonlinear Dynamical Multi-Scale Model of Associative Memory, International Conference on Machine Learning and Applications, Washington DC
- 2010-11-18 Neuroengineering IGERT @ Illinois Seminar Series, Urbana, IL
- 2010-10-13 Beckman Graduate Student Seminar, Urbana, IL
- 2010-06-24 Nonlinear Dynamical Models of Associative Memory, Computer Science Research Institute Seminar at Sandia, Albuquerque, NM
- 2010-06-18 Computational Explorations of the Kuramoto Model, New England Complex Systems Institute Summer School at MIT, Cambridge, MA

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## Selected Protégé Publications

- [1] F. Wang, "Implementation and Analysis of an AB Initio Multi-Scale Model of Associative Memory", Senior thesis, Department of Electrical and Computer Engineering, University of Illinois at Urbana-Champaign, Urbana-Champaign, IL, 2011, URI: <http://hdl.handle.net/2142/46969>.

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## Memberships

- 2013- IEEE {Computational Intelligence; Information Theory; Signal Processing} Society

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## Selected Teaching Experience

- 20(13 F, 14 S) **Teaching Assistant.** ECE 110 Lab: Introduction to ECE.
- 2013 S **Teaching Assistant.** ECE 101: Exploring Digital Information Technology.
- 20(09, 10) F **Teaching Assistant.** COE/LAS Honors Calculus II Project.
- 2008 F **Teaching Assistant.** Introductory Control Systems Lab.
- 20(06 - 08) **Tutor.** Department of Mathematics.

20(05 - 07) **Tutor.** Department of Physics.

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## Selected Personal Interests

- Music**
- Composition, songwriting, arrangement, improvisation
  - Capturing/communicating a concept, an emotion, a mood in/through music
  - Production, recording
  - Experimenting with a variety of acoustic, electronic, and software instruments, processing chains, sound design approaches
  - Exploring generative composition
  - Project management of tracks, EPs, LPs, etc.
  - Creative direction for a variety of music projects
  - Design/implementation of machine intelligence for many of the above

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## Version

2021-02-24