

# michael garbus

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## Summary

- **Background & Interests:** machine learning and statistical modeling, systems modeling and analysis, agent-based modeling of complex systems, Bayesian predictive models, intelligent usage of sensory data, embedded systems, signal processing, computational social sciences, statistical natural language processing, audio and speech analysis, human interaction with machines, human language acquisition, art and engineering.
- **R&D to Product:** demonstrated ability to generate, research, and develop ideas from conception to final product.
- **Intellectual Property:** three patents related to modeling the human perception of color in low-end microcontrollers and custom embedded systems.

## Education

University of Virginia • School of Engineering & Applied Science • Charlottesville, VA  
Member of the Institute for Operations Research and the Management Sciences (INFORMS)  
Graduate Courses in Systems and Information Engineering  
Classes: Intro. to System Engineering, Optimization, Stochastic Systems

Carnegie Mellon • School of Computer Science • Pittsburgh, PA • Graduated: August 2012  
Member of the Machine Learning for Signal Processing (MLSP) Group  
MS Language Technologies with an emphasis on statistical models for audio and speech analysis

Virginia Tech • School of Engineering • Blacksburg, VA • Graduated: May 2003  
BS Electrical Engineering with Minor in Mathematics

## Professional Experience

Aptima, Inc. • Washington, DC • June 2014 to now  
Senior Research Engineer

- Developed unsupervised on-line Bayesian model for predicting satellite maneuvering procedures from ground-based optical sensory data.
- Developed a novel unsupervised algorithm for discovering patterns in sociometric sensor information and used these patterns to predict and classify abstract psychological concepts like rapport between human beings.
- Researched differences in entity-relationship graphs based on a modified form of Latent Dirichlet Allocation (LDA) for different translations of Chinese documents.
- Implemented a Monte Carlo Markov Chain (MCMC) for estimating parameters of Hidden Markov Models (HMM).
- Wrote several implementations of Partially Observable Markov Decision Processes (POMDP) including Linear Value Function POMDPs, QMDPs, and various implementations of Myopic POMDPs.
- Wrote Monte Carlo simulation of cognitive load of airmen during multitasking exercises to

provide analysis and recommendations for future crew configurations and efficacy of automating certain systems onboard aircraft.

- Performed various other mathematical modeling and data analysis.
- Provided guidance to junior engineers.
- Authored SBIR proposal.

Curata Inc. • Cambridge, MA • October 2012 to August 2013

Machine Learning Engineer

- Researched automatic, unsupervised topic analysis for user defined corpora.
- Developed custom online learning algorithm to predict user interest in new articles from the internet using sparse feedback signals.
- Developed a system for ranking articles by relevance of latent user topics of interest.
- Presented at MIT's CSAIL on several personally developed techniques for automatic estimation of the number of topics present in a corpus of documents as a post-processing step to Latent Dirichlet Allocation (LDA).

Carnegie Mellon University • Pittsburgh, PA • August 2010 to August 2012

Graduate Research Assistant

- Developed method for automatically learning parameters of a speech synthesizer inspired by babbling in infants and the philosophy of analysis by synthesis.
- Researched effectiveness of using computer vision techniques to identify syllable and sub-syllable structures in spectrograms based on Seam Carving and the Hough transform.
- Performed sociolinguistic speech analysis and measured authority to predict performance of a group in a dialog-based task.
- Performed Arabic-specific data normalization for ASR built using RADC's Pan-Arabic Corpus.
- Developed and demonstrated a statistically motivated method to create new pronunciations for dialects of Arabic that are underrepresented in training data.
- Built audio scene analysis classifiers for IARPA TRECVID Aladdin project.

Applications Technology Inc. • McLean, VA • September 2008 to July 2010

Natural Language Senior Software Engineer

- Developed statistical machine translation models with customizable pre- and post-processing for Farsi to English, Farsi to Arabic, Hebrew to Arabic, Urdu to English, and English to Farsi.
- Integrated statistical models for French to English, Spanish to English, German to English, Italian to English, and Russian to English into custom Linux translation engine.
- Demonstrated automatic statistical Farsi punctuation generator for output of ASR.
- Produced software for reordering of Farsi verb and noun phrases for better statistical correlation with target language.
- Performed custom pruning of translation and language models.
- Performed multidimensional parameter optimization using the Nelder-Mead (Downhill Simplex) algorithm.
- Designed and wrote address identification program given spoken addresses and USPS database.
- Created system for acquisition of semi-aligned parallel data by crawling bilingual websites.

Renaissance Lighting • Herndon, VA • March 2006 to September 2008

Principal Engineer

- Wrote all firmware and algorithms for embedded microcontrollers of various devices in ANSI C.
- Developed and implemented automated color calibration process for production lighting fixtures in Linux and LabVIEW.
- Developed system-wide controls architecture for networked lighting systems with high-precision color consistency using sophisticated RS-485 serial protocol.
- Co-developed and implemented algorithms and methods for color management system within a PIC 16F678A and PIC 18F2525.
- Created custom ergonomic color palette and developed mathematics to map to a standard coordinate space (CIE 1931).
- Developed and implemented PID closed loop control system for color stability, along with other advanced 32-bit floating point mathematical functions, using 8-bit microcontrollers.
- Developed advanced custom color algorithms for white correction.
- Specified and designed an advanced control system using PDA and PC with intuitive and ergonomic GUI.
- Produced several Linux and LabVIEW simulators and emulators of internal controls projects.
- Developed 18-month high-level schedule and roadmap for course of future technology development and feature integration into product line.
- Managed team of three engineers to produce scalable, networked Bluetooth control system along with intuitive color sequencer software for advanced color shows.

Electronic Warfare Associates • Herndon, VA • June 2005 to March 2006

Electrical Engineer

- Designed system level architecture for device that passively intercepts, logs, and analyzes wireless communications IEEE 802.11 a, b, & g wireless traffic for military and intelligence applications.
- Provided senior management with a plan to complete all technical aspects of 802.11 project along with descriptions of appropriate personnel and their necessary skill sets.
- Built proof-of-concept of portions of system using several open source networking and hacking tools.
- Advised senior management of the benefits of developing a relationship with 802.11 hardware manufacturer Atheros Communications which was successfully pursued.
- Demonstrated proof-of-concept for inexpensive inter-device compression algorithm for project involving passively locating the point of origin of an FM signal.

NLX Corporation / Rockwell Collins • Sterling, VA • April 2004 to June 2005

Software Engineer

- Modeled functionality of classified radio equipment for a B-52 flight simulator in ANSI C.
- Developed software interface for DSP audio generation hardware.
- Conducted spectral analysis on audio information to correctly model the sounds of a B-52.
- Produced specification and managed work by a third-party to produce appropriate audio hardware.

Naval Surface Warfare Center Carderock Division • Bethesda, MD • June 2003 to April 2004

Electrical Engineer/Computer Engineer

- Independently developed and presented novel phase alignment algorithm in MATLAB that could greatly improve performance of certain systems used during war games with 688 fast attack submarines.
- Designed several digital LP filter circuit boards used in phase alignment of motion equipment.
- Generally increased performance of motion controller by conducting analysis of algorithms used in DSP and increasing SNR of analog and digital input signals.
- Wrote LabVIEW programs to interface and control high speed data recorders.
- Installed and aided in debugging of sonar latency equipment on 688 fast attack submarines.

General Electric • Greenville, SC • January 2001 to August 2002

Co-op/Systems Engineer

- Wrote all controls and data acquisition software for high-profile experiment to stall turbine engine under fuel injection failure modes.
- Performed spectral analysis on bearing vibration data to aid in diagnosis of turbine issues.
- Designed and built 4th order Butterworth LP filter for custom GE data acquisition system.
- Personally debugged and corrected binary machine code for persistent problem with older turbines in the field.
- Designed and tested controls for pyrometer sensor system for various gas turbine experiments.
- Provided general support of quality testing of turbines.

Hampton University • Hampton, VA

Assistant Physicist • May 2000 to August 2000

Work performed at the NSF's Center for Ultrafast Optical Science • Ann Arbor, MI

- Setup and calibrated custom data acquisition system for experimental low-cost technology to generate and control a beam of free electrons.
- Wrote LabVIEW interface for nuclear and particle physics equipment.
- Built (by-hand), calibrated, and helped installed several scintillating particle detectors.

Intern • May 1999 to August 1999

Hampton University's Graduate Nuclear and High Energy Physics Department • Hampton, VA

- Developed and implemented automated system for simultaneously testing and calibrating several scintillating particle detectors by integrating oscilloscopes and custom equipment using LabVIEW.

Thomas Jefferson National Accelerator Facility • Newport News, VA • Sept 1996 to May 1998

High School Intern

- Wrote ANSI C and FORTRAN Monte Carlo simulations of interactions between an electron beam and a beam position measurement system. Performed statistical analysis on outcomes.
- Aided in experiment involving electroproduction of kaons with a polarized electron beam.
- Aided in development of GUI's for real-time data collection in accelerator control room.

## **Publications & Patents**

- Mayfield, Garbus, Adamson, and Rose, “Data-Driven Interaction Patterns: Authority and Information Sharing in Dialogue”, AAAI Symposium 2011.
- Nallasamy, Garbus, Metze, Jin, Schaaf, and Schultz, “Analysis of Dialectal Influence in Pan-Arabic ASR”, INTERSPEECH-2011.
- Garbus, 7478922, “Set-Point Validation for Color/Intensity Settings of Light Fixture”
- Lyons, Garbus, Aldrich, 7560677, “Step-Wise Intensity Control of a Solid State Lighting System”
- Aldrich, Garbus, 8363069, “Calibration Method and Apparatus for Lighting Fixtures using Multiple Spectrum Light Sources and Light Mixing”

## **Notable Software**

- Bash Scripting
- Python
- Matlab
- C/C++
- C for PIC Microcontrollers
- Some Java and C#
- R
- LabView
- Latex