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Education

- Ph.D. in Electrical and Computer Engineering, Expected May 2003
Rice University, Houston, TX
Non-coherent and partially coherent space-time constellations
Advisor: Dr. Behnaam Aazhang GPA: 4.25/4.00
- M.S. in Communication Systems, January 1996
Sharif University of Technology, Tehran, IRAN
Multiuser detection and parameter estimation in CDMA communication systems
Advisor: Dr. M. Nasiri-Kenari GPA: 18.37/20
- B.S. in Electronics, September 1993
Sharif University of Technology, Tehran, IRAN GPA: 18.31/20

Research Interests

Wireless communication systems and networks; Information and coding theory: non-coherent and partially coherent space-time constellations, coherent space-time coding, multi-level and multi-dimensional coded modulation; Multiuser communications: CDMA and multi-carrier CDMA (OFDM-CDMA) communication systems, multiuser detection and channel estimation.

Honors

- Nokia Mobile Phones R&D Intern Scholarship, 2002
- Rice University Fellowship, 1999
- B.S. and M.S. degrees with highest honors from Sharif University of Technology, IRAN, 1993 and 1996
- Exemption from the national university entrance exam as an honor student and IMO medalist, 1989
- Silver Medal in International Mathematics Olympiad (IMO), Germany, 1989

Professional Activities and Affiliations

- *Reviewer* for IEEE Transactions on Information Theory, IEEE Transactions on Communications, IEEE Transactions on Wireless Communications, IEEE Communication Letters, IEEE International Symposium on Information Theory, and IEEE International Conference on Communications.
- *Member* of IEEE Communications and Information Theory societies.

Research Summary

The main contributions of my previous and current research work have been in the areas of multiple-antenna and multi-user communications. In the area of multiple-antenna systems, I have designed spectrally-efficient and power-efficient codes and constellations for a wide range of scenarios in terms of the amount of channel state information available at the receiver. In the area of multi-user communications, I have developed efficient receiver algorithms for CDMA and Multi-Carrier CDMA systems. Below, I have summarized the main contributions of my research.

Multiple-Antenna Systems

- *Coherent Space-Time Codes* (complete channel state information at the receiver, low mobility): A concatenated space-time code structure, which uses a single-antenna multi-dimensional TCM or MTCM scheme as the outer code and an orthogonal transmit diversity scheme as the inner code. It provides a systematic method to design space-time codes with significant performance improvement over the existing space-time block and trellis codes.
- *Non-coherent Space-Time Codes and Constellations* (no channel state information at the receiver, high mobility): A new code and constellation design criterion based on the Kullback-Leibler distance between distributions which results in power-efficient non-coherent space-time constellations for high spectral efficiencies, and a recursive construction method for designing real single-antenna constellations with low decoding complexity.
- *Partially Coherent Space-Time Codes and Constellations* (partial channel state information at the receiver, moderate speeds): A code and constellation design criterion based on the KL distance between distributions which results in partially coherent constellations with significant performance improvement over the existing coherent constellations in the presence of channel estimation errors.

Multiuser Communications

- *CDMA Systems*: A computationally efficient suboptimal receiver for CDMA systems in fast fading multipath environments based on the EM algorithm and canonical representation of the signals and the channel, which has an iterative structure similar to the parallel interference cancellation scheme but with significantly improved performance.
- *Multi-Carrier CDMA Systems*: Efficient channel estimation and signal detection algorithms for MIMO multi-carrier CDMA systems in the presence of transmit pulse-shaping filter.

Work Experience

- **Internship**, *Nokia Mobile Phones, Irving, Texas* (May—Oct 2002)
Worked on receiver algorithms for MIMO MC-CDMA systems.
- **Summer Internship**, *Nokia Mobile Phones, Oulu, Finland* (May—July 2000)
Worked on suboptimal receivers for BLAST (Bell Laboratories Space-Time) architecture, and proposed an iterative joint detection and decoding algorithm with soft inputs for the decoder.
- **Research Assistant**, *Rice University* (June 1999—present)
Worked on design criteria and construction of non-coherent and partially coherent space-time constellations. Worked on coded modulation and space-time coding schemes for a wireless LAN project.
- **Director of Training and Supporting Section**, *Bamdad Computer Company* (September 1996—January 1999)

Offered several training courses and conducted several projects on Unix systems and networks administration.

- **Research Assistant**, *Sharif University of Technology* (October 1994—March 1996)
Worked on multiuser detection and channel estimation techniques for DS-CDMA communication systems.
- **Systems and Network Administrator**, *Tehran Municipality* (May 1994—August 1996)
Administered Unix systems and network, including different Solaris and Windows operating systems.
- **Undergraduate Industrial Training Course**, *Iran Telecommunications Research Center* (June—August 1992)
Designed and implemented a carrier amplitude modulator and demodulator for transmission and reception of dialing signals and On-Hook/Off-Hook states of pulse mode telephone systems over a DC rejecting wire channel.

Publications

In Preparation

- M. J. Borran, A. Sabharwal, B. Aazhang, “Partially coherent space-time constellations”, to be submitted to the *IEEE Transactions on Information Theory*.
- M. J. Borran, A. Sabharwal, B. Aazhang, “A recursive construction for low-complexity non-coherent constellations”, to be submitted to the *IEEE Transactions on Communications*.

Submitted

- M. J. Borran, A. Sabharwal, B. Aazhang, “On design criteria and construction of non-coherent space-time constellations”, submitted to the *IEEE Transactions on Information Theory, Special Issue on Space-Time Transmission, Reception, Coding and Signal Design*, 2002.
- M. J. Borran, A. Sabharwal, B. Aazhang, “Power-efficient non-coherent space-time constellations”, submitted to the *IEEE International Symposium on Information Theory (ISIT)*, 2003.
- M. J. Borran, P. Varshney, H. Vilpponen, P. D. Papadimitriou, “Channel estimation and signal detection for multi-carrier CDMA systems with pulse shaping filter”, to appear in the *Proceedings of the IEEE International Conference on Communications (ICC)*, 2003.
- M. J. Borran, M. Memarzadeh, B. Aazhang, “Design of coded modulation schemes for orthogonal transmit diversity”, submitted to the *IEEE Transactions on Communications*, 2001.

Published

- M. J. Borran, A. Sabharwal, B. Aazhang, “Constellations for imperfect channel state information at the receiver”, *Proceedings of the 40th Annual Allerton Conference on Communication, Control, and Computing*, 2002.
- M. J. Borran, A. Sabharwal, B. Aazhang, D. H. Johnson, “On design criteria and construction of non-coherent space-time constellations”, *Proceedings of the IEEE International Symposium on Information Theory (ISIT)*, 2002.
- M. J. Borran, B. Aazhang, “EM-based multiuser detection in fast fading multipath environments”, *EURASIP Journal on Applied Signal Processing, Special Issue on 3G Wireless Communications and Beyond*, August 2002.

- M. J. Borran, M. Memarzadeh, B. Aazhang, “Design of coded modulation schemes for orthogonal transmit diversity”, *Proceedings of the IEEE International Symposium on Information Theory (ISIT)*, 2001.
- M. J. Borran, R. Nowak, “Wavelet-based denoising using hidden Markov models”, *Proceedings of the International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*, 2001.
- M. J. Borran, B. Aazhang, “Multilevel codes and iterative multistage decoding: rate design rules and practical considerations”, *Proceedings of the IEEE Wireless Communication and Networking Conference (WCNC)*, 2000.
- M. J. Borran, M. Nasiri-Kenari, “An efficient detection technique for synchronous CDMA communication systems based on the expectation maximization algorithm”, *IEEE Transactions on Vehicular Technology*, vol. 49, pp. 1663-1668, Sept 2000.
- M. J. Borran, M. Nasiri-Kenari, “Joint multiuser detection and parameter estimation in CDMA communication systems based on the EM algorithm” (in Farsi), *Proceedings of the Fifth Iranian Conference on Electrical Engineering*, 1997
- M. J. Borran, M. Nasiri-Kenari, “An efficient decoding technique for CDMA communication systems based on the expectation maximization algorithm”, *Proceedings of the IEEE Forth International Symposium on Spread Spectrum Techniques and Applications*, 1996.
- M. J. Borran, “Multiuser detection and parameter estimation in CDMA communication systems” (in Farsi), MS thesis, January 1996.

Presentations

- “Constellations for imperfect channel state information at the receiver”, *Allerton Conference on Communication, Control, and Computing*, 2002.
- “Design of coded modulation schemes for orthogonal transmit diversity”, *IEEE International Symposium on Information Theory (ISIT)*, 2001.
- “Wavelet-based denoising using hidden Markov models”, *International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*, 2001.
- “Multilevel codes and iterative multistage decoding: rate design rules and practical considerations”, *IEEE Wireless Communication and Networking Conference (WCNC)*, 2000.
- “Joint multiuser detection and parameter estimation in CDMA communication systems based on the EM algorithm”, *Iranian Conference on Electrical Engineering*, 1997
- Annual poster presentations at the Industrial Affiliates Meeting, ECE Department, Rice University, 1999-2002

Patents

- “Constellations for imperfect channel state information at the receiver”, M. J. Borran, A. Sabharwal, B. Aazhang, *Provisional patent application has been filed.*
- “Channel estimation and signal detection for multi-carrier CDMA systems with pulse shaping filter”, M. J. Borran, P. Varshney, H. Vilpponen, P. D. Papadimitriou, *Provisional patent application has been filed.*

Teaching

- *Teaching Assistant* for five semesters, ECE Department, Rice University. Experience involved conducting guest lecture sessions and help sessions, grading assignments and exams, and preparing solution sets for courses on digital and wireless communications, and designing lab assignments for digital communications lab using Matlab Simulink.
- *Participated in several teaching workshops* at Rice intended for graduate students and faculty. These workshops addressed several issues including teaching and learning styles, use and abuse of technology in the classroom, teacher's responsibilities, and other related issues.
- *Instructor and director of Training and Supporting Section* of Bamdad Computer Company (Tehran, IRAN) for three years. Experience involved designing and offering several courses on different operating systems and computer networks for different audiences on both theoretical and practical subjects.

Course Work

Detection Theory, Spectral Analysis, Advanced Digital Signal Processing (Wavelets), Wireless Communications, Estimation Theory, Data Networks, Mobile Communications, Information Theory and Coding, Digital Image Processing, Radar Systems, Microwave Active Circuits, Advanced Digital Communication Systems
Functional Analysis, Optimization Theory, Stochastic Analysis, Measure Theory

References

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