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POSITION

MRS-II research scientist at (Xerox) PARC, working in the areas of control systems, convex optimization, manufacturing systems, networks and embedded systems.

EDUCATION

Ph.D.	<i>Stanford University</i> , Electrical Engineering	2000
M.S.	<i>Stanford University</i> , Electrical Engineering	1992
B.Sc.	<i>Imperial College</i> , Physics	1990

THESIS TOPIC

Local Analysis of Perturbed Linear Systems with Application to Saturating Control Systems
Research advisors: Professor Stephen Boyd and Professor John Fox

AWARDS

- Hugo Schuck Best Theory Paper Award, American Control Conference 1998
- Numerous Best in Session Prizes, at major conferences 1998-2006

RESEARCH EXPERIENCE

Research Scientist, *Palo Alto Research Center (PARC)*, Dr. Wheeler Ruml 2003-Present

- Developing general protocols for state synchronization of distributed networked control systems. Enables new agents to join in and leave a cooperative control task, and seamlessly continue a control task from where another agent left off, in the presence of network communication delays.
- Developed new extensions of network flow theory (multistage multicommodity) for routing and scheduling in complex manufacturing networks. Our method provides new convex relaxations for the hard problem of throughput optimization, enabling existing methods to scale to much larger problems and the explicit computation of provably optimal discrete schedules using mixed integer network flows.
- Time-optimal and quadratic feedback and feedforward control architecture for both stabilization and trajectory tracking, with asynchronous measurements and network delays.
- Embedded systems software design and implementation of various networked control algorithms and protocols, for deployment on fixed point DSP processors in a networked environment.
- Mixed interger programming procedures for image segmentation problems in machine vision and perceptual document analysis.
- Preparation of grant proposals and internal lectures on optimization and control.

Post-Doctoral Research Associate, *Stanford University*, Prof. Stephen Boyd 2000-2003

- Developing convex semidefinite relaxation methods for general matrix rank minimization problems which arise control, signal processing, statistics and econometrics. Methods developed can be used to synthesize low complexity system models, making practical high-speed implementation considerably easier.

- Methods for automating computation of optimal multivariable nonparametric uncertainty models from frequency domain data, for use in robust control design. The techniques developed allow engineers to obtain uncertainty models directly from the data, thus saving time on the complex task of uncertainty modeling.
- Control of dynamical systems and networks with communication resource limits. Wrote and tested interior-point convex-optimization code for network optimal routing and resource allocation. Results showed large improvements in network throughput and closed loop performance are possible, by simultaneously optimizing both communication resources and network or dynamical system.
- Algorithms for coordination and control of sensors networks, and for performing tasks such as target tracking and estimation. Cutting plane optimization methods for polyhedral estimation; developed Markov chain models for tractable performance analysis.
- Gained experience in writing and managing research grants from NSF and DARPA.

Research Control Engineer, *Quantum Corporation*, Dr. Richard Ehrlich 1998-2000

- Control design for high-speed on-track MEMS head positioning system in computer data storage devices, using multivariable dynamic game-theory (H_∞ -control). Determined limits of performance via multiobjective optimization. Superior tracking performance of these controllers proved it possible to significantly increase storage capacity of disk drives by reducing track spacing.
- Modeling and frequency-domain subspace identification of multivariable disk drive dynamics, uncertainty and disturbance noise spectra. Development of new techniques for automated identification of disturbances and for computation of tight uncertainty models which can increase yield in manufacturing.
- Gave talks, seminars and workshops on the use of modern control theory and optimization for the modeling, identification and control of disk drives.
- Evaluated various patents and new technologies; reviewed papers for journals and conferences.

Research Assistant, *Stanford University*, Prof. Stephen Boyd 1994-2000

- Theory and efficient convex optimization based computational algorithms for Lyapunov analysis of local stability, disturbance rejection, and rms-gain of systems with nonlinear components. The techniques developed enable engineers to compute safety guarantees about systems which operate at the edge of their performance envelope, such as upper bounds on distortion, regions of attraction, etc.
- Method for multiobjective H_2/H_∞ control: LMI theory used to eliminate truncation errors in cost and constraints; Q -parametrization used to reduce conservatism of multiobjective design. These techniques allow precise computation of tradeoffs between critical control design objectives such as actuator effort, closed loop response and system robustness.
- Robust optimization techniques for solution of linear approximation problems with uncertainty in problem data. Considered structured, unstructured, deterministic and stochastic uncertainty. This extends least squares techniques to explicitly allow for errors in coefficient matrices.

Research Assistant, *Stanford Linear Accelerator Center*, Prof. John Fox 1991-97

- Led design and evaluation of decentralized high-speed control algorithms for charged particle storage rings, implemented on DSP processors. Used optimal control to tradeoff between computation time, amplifier power and particle-beam motion. Various optimality criteria used, such as closed loop rms performance, and peak-to-peak gain. Algorithms led to doubling performance of synchrotron radiation in key national lab facilities.
- Developed formal model of interaction between charged particle beam and feedback system using techniques from control theory, signal processing and estimation, such as frequency domain analysis, state-space modeling, digital control, statistical modeling of noise disturbances. Allowed prediction of unstable behavior without wasting valuable machine run-time.

- Wrote code for automatic system identification of both state-space and frequency domain models of process and time delay, using white noise and shaped noise signal excitation. Worked order of magnitude faster than frequency swept methods.
- Analyzed effects of power amplifier noise on closed loop rms noise. Investigated effects of downsampling on noise rejection in feedback system using both analytical modeling and simulation.
- Designed and implemented in 'C' a Pairwise Nearest Neighbor Clustering Algorithm for grouping magnets with similar focusing errors using sophisticated data structures.

Research Assistant, Imperial College & Schlumberger Instruments, Prof. Asoke Nandi 1990

- Implementation of quadratic programming algorithm for optimization of shock testing waveforms in Schlumberger frequency response analyzers (summer research position).

Research Assistant, Imperial College, Prof. Igor Aleksander 1989

- Computer simulation in 'C' of neural network of Probabilistic Logic Neurons (PLNs), in both synchronous and asynchronous operation (summer research position).

TEACHING EXPERIENCE

Lecturer, Duke University & U.C. Berkeley (co-taught with Prof. John Fox) 1995, 1997

- Taught one week course on Optimal Control and Estimation (UC Berkeley Physics 416). Prepared 200 page course reader, homework problems, and computer exercises. Student evaluations rated course as excellent.

Lecturer, Stanford University & PARC (co-taught with Prof. Stephen Boyd) 2001, 2006

- Taught short course on Convex Optimization and ran seminar for Software Enabled Control Group in the Electrical Engineering and Aeronautics and Astronautics Departments and, once again, in-house at PARC.

Research Mentor, Stanford University & PARC 1997-present

- Mentor to Ph.D. students from electrical engineering, aeronautics and applied physics at Stanford University, and PhD intern students at PARC. Advised on problems in control, convex optimization and numerical methods.

ADMINISTRATIVE AND TECHNICAL COMMITTEE SERVICES

Grant Writing/Administration, Stanford University & PARC, 2000-present

- Experience in writing and maintenance of grants from NSF, DARPA, AFOSR; managing customer relationships; compiling quarterly reports on group research activity; preparing presentations for funding reviews.

Academic Representative, Imperial College, Physics dept. 1987-88, 1988-89

- Position involved the administration of course surveys from the students, collecting statistics, and personal communication of feedback from over 200 students in my year to professors about their courses.

Reviewer, Stanford University & PARC, 1998-present

- IEEE journals: Trans. on Automatic Control; Trans. on Signal Processing; Trans. on Magnetics; and Automatica; Journal of Nuclear Instruments; American Control Conference; IEEE Conference on Decision and Control.

COMPUTER SKILLS

- Expert in MATLAB programming, experience in 'C', knowledge of Simulink.
- Experience with various optimization software packages CPLEX, CVX, SeDiMi, etc.
- Knowledge of assembly and DSP programming, UNIX environment.
- Latex, Word, PowerPoint document preparation.

PERSONAL INFORMATION

- Strong communication and organizational skills.
- Multilingual, traveled extensively.
- Enjoy outdoor activities such as cycling, hiking and windsurfing.
- Love learning new theories to solve real problems.

SELECTED PUBLICATIONS

- H. Hindi, W. Ruml, “Network Flow Modeling for Flexible Manufacturing Systems with Re-entrant Lines.” *Proc. IEEE Conf. on Decision & Control*, December 2006.
- H. Hindi. “Tutorial on Convex Optimization II: Duality and Interior Point Methods.” *Proc. American Control Conference*, Jun 2006.
- S. Yuksel, H. Hindi, L. Crawford. “Optimal Tracking with Feedback-Feedforward Control Separation over a Network.” *Proc. American Control Conference*, Jun 2006.
- H. Hindi, L. Crawford, “Synchronization of State Based Control Processes with Delayed and Asynchronous Measurements.” *Proc. IEEE Conf. on Decision & Control*, December 2005.
- M. Fromherz, L. Crawford, H. Hindi. “Coordinated Control for Highly Reconfigurable Systems.” *Hybrid Systems Control Conference*, Mar 2005.
- H. Hindi. “Tutorial on Convex Optimization.” *Proc. American Control Conference*, Jun 2004.
- L. Xiao, M. Johansson, H. Hindi, S. Boyd, A. Goldsmith. “Joint Optimization of Communication Rates and Linear Systems.” *IEEE Trans. Aut. Contr.*, January 2003.
- H. Hindi, C. Seong, S. Boyd. “Computation of Optimal Uncertainty Models from Frequency Domain Data.” *Proc. IEEE Conf. on Decision & Control*, December 2002.
- K.-Y. Tsai, H. Hindi. “DQIT: μ -Synthesis without D-Scale Fitting.” *IEEE Trans. Aut. Contr.*, 2003.
- M. Fazel, H. Hindi, S. Boyd. “Log-Det Heuristic for Matrix Rank Minimization with Applications to Hankel and Euclidean Distance Matrices.” *Submitted to American Control Conference*, June 2003.
- M. Fazel, H. Hindi, S. Boyd. “A Rank Minimization Heuristic with Application to System Approximation.” *Proc. American Control Conference*, June 2001.
- L. Xiao, H. Hindi, M. Johansson, S. Boyd. “Distributed Active Sensing in the MVE Framework.” *Presented at the DARPA PI Meeting*, May 2001.
- T. Paré, H. Hindi, J. How, D. Banjerdpongchai. “Local Control Design for Systems with Saturating Actuators using the Popov criteria.” *Proc. American Control Conference*, San Diego, CA, July 1999.
- H. Hindi, S. Boyd. “Analysis of Linear Systems with Saturation using Convex Optimization.” *Proc. IEEE Conf. on Decision and Control*, Tampa, FL, December 1998.
- H. Hindi, B. Hassibi, and S. Boyd. “Multiobjective H_2/H_∞ -Optimal Control via Finite Dimensional Q -Parametrization and Linear Matrix Inequalities.” *Proc. American Control Conference*, Philadelphia, PA, June 1998.
- H. Hindi, S. Boyd. “Robust Solutions to l_1 , l_2 , and l_∞ Uncertain Linear Approximation Problems using Convex Optimization.” *Proc. American Control Conference*, Philadelphia, PA, June 1998.
- H. Hindi, S. Prabhakar, J. Fox, et al. “Design and Verification of Controllers for Longitudinal Oscillations using Optimal Control Theory and Numerical Simulation: Predictions for PEP-II.” *Proc. 1997 Particle Accelerator Conference*, Vancouver, May 1997.
- S. Prabhakar, J. Fox, H. Hindi. “A Matrix Formalism for Landau Damping.” *Presented at 14th Advanced ICFA Beam Dynamics Workshop: Beam Dynamics Issues for $e^+ e^-$ Factories (ICFA 97)*, Frascati, Italy, October 1997.
- H. Hindi, S. Prabhakar, J. Fox, et al. “Clustering using a Pairwise Nearest Neighbor (PNN) Algorithm.” *Technical Report AP-Note-96.26, Stanford Linear Accelerator Center*, June 1996.

- H. Hindi, J. Fox et al. "Measurement of Multi-Bunch Transfer Functions using Time-Domain Data and Fourier analysis." *Fifth Annual Beam Instrumentation Workshop*, 1994.
- H. Hindi, J. Fox et al. "A Formal Approach to the Design of Multi-Bunch Feedback Systems: LQG Controllers." *Fourth European Particle Accelerator Conference*, 1994.
- H. Hindi, J. Fox et al. "Analysis of DSP-Based Longitudinal Feedback System: Trials at SPEAR and ALS." *Proc. of the International Conf. on Particle Accelerators*, 1993.
- H. Hindi, W. Hosseini, D. Briggs, J. Fox, A. Hutton. "Down Sampled Signal Processing for a B-Factory Bunch-By-Bunch Feedback System." *Proc. Third European Particle Accelerator Conference*, Berlin, March 1992.

Papers may be downloaded from my website: <http://www2.parc.com/isl/members/hhindi>