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RESEARCH INTERESTS

Information Theory, Communication Theory, Machine Learning, Game Theory, Statistical Inference, Cognitive Radios, Wireless Systems and Networks, Wireless Security and Cross-Layer Resource Allocation

EDUCATION

Ph.D	Electrical and Computer Engineering	<i>University of Massachusetts</i>	Sept.	2003
Advisor:	Prof. Dennis L. Goeckel			
M.S.	Communication & electronic systems	<i>Tsinghua University, China</i>	July	1998
Advisor:	Prof. Xiuming Shan			
B.E.	Electronic Techniques & Information Systems	<i>Tsinghua University, China</i>	July	1995
Advisor:	Prof. Xiuming Shan			

WORK EXPERIENCE

Aug. 2009– present	Associate Professor (with tenure)	Louisiana State University
Aug. 2003– Aug. 2009	Assistant Professor	Louisiana State University
Sept. 1998– Aug. 1999	Graduate Teaching Assistant	University of Massachusetts
Sept. 1999– Aug. 2003	Graduate Research Assistant	University of Massachusetts

AWARDS and HONORS

- Elevated to IEEE Senior Member, May 2016
- Michael B. Voorhies Distinguished Professor of Electrical Engineering, Dec. 2013 – present
- Air Force Summer Faculty Fellowship: 5/2010 – 7/2010 (10 weeks)
- Oversea Visiting Scholar at Tsinghua University, China, 07/2010 – present
- Distinguished Visiting Scholar, Shanghai Jiao Tong University (SJTU), China, Nov. 2017

Please find on succeeding pages the summary of my research, teaching and service activities at LSU for your perusal during the evaluation of my case for full professor promotion at the Louisiana State University at Baton Rouge. I have attempted to be brief in this document, but further supporting information (curriculum vita, reprints of significant papers) is available from:

<http://www.ece.lsu.edu/swei/FP.promotion.html>

1 Summary

1.1 Research

In my pursuit of quality research work, I am not confined within a specific application area or a particular type of methodology, but rather I am guided by the compelling research problems that I have passion with, and feel strongly excited with. Actually over the years, I have worked on a variety of problems on diverse topics ranging from physical layer communication limits to cross-layer resource allocation optimization, from information theoretical secrecy to graphical structure inferences in communication networks. Although the problems I have tackled span across multiple research subareas, my research activities have always been under a common theme: compelling and emerging applications drive theoretical inquiries with corresponding constraints taken into account to develop underpinning models, which are then investigated to seek either analytic or algorithmic solutions to provide further fundamental insights on the corresponding engineering problems.

Up to date, I have authored or co-authored 28 published and in-press peer-reviewed journal articles, with 25 of them submitted after I joined LSU, and 18 of them since I received tenure in 2009. There are 4 more journal submissions under review. My research works have been published by high quality peer-reviewed professional journals including *IEEE Transactions on Information Theory*, *IEEE Transactions on Communications*, *IEEE/ACM Transactions on Networking*, *IEEE Transactions on Information Forensics & Security*, to name a few. Moreover, I have thus far authored or co-authored 66 published and in-press peer-reviewed conference papers, with 58 of them submitted since joining LSU, and 31 of them published since 2009. Most of conference papers are published by IEEE flag-ship conferences including *IEEE International Symposium on Information Theory*, *ICC*, *Globecom*, to name a few. To date (as of the end of Aug. 2017), there have been 998 citations of my research works based on Google Scholar Search, out of which 744 have been recorded since 2009. ¹

To summarize my major research contributions, I next focus on five specific areas and corresponding solutions as listed below ²

Information for Establishing Graphical Structures in Coordination and Statistical Inference: One of my current research interests is to address issues regarding the efficacy, efficiency and privacy of communications in the context of coordination among interacting agents in a networked environment. In particular, we have recently investigated the problem of partitioning of accessing users through communications over the underlying MAC channel [J6,J9,C3,C12,C13]. The objective of transmission is not to restore the message, but to partition active users into distinct groups so that they can, subsequently, transmit their messages without collision. A novel formulation is proposed for a random coding scheme, in which a sequence of channel operations and interactions induces a hypergraph. The formulation intuitively describes the transmitted information in terms of a strong coloring of this hypergraph.

Gaussian graphical models have found diverse applications in social networks, biology, and economics, to name a few. Gaussian trees in particular have attracted much attention due to their sparse structures, as well as existing computationally efficient algorithms in learning the underlying topologies. We have recently studied both topological and algebraic properties of unrooted Gaussian trees in order to characterize their security performance [J2,C7,C11]. Such performance is measured by the corresponding potential in extracting common randomness from a given tree. In [C2,J32], a new synthesis scheme is proposed to generate a random vector with prescribed joint density that induces a (latent) Gaussian tree structure. Our proposed layered and successive synthesis scheme relies on the learned structure of tree to use sufficient number of common random variables to synthesize the desired density.

Physical Layer Security: The very open nature of wireless transmission makes wireless com-

¹All my journal papers including published, under review and in preparation are numbered as [J*] in my Vita. All my conference publications are numbered as [C*] in my Vita.

²A subset of selected journal papers can be downloaded at <http://www.ece.lsu.edu/swei/FP.promotion.html>.

munications more susceptible to jamming and eavesdropping attacks. We have recently made a thorough investigation of jamming and its counter-measures in wireless fading channels using outage probability as a pay-off function [J19,C29,C32,C33,C37,C40]. Both pure and mixed strategies are developed for the underlying two-person zero-sum game. During the course of finding the mixed strategy Nash equilibrium points, we have successively solved a much more general problem extended from special cases considered by Bell and Cover ¹, and Hughes and Narayan ² decades ago.

Information theoretic security has attracted lots of attention lately due to its significance to the ultimate communication confidentiality in Shannon sense. We have made contributions to this area by finding out that the interaction between legitimate transceivers, in the presence of an inactive eavesdropper and limited feedback channel capacity, should be wisely used and could consequently lead to a larger secrecy rate than that without exploring feedback information [J14,J15,C27,C34].

Achievability of physical layer secrecy rests upon a more favorable physical layer channel between legitimate users than that perceived by an eavesdropper, and is thus deemed a physical layer approach to attaining end-to-end message secrecy. It used to be treated independently of crypto approaches dwelling on the higher layer of a network. Inspired by the Wyner type secrecy encoding framework, our group in recent years has launched extensive studies aiming at further strengthening secrecy on top of already existing ciphers at the application layer [J3,J5,J10,J12,J13,C14,C17,C18,C20,C21,C22,C24,C25,C26]. The main idea is to encode the plaintext using Wyner type codes before having it encrypted. It exploits an equivalent end-to-end degraded wiretapper channel on the application layer created by resorting to both intentionally added noise in cipher texts and strength of existing block or stream ciphers to seek further enhancement of end-to-end secrecy.

Modeling and Resource Allocation in Public Safety Radio Networks: One of my current research areas is resource allocation in public safety radio networks (PSRN) with models learned by mining voice meta data from PSRN. In particular, we have studied the optimal control of both admission and preemption in a two-class finite source loss system, such as PSRN. We have also proposed a novel model that incorporates the coupling between uplink control and communication segments (layers) of finite source systems, which was primarily motivated by mission critical voice applications in PSRN. The findings from these works have appeared in [J1,J7,C9,C10]. I have worked closely with a few engineers from the state agency running Louisiana Wireless Information Network (LWIN), which allows me to gain some invaluable knowledge and insights regarding the infrastructure enabling mission critical traffic over PSRN.

Cooperative Diversity–Asynchronism Issue: When space-time coding is applied to exploiting cooperative diversity over multiple nodes in relay channels, it is often implicitly assumed that coded symbols transmitted by different nodes are perfectly synchronized in both carrier and symbol epoch, which is nearly impossible to realize in wireless networks. In [J23,C55], we have proposed a novel minimum mean squared error (MMSE) receiver for combining disparate inputs in the multiple-relay channel. In [J20,C53,C54], a comprehensive investigation of asynchronism in relay channels is conducted in terms of the multiplexing gain and diversity gain tradeoff. Our work has pioneered the study of symbol level asynchronism in relay channels and been widely cited in literature, as evidenced in the more than four hundred (401) citations recorded by Google Scholar.

Peak-to-Average Power Ratio (PAPR) of OFDM Signals: One of the major issues in OFDM systems is the high PAPR problem, which causes inefficiency in amplifier utilization at the transmitter. The characterization of the PAPR of the OFDM signal has been a much-studied research area, and a number of researchers have roughly used a central limit theorem motivation to employ a Gaussian random process assumption in the characterization; however, the proof that the OFDM signal properly converges to a Gaussian random process is non-trivial and had never

¹R. M. Bell and T. M. Cover, “Competitive optimality of logarithmic investment,” *Math. Oper. Res.*, vol. 5, pp. 161166, 1980.

²B. Hughes and P. Narayan, “Gaussian arbitrarily varying channels,” *IEEE Trans. Inform. Theory*, vol. 33, pp. 267284, March 1987.

been established before. We for the first time rigorously established such a result and then applied powerful tools from extreme value theory in [J17,C58,C60] to arrive at accurate characterizations of the OFDM envelope. Both our proof and our novel approach to computing the PAPR distributions have become quite notable and cited often (48 citations by Google Scholar) in subsequent works studying the PAPR problem in OFDM systems.

Sponsored Research

For research funding, I have received grants and awards in the amount of \$1,260,294 in total since joining LSU. I have received external and competitive research grants in the amount of \$808,194 since 2009 when I received tenure. In particular, I have been awarded three prestigious NSF regular grants in total of \$541,644 including one as the PI at LSU (in 2016), one as the leading PI (in 2013), and one as a Co-PI at LSU (in 2010). I have also established a productive collaboration relationship with a local IT company Bascom Hunter. Together we received one NSF SBIR Phase I grant (with myself as the sole PI at LSU) in total of \$150,000 with LSU share \$36,550 in 2013, and an Air Force SBIR Phase I grant (with myself as a Co-PI at LSU) in total of \$99,932 with LSU share of \$30,000 in 2011. In addition, I also received an ITRS grant (as the PI) in total of \$200,000 from Board of Regents of Louisiana with a matching in the amount of \$31,000 from Bascom Hunter in 2009. Also notable is that in Summer 2010, I was awarded an Air Force Summer Faculty Fellowship.

1.2 Teaching

My motto for teaching is “Teaching is not just my mission, but my passion.” Teaching should be a pleasant two-way interactive process through which students are inspired, motivated and educated. No matter what course I am assigned to teach, my first and foremost priority job is always to motivate students to develop strong interests learning the materials. I hold a strong belief that the enthusiasm expressed by a professor towards teaching will have a great impact on students’ attitude towards learning as well. I never let them forget why a certain topic is important. As far as teaching method is concerned, I always give them intuitions behind those seemingly dry math equations and formulas put on the blackboard. Key points are repeated. During the lectures, I keep on reminding students that even if they may forget some specifics of course materials after a while, they, however, should understand the intuitions behind the theory in a big picture as an electrical engineer.

In summary, I have taught 11 different courses since joining LSU in Fall 2003, including one new course EE7625: Digital Communications II proposed and put in catalog, and another new special topic course: EE7600: Security in Wireless Systems and Networks: a Cross-layer Perspective. The average teaching evaluation scores over 37 courses taught till Spring 2017 semester are Instructional Technique: 3.552 Instructional Support Effort: 3.557, and Overall Effectiveness: 3.582 (on a scale of 4.00).

Up to date, I have served as the major professor for 4 completed Ph.D. dissertations and 9 completed M.S. thesis. I also co-advised one completed Ph.D. dissertation from Tsinghua University, China. I am currently supervising 2 more Ph.D. students at LSU. In addition, I am co-supervising two Ph.D. students, one from LSU, and one from Tsinghua University, toward the future completion of their dissertations. I also served as a committee member of 12 other M.S. thesis or oral exams, and 13 other completed Ph.D. dissertations.

I have mentored 7 undergraduate senior project teams to complete, and one undergoing. Two of these 8 projects were sponsored by Bascom Hunter, a local IT start-up company, through the initiation of my research collaboration with the company. I also supervised 3 undergraduate research projects including one supported by the Chancellor Future Leaders in Research Program (CFLRP).

Selected Teaching Evaluation Comments

I include here selected samples of the comments from the student evaluations that support my commitment to graduate and undergraduate education. Note that I have replicated the original spelling and grammar of the student comments to the best of my ability.

- “Dr. Wei, I really like the examples you give in class. Your examples make it easier for us students to understand where and when we will be using probability in our career as an Electrical or Computer Engineering. Plus those examples relate to other subjects too, I your class I had many moments were my doubts regarding other subjects were cleared. Thank you very much for your teachings.” (EE3150 Spring 2017)
- “Great teacher. Thoroughly know the material. I love the amount of examples and graphs that were discussed in class.” (EE3610/Spring 2016)
- “.. He explained very well and more importantly went at appropriate pace. Tests and homework were related to the subject being taught and did not require more than what was taught.” (EE3150/Fall 2015)
- “The thing I like the most about Dr. Wei is how he makes sure we have an intuitive understanding of the material. We are not just plugging and chugging into formulas for no comprehensible reason.” (EE3150/Fall 2014)
- “Overall, I believe this was an excellent course with a very effective teacher.” (EE4615/Spring 2010)
- “Dr. Wei is a wonderful instructor. All his lectures were excellent. But at times he is fast.” (EE4625/Spring 2009)
- “Class was very hard, but teacher tried his best to teach. His desire to teach was unmatched in the EE department.” (EE3610/Spring 2008)
- “I would refer any students to take his class. He was available after class and helped anyone anyway he knew how.” (EE3610/Spring 2008)
- “This was by far the best course I have taken as a graduate student and the teacher played a large part in that. The material was very well explained and the teacher was willing to devote much time and effort to help the students better understand the material on his own time. I highly recommend this course and I look forward to taking more courses with Dr. Wei.” (EE7640/Fall 2006)
- “Overall, Dr. Wei is by far the best Professor I’ve had as a graduate student at LSU. Dr. Wei is very demanding and tough, yet easy to talk to if students have questions. H.W. are very tough, yet generate students interest and understanding because they are written by the instructor.” (EE7620/Fall 2004)

1.3 Summary of My Service

In addition to pursuing an active and productive research agenda and teaching regular communication courses at LSU, I am always committed to both university service and professional service in our community. At LSU, I have been actively serving for ECE department/division on Graduate Studies Committee, Curriculum Committee, Graduate Admissions Committee, Scholarship Committee, and Faculty Search Committee. I am an elected ECE Internal Advisory Committee Member.

In our professional community, I have been elected to IEEE Senior Membership recently. I have served on different journal editorial boards. In particular, I have been serving as an Editor for *IEEE Access* since June 2013, and was an Editor for *IEEE Transactions on Wireless Communications*, and an Associate Editor for *IEEE Transactions on Vehicular Technology*. I also served as a Conference Publicity Chair for one IEEE conference, and Workshop Co-Chair for another international conference. I served for many international conferences as a technical program committee member. I have been a frequent reviewer for prominent international professional journals and conferences over years. I have also been invited to serve on panels for National Science Foundation (NSF),

Department of Homeland Security (DHS), National Institute of Standards and Technology (NIST), and Department of Energy (DOE). I have volunteered myself multiple times as a judge for both regional and state-wide science fairs in Louisiana.