

Education

Stanford University	Stanford, CA
Ph.D. in Electrical Engineering (GPA: 3.948)	2010
M.S. Mathematics	2009
M.S. Electrical Engineering	2005
University of California, Berkeley	Berkeley, CA
B.S. Electrical Engineering and Computer Science	2003

Research Interests

Scientific computing, signal and image processing, machine learning, optimization, telecommunications, information theory, web technologies, combinatorics, recreational math, NLP

Work and Research Experience

Quantitative Engineering Design Inc. (<http://qed.ai>) California
CEO and Co-Founder 2008 - present

- QED develops scientific computing solutions for a variety data-driven markets, including bioinformatics, agriculture, computer vision, finance, and real estate. We provide clients with end-to-end information processing workflows, starting with rigorous problem formulation, followed by data collection, ETL cycles, machine learning and algorithmics, and customer-facing data visualizations and decision tools.
- Example projects: ad revenue optimization, clinical data analysis, wind forecasting, precision agriculture, EMR, computer vision for mobile apps, 3D rendering, NLP.
- Daily direction of all aspects of a >10 FTE operation, including engineering, marketing, staffing, admin.

Africa Soil and Information Service Africa
QED - Phase II Technology Development 2014 - present

- Direction, management, and sourcing of an international software development team for building end-to-end tools for soil information management and analysis. Applications developed by QED include:
 - Android and web applications for field surveys (<http://mobilesurvey.qed.ai>).
 - crowdsourcing platforms (<http://geosurvey.qed.ai>),
 - databasing systems (<http://afsisdb.qed.ai>),
 - cloud computation and machine learning tools (<http://spectpred.qed.ai>)
 - machine learning competitions (<http://kaggle.com/afsis-soil-properties>)
 - UAV image processing (<http://uav.qed.ai>)
 - interactive GIS mapping applications (<http://maps.qed.ai>).
- Composition of technical proposals for competitive RFPs and fundraising efforts.

NASA Jet Propulsion Laboratory Pasadena, CA
Telecommunications Engineer and Researcher (<http://jpl.nasa.gov>) 2010 - 2013

- OPALS: Telecommunications Cognizant Engineer responsible for design and implementation of digital signaling, source coding, channel coding, and frame synchronization for building a free-space optical communications link between Earth and the ISS. Design and implementation of image processing algorithms for optical communications. Jointly responsible for statistical link budget analysis. Relevant technologies: C, C++, Python, Perl, Mathematica, Reed-Solomon codes, PN sequences, h.264 compression.

- MRO: Simulation and Analysis Lead responsible for researching novel spectral estimation and low-complexity filtering techniques for dynamic mitigation of EM interference on satellites.
- Compressed sensing: Investigated the application of compressed sensing to spotlight synthetic aperture radar, for star-field images similar to those found in astronomical applications. Techniques used included Co-SAMP, convex optimization, and morphological image processing.
- Radioscience: Lagrange polynomial interpolation to correct for frequency biases pertaining to the GRAIL mission. Development of AJAX-based websites enabling real-time quicklooks of radio signals for multiple missions, such as MRO, MER, etc. Denoised radio signals from Cassini using filter-and-decimate DSP.
- Cloud computing: Designed and implemented cloud-based error-correcting encoders and decoders using Hadoop Streaming and AWS tools. Deployed a cloud-based Monte Carlo simulator for generating empirical waterfall curves for Turbo codes, compressing 1-2 month simulations into 1-2 hours for roughly \$50 dollars. Assisted with prototyping cloud-based computer subsystems for NASA JSC.
- Hyperspectral imaging: Briefly researched context modeling for hyperspectral image compression.
- Communications research: publishing technical papers, short proofs, and writing of research proposals.

Oregon Health and Sciences University
Bioinformatics Technical Consultant

Portland, Oregon
02/2010 - present

- Built several internal websites allowing life science researchers to share and probe large confidential datasets. Includes Mathematica-powered visualizations of bioinformatics data plotted across different dimensions. Custom-designed service oriented architecture and user management systems.
- Exercised many web technologies, including Apache, PHP, MySQL, CSS, Javascript, AJAX, webMathematica, Joomla. Implemented security safeguards using SSL, CAPTCHAs, and MD5.
- Saved upwards of \$150,000 to \$250,000 yearly through the automation of slow and error-prone manual data entry procedures, enabling technical staff to focus on higher-level research.
- Custom image segmentation algorithms using morphological image processing and denoising.

Jumio, Inc.
Computer Vision / Machine Learning Technical Consultant

Palo Alto, CA
05/2013 - 12/2013

- Machine learning and computer vision research and software development to support Jumio's NetSwipe technology that enables friction-free mobile and online credit card scanning, thereby providing revenue enhancement for various customers including Facebook, Groupon, eBay, etc.

LookAllure
Computer Vision Researcher and Development

Palo Alto, CA
12/2012 - 5/2013

- Computer vision R&D for an iPhone app that identifies shoes in a scene and returns shoes of a similar style and shape, along with prices and links to purchase.

The Math Path (<http://themathpath.com>)
Founder

California
2008 - 2010

- Established tutoring services in California and NYC for topics such as probability, MATLAB, linear algebra, differential equations, and real analysis.

Stanford University
Information Theory Teaching Assistant

Stanford, CA
01/2009 - 03/2009

- Head teaching assistant for Thomas Cover's information theory course. Redesigned website and wrote 62-page supplementary reader. Won award from EE department. "You're the best T.A. I've ever had." – T.Cover

NEC Research Labs, China
Networking Research Intern

Beijing, China
06/2007 - 09/2007

- Developed a cross-layer algorithm for the dynamic assignment of frequency channels to access points in 802.11 wireless LANs, to reduce interference and increase network throughput.

- Algorithm takes real world signal-and-traffic measurements, constructs a network graph accordingly, reduces channel assignment to a graph partitioning problem, and quickly finds a channel assignment using convex optimization (SDP).
- Implemented algorithms on a 500 m^2 20 AP office-floor testbed. Increased throughput by 30-40%.

Apple Computers, VLSI Group

Hardware Design Verification and Perl Scripting

Cupertino, CA
05/2000 - 03/2001

- Verified functions on a prototype PCI ASIC designed for the Apple PowerCube, using Vera. Located bugs then fixed in Verilog. Miscellaneous Perl scripting.

Stanford University, Information Systems Laboratory

Research Assistant for Professor Brad Osgood (advisor)

Stanford, CA
03/2005 - 6/2010

- Signal Processing: Developed discrete generalizations to the Nyquist-Shannon Sampling Theorem, allowing for irregular sampling and arbitrary signal spaces. Wrote algorithms for leveraging prior knowledge about the vector space where signals reside in order to sample and reconstruct more economically.
- Combinatorics and Probability: Discovered a new class of numbers associated with falling factorials and conjoint ranking tables. Provided combinatorial characterizations, formulas, recurrences, and relations to Stirling numbers. Researched probabilistic algorithms for the “100 prisoners and a light bulb” puzzle.
- Information Theory: Resolved a disparity between Huffman coding and the game of Twenty Questions. Researched tradeoffs between decoding delay and data rate in the theory of ergodic interference alignment.
- Geometry: Discovered geometric and algebraic phenomena associated with intersections of Bezier curves.

Publications

- Discrete Sampling and Interpolation: Orthogonal Interpolation for Discrete Bandlimited Signals. Siripuram, A.; Wu, W.; Osgood, B. Submitted to IEEE Trans. on Information Theory. ArXiv: <http://arxiv.org/abs/1411.7086>
- Using Cloud Computing To Build Flexible Low-Cost Telecom Decoders. Wu, W.; Cheng, M.. NASA Spontaneous Research and Technology Development program, FY2012.
- Discrete Sampling and Interpolation: Universal Sampling Sets for Discrete Bandlimited Spaces. Osgood, B.; Siripuram, A.; Wu, W. IEEE Trans. on Information Theory, vol. 58, no. 7, July 2012.
- Global Cloud Cover for Assessment of Optical Satellite Observation Opportunities: A HyspIRI Case Study. Mercury, M.; Green, R.; Hook, S.; Oaida, B.; Wu, W.; Gunderson, A.; Chodas, M. Remote Sensing of Environment 126 (2012) 62-71.
- A Fast Algorithm for Sparse Matrix Computations Related to Inversion. Li, S.; Wu, W. Accepted to Journal of Computational Physics on 3/9/2013.
- Twenty Questions Games Always End With Yes. Wu, W.; Gill, J. JPL IPN Progress Reports, August 15, 2011.
- Delay-Rate Tradeoffs for Ergodic Interference Alignment in the Gaussian Case. Koo, J.; Wu, W.; Gill, J. 48th Annual Allerton Conf. on Communication, Control, and Computing, Monticello, IL, Sept. 29 – Oct. 1, 2010.
- Measurement-Based Channel Management in WLANs. Liu Y.; Wu, W.; Bo, W.. IEEE Wireless Communications & Networking Conference 2010.
- 100 Prisoners and a Light Bulb – Logic and Computation. Ditsmarch, H.; Eijck, J.; Wu, W. KR 2010 (Principles of Knowledge, Representation, and Reasoning).
- Verifying 100 Prisoners and a Light Bulb. Ditsmarch, H.; Eijck, J.; Wu, W. JANCL 2010 (Journal of Applied Non-Classical Logics).
- Falling Factorials, Generating Functions, and Conjoint Ranking Tables. Wu, W.; Osgood, B. Journal of Integer Sequences, Vol. 12, 2009, Article 09.7.8.

Ph.D. Dissertation

- Advisor: Professor Brad Osgood
- Title: *“Discrete Sampling” - Digital Generalizations To The Nyquist-Shannon Sampling Theorem*

Extended Shannon’s 1949 Sampling Theorem in the discrete, finite dimensional setting, and asked when it is generally possible to interpolate a signal from a limited number of samples, using an interpolation equation like Shannon’s. Built a foundational framework for constructing such interpolation equations in arbitrary vector spaces. Research is motivated by limitations of the Nyquist-Shannon paradigm in cutting-edge technologies including NMR, ultrawideband, and analog-to-digital conversion.

Personal Projects

[[wu :: riddles](http://wurriddles.com)]

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Online Mathematics Education, Website Design and Administration

03/2002 - present

- Built and maintained a popular website for riddles and mathematical puzzles.
- Active forum community with +15,000 members, engaging in daily problem-solving discussions.
- Featured on slashdot, MENSA, Yahoo!, MSN, and several recreational math books.

Computer Skills

Scientific Computing: Python, Mathematica, Matlab

- Python libraries: nltk, scikit-learn, numpy, boto, Django, sympy, pandas
- Mathematica libraries/tools: image processing, Combinatorica, webMathematica
- MATLAB libraries: cvx, MOSEK

Compiled Languages: C, C++

- C/C++ libraries: GSL, OpenCV, Boost, CLAPACK

Scripting: PHP, Javascript, Chatscript

Visualization: d3.js, OpenGL, Google Maps, MapBox

Markup: HTML, CSS, LaTeX, Twitter Bootstrap

Source Control: Git, Gitolite, SourceTree

Editors and IDEs: vim, PyCharm, Dreamweaver, Wolfram Workbench

Databases: MySQL, MongoDB, PostgreSQL

Web Servers: Nginx, Apache

Project Management: Asana, Trello, Omniplan

Cloud Computing AWS: {EC2, S3, SQS, SNS, EMR}, Hadoop, cPanel

Hardware: Google Glass, Arduino, Raspberry Pi

Operating Systems: Mac OS X, Linux/UNIX, Windows 95/98/2000/XP/7

CMS: Wordpress, Joomla, Mediawiki

Graphic Design: OmniGraffle, xfig, Photoshop, UltraFractal

Publishing: L^AT_EX, MS Office, Google Apps for Business, Pages

Github: <http://github.com/qedsoftware>

Presentations

“Introduction to Network Coding.” NEC Research Labs, Beijing, China, 7-6-2007.

“Dynamic Channel Assignment for WLANs.” Research group of John M. Cioffi, Stanford, 4-16-2010.

“Discrete Sampling - Discrete Generalizations of the Nyquist-Shannon Sampling Theorem”

- Computer Forum, Stanford University, 4-15-2009.
- Center for Computer Research in Music & Acoustics, Palo Alto, CA, 4-22-2009.
- Information Systems Lab Student Colloquium, Stanford University, 5-15-2009.
- Hewlett-Packard Labs, Palo Alto, CA, 6-24-2009
- Jet Propulsion Laboratory, Pasadena, CA, 1-21-2010.
- Courant Institute of Mathematical Sciences, New York, NY, 2-24-2010.
- Center for Communications Research, Princeton, NJ, 4-27-2010.
- Bell Labs, Murray Hill, NJ, 5-03-2010.
- IDeAS Seminar, Princeton University, 5-04-2010.

“Research Problems in Telecommunications.” Exponent, Inc. 420 Lexington Ave., NY, 3-24-2010.

“Graph-Theoretic Problems in Sampling and Compression.” Discrete Mathematics Seminar, Columbia University IEOR Department, 3-30-2010.

Awards

- Technical Awards
 - Berkeley Social Innovation Hackathon, First Place 2014
 - NASA Silver Achievement Award (OPALS) 2014
 - Berkeley Cleanweb 2.0 Hackathon, First Place Water Track 2014
 - UC Berkeley Center For New Media (BCNM) Chatbot Hackathon, First Place 2014
 - MATLAB Programming Contest Twilight Round, 6th Place 2012
 - Stanford Flipside Rebus Puzzle Contest, Fall Quarter Winner 2011
 - DARPA Shredder Challenge, Honorable Mention, 13th out of +9000 teams worldwide 2011
 - Mathematica One-Liner Competition, Third Place and Two Honorable Mentions 2011
 - 1st Place CLTAC Chinese Speech Competition, 3rd year division 2007
 - Tau Beta Pi and Eta Kappa Nu 1999-2003
 - UC Berkeley CS150 Digital Logic Design Competition, First Place 2001
 - SF Bay Area Science Fair, Physical Science, First Place 1999
- Teaching Awards
 - Hugh H. Skilling Teaching Award from Stanford Electrical Engineering Department 2008-2009
 - Tau Beta Pi 2nd Place Tutoring Award, UC Berkeley Chapter 2003
- Scholarships
 - Frank H. and Eva Buck Scholarship (full tuition + board through doctorate) 1999-2009
 - Wheeler J&E Scholarship (UC Berkeley) 1999-2000

Coursework

Electrical Engineering

signal processing, DSP, communications, linear systems, information theory, error correcting codes, estimation, network coding, image processing, linear & nonlinear control

Computer Science

deterministic and randomized algorithms, machine learning, data structures and programming, complexity theory, computer architecture, operating systems, logic design

Mathematics

probability, stochastics, linear algebra, convex optimization, combinatorics, fourier analysis, real and complex analysis, mathematical finance, abstract algebra, representation theory, statistical inference, functional analysis, differential eqns., dynamic programming, number theory

Citizenship and Verbal Skills

U.S. Citizen. Native speaker of English. Experienced with technical presentations and public speaking. Conversational fluency in Mandarin; participated in exchange programs with both Tsinghua and Beijing University.

Hobbies

recreational puzzles, coding, tutoring, web design, rollerblading, game emulation, juggling, nunchaku.

References

David Bell Group Supervisor Jet Propulsion Laboratory, Communications Systems Eng.	David.J.Bell@jpl.nasa.gov (818) 393-9048 4800 Oak Grove Dr., Pasadena, CA 91030
Brad G. Osgood Professor of Electrical Engineering; PhD Advisor Stanford University	osgood@stanford.edu (650) 723-4002 350 Serra Mall, Packard 271, Stanford, CA 94305
Thomas Willomitzer Chief Technology Officer; developer of Last.FM Jumio	willo@jumio.com 268 Lambert Ave., Palo Alto, CA 94306
Kenneth S. Andrews Technical Staff Jet Propulsion Laboratory, Communications Research	Kenneth.S.Andrews@jpl.nasa.gov (818) 354-5865 4800 Oak Grove Dr., Pasadena, CA 91030
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