

Education

Stanford University	Stanford, CA
Ph.D. in Electrical Engineering	09/2003 - 06/2010
M.S. Mathematics	09/2005 - 06/2009
M.S. Electrical Engineering	09/2003 - 06/2005
University of California, Berkeley	Berkeley, CA
B.S. Electrical Engineering and Computer Science	09/1999 - 05/2003

Ph.D. Dissertation

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

Reexamined Shannon’s 1949 Sampling Theorem and asked when it is generally possible to interpolate a discrete signal from a limited number of samples, using an interpolation equation like Shannon’s. Built a theory of “Discrete Sampling” that lays a foundational framework for constructing such interpolation equations. Research is motivated by the limitations of the Nyquist-Shannon sampling paradigm in many cutting-edge technologies including NMR, ultrawideband, and analog-to-digital conversion.

Research Interests

Signal and image processing, telecommunications, information theory, error-correcting codes, algorithms, web tech., optimization, combinatorics, probability, recreational math, natural language processing.

Research Experience

Jet Propulsion Laboratory	Pasadena, CA
Member of Technical Staff, Communications Architectures and Research	10/2010 - present

- Research and implementation of novel, highly-efficient algorithms for spectral estimation and adaptive filtering of interference aboard spacecraft with severely limited computational resources.
- Telecommunications Cognizant Engineer responsible for design and implementation of signaling and coding schemes used for optical communications links, including video compression, error correction codes, frame synchronization, etc. Channel capacity analysis and statistical link budgets. Computer vision algorithms for laser detection and tracking.
- Demonstrated how Hadoop and the Amazon Elastic Compute Cloud can be used to dramatically reduce temporal and financial costs of embarrassingly parallel large computations related to both the practical processing and theoretical analysis of error-correcting codes.
- Researched applications of compressed sensing to synthetic aperture radar, making contributions related to image processing, optimization, numerical analysis, and software management.

- Implementation of signal processing algorithms and numerical methods for GRAIL, Cassini, MSL.
- Theoretical research in signal processing and information theory, including composing proofs and publishing papers. Conception of new research ideas and writing proposals.
- Relevant technologies: C, C++, Mathematica, MATLAB, Python, Perl, Reed-Solomon codes, LDPC codes, PN sequences, h.264 compression, parallel computing, digital filtering, LAMP, Amazon EC2/EMR/S3, Hadoop, Joomla, cvx, MOSEK

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:**
 Discovered a new class of numbers associated with falling factorials and conjoint ranking tables. Provided combinatorial characterizations, formulas, recurrences, and relations to Stirling numbers.
- **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.
- **Recreational Math:**
 Researched probabilistic algorithms for the “100 prisoners and a light bulb” puzzle.
- **Geometry:**
 Discovered geometric and algebraic phenomena associated with intersections of Bezier curves.

NEC Research Labs, China
 Networking Research Intern

Beijing, China
 06/2007 - 09/2007

- Developed cross-layer algorithm for 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 corresponding network graph, reduces channel assignment to a graph partitioning problem, and quickly finds an approximately optimal channel assignment using semidefinite programming (convex optimization).
- Implemented algorithms on a 500 m^2 20 AP office-floor testbed. Throughput increase of 30-40%.

Work Experience

[redacted for confidentiality]
 Independent Technical Consultant

[redacted for confidentiality]
 [redacted]

- Developed and deployed several easy-to-use internal websites allowing bioinformatics researchers to investigate large confidential datasets in a distributed fashion, primarily for medical diagnosis and tracking applications. Includes web-based graphical visualizations of multi-dimensional data.

- Custom designed service oriented architecture and user management systems.
- Websites for the scheduling of medical procedures, using persistent state techniques (Comet).
- Relevant technologies: PHP, Javascript, Python, AJAX, CSS, LAMP, Mathematica, webMathematica, Wolfram CDF, Joomla, SSL, CAPTCHAs, MD5.
- Designed and implemented customized automated image segmentation algorithms using morphological image processing and denoising techniques.

The Math Path, LLC (<http://themathpath.com>)
Co-Founder

California
2008 - present

- Founded a small consulting company offering statistical consulting and math tutoring services to a wide range of clients, ranging from individuals to corporations.
- Projects have included ad revenue optimization, clinical data analysis, orchard insect detection, bioinformatics software, quantitative finance, and natural language processing.
- Established tutoring services in California and NYC for topics such as probability, MATLAB, linear algebra, differential equations, and real analysis.

Apple Computers, VLSI Group
Hardware Design Verification Intern

Cupertino, CA
05/2000 - 03/2001

- Verified functions on an ASIC for the Apple PowerCube, using Vera. Located bugs fixed in Verilog.

Publications

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 HypsIRI 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 Conference 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.

Dynamic Channel Assignment in Wireless LANs. Bo, W.; Wu, W.; Liu, Y. Power Electronics and Intelligent Transportation Systems (PEITS), 2008.

Presentations

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

“Dynamic Channel Assignment for WLANs”, Communications research group of John M. Cioffi, Stanford University, 4-2010.

“Geometry and Algebra of Bezier Curves”, Information Theory group of Thomas Cover, Stanford University, 9-2009.

“Falling Factorials, Generating Functions, and Conjoint Ranking Tables”, Information Theory group of Thomas Cover, Stanford University, 10-2009.

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

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

“Research Problems in Telecommunications.” Exponent, Inc. 420 Lexington Ave., Suite 1740, NY 10170, 3-2010.

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

Teaching Experience

Stanford University

Information Theory Teaching Assistant

Stanford, CA

01/2009 - 03/2009

- Served as head teaching assistant for Thomas Cover’s information theory course. Redesigned website and wrote a 62-page supplementary reader. “You’re the best T.A. I’ve ever had.” – T.Cover

themathpath.com

Mathematics Education

Berkeley, CA / Palo Alto, CA / New York, NY

09/2005 - present

- Offered wide range of tutoring services in California and NYC, including probability, MATLAB, linear algebra, and custom courses such as real analysis for gifted teens.

Teaching Interests

signal processing, probability and random processes, linear dynamical systems, mathematica and matlab programming, communications engineering, information theory, real analysis, group theory

Personal Project

[**wu :: riddles**] <http://wuriddles.com>
 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.

buckscholars.org <http://buckscholars.org>
 Webmaster 6/2009 - present

- Built and maintained a website to help a group of scholars stay connected and informed about each others' talents. One might call it a really tiny Facebook, but without all the annoying stuff.
- Features (all custom-written): SSL, search GUI, Google Maps integration, user profiles and privacy management system, CAPTCHAs, fundraising donations, videos, graphs, Facebook Connect.

Computer Skills

Languages: Mathematica, Matlab, C, C++, Python, Perl, PHP, Javascript

Languages I Could Re-learn: Java, Lisp, iPhone SDK, Verilog, MIPS, x86

Source Control: Git

Packages: Hadoop, GSL, NLTK, OpenCV, cvx, MOSEK, CLAPACK, Combinatorica, OpenCV

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

Web: PHP, MySQL, HTML, CSS, AJAX, Dreamweaver, webMathematica, Apache, Tomcat, Mediawiki, Joomla, Wordpress, Google Apps, cPanel, cloud hosting, AWS (EC2, EMR, S3, CloudFormation)

Graphic Design: OmniGraffle, xfig, Photoshop, UltraFractal

Publishing: L^AT_EX, MS Office, Pages

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

Awards

- Teaching

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 and board through doctorate)	1999-2009
Wheeler J&E Scholarship (UC Berkeley)	1999-2000
- Technical Awards

MATLAB Programming Contest Twilight Round, 6th Place	2012
DARPA Shredder Challenge, Honorable Mention, 13th out of +9000 teams worldwide	2011
Mathematica One-Liner Competition, 3rd Place and 2x Honorable Mentions	2011
Tau Beta Pi and Eta Kappa Nu	1999-2003
1st Prize in UC Berkeley CS150 Digital Logic Design Competition	2001
SF Bay Area Science Fair, First Place in Physical Science	1999
- Non-Technical Awards

Stanford Flipside Rebus Puzzle Contest, Fall Quarter Winner	2011
1st Place CLTAC Chinese Speech Competition, 3rd year division	2007

Coursework

Electrical Engineering

signal processing, digital communications, linear systems, information theory, error correcting codes, digital image processing, morphological image processing, convex optimization, dynamic programming, wireless, network coding, medical imaging, linear & nonlinear control

Computer Science

theory of algorithms, randomized algorithms, complexity and automata theory, data structures and programming, machine learning and data mining

Probability and Statistics

theory of probability, stochastic processes, statistical inference, mathematical finance

Mathematics

real and complex analysis, combinatorics, abstract algebra, fourier analysis, representation theory, functional analysis, differential equations, number theory

Citizenship and Verbal Skills

U.S. Citizen. Native speaker of English. Conversational fluency in Mandarin Chinese. Experienced with technical presentations and public speaking.

Hobbies

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

References

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