Aly El Gamal

Assistant Professor, School of Electrical and Computer Engineering
Purdue University

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West Lafayette, IN 47907   http://web.ics.purdue.edu/~elgamala   e-mail: elgamala@purdue.edu

EDUCATION

University of Illinois at Urbana-Champaign, Ph.D. in *Electrical and Computer Engineering*, May 2014, <u>GPA:</u> 4.0

<u>Dissertation:</u> *Interference Channels with Coordinated Multi-Point Transmission*

<u>Advisor:</u> Prof. Venugopal V. Veeravalli

University of Illinois at Urbana-Champaign, M.S. in *Mathematics*, May 2013, <u>GPA:</u> 3.96

Nile University, M.S. in *Electrical Engineering*, Jul. 2009, <u>GPA:</u> 3.82

<u>Thesis:</u> *The Two-Way Wiretap Channel: Theory and Practice*

<u>Advisor:</u> Prof. Moustafa Youssef

Cairo University, B.S. in *Computer Engineering*, Jul. 2007

<u>Grade:</u> Distinction with Honors Degree

PROFESSIONAL EXPERIENCE

Assistant Professor, School of Electrical and Computer Engineering, Purdue University, August 2015—Now

Simons Postdoctoral Fellow, University of Texas at Austin, May 2015 – August 2015

<u>Advisors:</u> Prof. Sriram Vishwanath and Prof. Francois Baccelli

Postdoctoral Research Associate, University of Southern California, May 2014 – May 2015

<u>Advisor:</u> Prof. Salman Avestimehr

Summer Intern, Qualcomm Inc. The Office of the Chief Scientist, May – Aug. 2012

<u>Project Description:</u> Indoor localization in Ultra Wide-Band Enviornments

<u>Managers:</u> Alok Gupta, Bin Tian

Research Assistant, University of Illinois at Urbana-Champaign, Aug. 2009 – May 2014

<u>Advisor:</u> Prof. Venugopal V. Veeravalli

Research Assistant, Nile University, Nov. 2007 – Aug. 2009

<u>Advisor:</u> Prof. Moustafa Youssef

Teaching Assistant, Cairo University, Sep. 2007 – Jan. 2008

Department of Computer Engineering

GRANTS

Role: PI – Project: Adaptive Wireless Networks for Spectrally Efficient Communication –
Sponsor: DARPA and AFRL – Amount: $1,980,722
Collaborators: Nicolo Michelusi, Borja Peleato, David Love, James Krogmeier, Alexander Sprintson
Role: PI – Project: Adaptive Wireless Networks for Spectrally Efficient Communication –

Sponsor: DARPA – Amount: $375,000
Collaborators: Nicolo Michelusi, Borja Peleato, David Love, James Krogmeier, Alexander Sprintson
Role: PI – Project: XHAUL for Dynamic Interference Management –
Sponsor: Huawei Technologies – Amount: $51,500
Role: Co-PI – Project: Machine Learning Group and Graduate Course Development –
Sponsor: Purdue College of Engineering Data Science Initiative – Amount: $75,000
Collaborators: Stanley Chan
Role: PI – Project: Purdue Engineering Faculty Summer Fellowship in Europe – Amount: $16,500
Role: PI – Project: Purdue – USMA Indy Autonomous Challenge (IAC) Team Award – Amount: $56,383
Collaborators: Joseph Pekny
Role: PI – Project: Splunk Gift Award for Purdue-USMA IAC Team – Amount: $50,000
Sponsor: Splunk Inc.
Collaborators: J. Eric Dietz
Role: PI – Project: AI for Small Unit Maneuver (AISUM) Beta Testing Team – Amount: $60,000
Sponsor: Indiana Economic Development Corporation (IEDC)
Collaborators: J. Eric Dietz

AWARDS
Huawei Innovation Research Program (HIRP) OPEN Award, Nov. 2015.
DARPA Contract Award for the Spectrum Collaboration Challenge (SC2), Nov. 2016.
Purdue Seed for Success, Oct. 2017.
DARPA Award for top 10 teams in SC2 Phase 1 Preliminary Event, Dec. 2017.
Seminal paper selected by Purdue ECE CNSIP area for showcase to dean, Mar. 2018.
Nominated by Purdue College of Engineering and selected to attend the National Effective Teaching Institute Workshop (NETI-1), May 2018.
DARPA Prize for top 10 teams passing the Payline criterion in SC2 Phase 2 Preliminary Event, Jan. 2019.
Purdue Engineering's 2019 Faculty Summer Fellowship in Europe. Apr. 2019.
Purdue Engineering's Spring 2019 Outstanding Teacher Award, Aug. 2019.
Purdue Engineering's Fall 2020 Outstanding Teacher Award, Jan. 2021.
2021 Purdue Online Innovative Course Design and Use of Technology Award, May 2021.
2021 American Society of Agricultural and Biological Engineers (ASABE) Information Technology, Sensors, and Control Systems (ITSC) Paper Award, Jun. 2021.

RESEARCH GROUP
Title: Foundations and Applications of Machine Intelligence Lab for societY (FAMILY)
Ph.D. Students: Teng-Hui Huang, Ahmed Mohamed, Shafin Jameel (Summer '21 Intern at InterDigital), Shreya Ghosh, Rohan Manna, Shakti Wadekar (Summer '21 Intern at Micron), Vishnu Chellapandi, Aanis Ahmad, Varun Aggarwal, Salah Abdeljabar
M.S. Students (non-Thesis option): Mohamed Marei, Roderick Renwick, Wenjing Bao, Kashif Khan, Zack Havelka
Ph.D. Alumni: Tolunay Seyfi (Now with Qualcomm Inc.)
M.S. Alumni (Thesis option): Xiaoyu Liu, Rehana Mahfuz, Shreya Ghosh

M.S. Alumni (non-Thesis option): Manik Singhal, Xiwen Zhang**,** Yu-Hsiang Tseng, Dwarakanath Jampani

Undergraduate Alumni: Jinho Yi, Xingchen Wang, Shengtai Ju, Kirthi Sivamani, Sharan Ramjee

Other Purdue Mentored Students: Diyu Yang (Deep Learning for Modulation Classification), Rajeev Sahay (Adversarial Deep Learning), Dennis Ogbe (DARPA SC2), Stephen Larew (DARPA SC2), Mai Zhang (DARPA SC2), Tomohiro Arakawa (DARPA SC2), Bharath Keshavamurthy (DARPA SC2), Shyam Kannan (Indy Autonomous Challenge), Manuel Mar (Indy Autonomous Challenge), Yasemin Karacora (Exchange with Ruhr-University Bochum), Ana Maria Rodriguez (Purdue-Colombia Program), Eliana Martinez (Purdue-Colombia Program), Autonomous Motorsports Purdue (AMP) Student Club Members.

RESEARCH AREAS

Information Theory for Wireless Cooperative Interference Management

Our goal is to build a theoretical framework that suits the nature of future wireless networks. With recent advances in the cloud and cooperative communication schemes (Coordinated Multi-Point or CoMP communication), it is possible to envision a paradigm where scheduling, modulation and coding schemes decisions are optimized in a centralized fashion for large networks. This poses interesting combinatorial problems with the potential of achieving rate gains that were considered infeasible before, through simple practical schemes that have minimal delay requirements. More recently, we have also been working on information theoretic analysis of blockchain-enabled monetary mechanisms that incentivize distributed cooperative interference management, as well as coded caching strategies that amplify the potential gains of cooperative interference management.

Machine Learning for Autonomous Wireless Communication Systems

I have been leading the Purdue, Texas A&M, and Raytheon BBN BAM! Wireless Team in the DARPA Spectrum Collaboration Challenge (SC2) since January 2017. Our participation in the challenge stimulated empirical machine learning research for wireless communications and networking. We are investigating the value of using deep neural networks for tasks required in wireless communication systems, ranging from creating signatures for other spectrum users to end-to-end resource management decisions such as channel allocation and flow scheduling. Recent work reveals the potential of deep neural networks for analyzing received wireless signals. Convolutional layers can mimic the convolutional operations of matched filters and Long Short-term Memory (LSTM) units can identify temporal correlations in the received signal. Further, unlike traditional methods for processing wireless signals, there is no necessary requirement for the deep learning approach to have a mathematical model for the wireless channel; a task that could be daunting in presence of various uncertainties that could alter the signals due to environmental conditions.

Adversarial Machine Learning

Deep neural networks have been identified recently as being vulnerable to input perturbations that are intentionally crafted by an adversary. This problem stands as an obstacle towards the ubiquitous deployment of such networks. Our research is guided by two fundamental aspects of this problem: 1- Identifying the value of knowledge at the defender and attacker about each other's strategies as well as the machine learning

model, 2- Identifying the computational cost required by successful defense strategies as well as the required computational cost to circumvent these strategies.

Machine Learning for Network Security

The goal here is to develop self-improving agile algorithms for detection of network attacks in complex and dynamic environments, by employing state of the art machine learning algorithms for supervised signature-based detection, unsupervised anomaly-based detection, as well as reinforcement-learning-based honeypot techniques. We have proposed a novel architecture – called LIDAR – that is currently being patented, and its development is starting in Fall '19.

Machine Learning for Autonomous Racing

I am currently serving as a Technical Lead for the Purdue and United States Military Academy at West Point team competing in the Indy Autonomous Challenge. We aim to develop and employ state of the art machine learning algorithms for fusing inputs from cameras, LIDAR and RADAR sensors to optimize a racing car – that runs at speeds reaching 200 mph – through its control parameters including steering and throttle. Our software will be developed through the ANSYS VRXPERIENCE simulator and will be deployed in May '21 on a Dallara IL-15 Indy Lights race car.

Data Science for Sports Applications

The goal of this line of research is to use machine learning and statistical analysis to provide guidance for the design of sports training sessions based on data collected from sensors worn by the players. This research is set up in collaboration with the Purdue Women's Soccer Team. So far, we had obtained new results for predicting dynamic stress load values for the players using previously collected data.

PUBLICATIONS
Book
Venugopal V. Veeravalli, Aly El Gamal: Interference Management in Wireless Networks: Fundamental Bounds and the Role of Cooperation. Cambridge University Press, Feb. 2018.

Patent
Aly El Gamal, Ali Elghariani, Arif Ghafoor: LIDAR: Lifelong-learning-based Intelligent, Diverse, Agile and Robust architecture for network attacks detection. Non-Provisional filed in Nov. 2020.

Journal Papers (In Preparation)
[J24] Teng-Hui Huang, Aly El Gamal: Convergence Analysis for an Efficient Information Bottleneck Solution via ADMM. In preparation for submission to the IEEE Transactions on Information Theory.

[J23] Varun Aggarwal, Aanis Ahmad, Dharmendra Saraswat, Aly El Gamal: Performance Evaluation of YOLOv4 for Weed Identification. In preparation for submission.

[J22] Aanis Ahmad, Dharmendra Saraswat, Aly El Gamal: A Survey on using Deep Neural Networks for Plant Disease Identification and Recommendations for Development of Appropriate Tools. In preparation for submission.

[J21] Jinho Yi, Ahmed Mohamed, Shafin Jameel, Aly El Gamal: Gradient-based Adversarial Deep Modulation Classification with Data-driven Subsampling. In preparation for submission.

[J20] Sharan Ramjee, Aly El Gamal: Efficient Wrapper Feature Selection using Autoencoder and Model Based Elimination. In preparation for submission.

Journal Papers (Submitted)

[J19] Rehana Mahfuz, Rajeev Sahay, Aly El Gamal: Mitigating Gradient-based Adversarial Attacks via Denoising and Compression. Submitted to the IEEE Transactions on Pattern Analysis and Machine Intelligence. Jan. 2021.

[J18] Sharan Ramjee, Shengtai Ju, Diyu Yang, Xiaoyu Liu, Aly El Gamal,Yonina C. Eldar: Ensemble Wrapper Subsampling for Deep Modulation Classification. Submitted to the IEEE Transactions on Cognitive Communications and Networking (TCCN), May 2020.

Journal Publications

[J17] Shafin Jameel, Ahmed Mohamed, Xiwen Zhang, Aly El Gamal, Deep Learning for Frame Error Prediction using a DARPA Spectrum Collaboration Challenge (SC2) Dataset. Accepted at the IEEE Networking Letters. Jun. 2021.

[J16] Tolunay Seyfi, Ahmed Mohamed, Aly El Gamal: A Number Theoretic Approach for Fast Discovery of Single-Hop Wireless Networks. IEEE Networking Letters, vol. 3, no. 2, pp. 89-93, Jun. 2021.

[J15] Aya Mostafa Ahmed, Udaya Sampath K.P. Miriya Thanthrige, Aly El Gamal, Aydin Sezgin: Deep Learning for Direction of Arrival Estimation in MIMO Radar Systems via Emulation of Large Antenna Arrays. IEEE Communications Letters, vol. 25, no. 5, pp. 1559-1563, May 2021.

[J14] Yousef Alhassoun, Faisal Alotaibi, Aly El Gamal, Hesham El Gamal: On the Design and Analysis of Optimal Wireless Caching Schemes with Placement Cost and Unlimited Memory. IEEE Wireless Communication Letters, vol. 9, no. 9, pp. 1374-1378, Sep. 2020.

[J13] Manik Singhal, Tolunay Seyfi, Aly El Gamal: Joint Uplink-Downlink Cooperative Interference Management with Flexible Cell Associations. IEEE Transactions on Communications, vol. 68, no. 9, pp. 5420-5434, Aug. 2020.

[J12] Xingchen Wang, Shengtai Ju, Xiwen Zhang, Sharan Ramjee, Aly El Gamal: Efficient Training of Deep Classifiers for Wireless Source Identification using Test SNR Estimates. IEEE Wireless Communication Letters, vol. 9, no. 8, pp. 1314-1318, Aug. 2020.

[J11] S. Bagchi, V. Aggarwal, S. Chaterji, F. Douglis, A. El Gamal, J. Han, B. J. Henz, H. Hoffman, S. Jana, M. Kulkarni, F. X. Lin, K. Marais, P. Mittal, S. Mou, X. Qiu, G. Scutari: Vision Paper: Grand Challenges of Resilience: Autonomous System Resilience through Design and Runtime Measures. IEEE Open Journal of the Computer Society, vol. 1, pp. 155-172, Jul. 2020.

[J10] Kirthi Sivamani, Rajeev Sahay, Aly El Gamal: Non-Intrusive Detection of Adversarial Deep Learning Attacks via Observer Networks. IEEE Letters of the Computer Society, vol. 3, no. 1, pp. 25-28, Jan-Jun. 2020.

[J9] Tolunay Seyfi, Yasemin Karacora, Aly El Gamal: Fundamental Limits of Dynamic Interference Management with Flexible Message Assignments and Separate Deep Fading Block Coding. IEEE Transactions on Information Theory, vol. 66, no. 2, pp. 1193-1212, Feb. 2020.

[J8] Meghana Bande, Aly El Gamal, Venugopal V. Veeravalli: Degrees of Freedom in Wireless Interference Networks with Cooperative Transmission and Backhaul Load Constraints. IEEE Transactions on Information Theory, vol. 65, no. 9, pp. 5816-5832, Sep. 2019.

[J7] Aly El Gamal, Hesham El Gamal: A Single Coin Monetary Mechanism for Distributed Cooperative Interference Management. IEEE Wireless Communication Letters, vol. 8, no. 3, pp. 757-760, Jun. 2019.

[J6] Sharan Ramjee, Shengtai Ju, Diyu Yang, Xiaoyu Liu, Aly El Gamal, Yonina C. Eldar: Fast Deep Learning for Automatic Modulation Classification. IEEE Machine Learning for Communications Emerging Technologies Initiatives, May 2019.

[J5] Aamir Anis, Aly El Gamal, A. Salman Avestimehr, Antonio Ortega: A Sampling Theory Perspective of Graph-based Semi-supervised Learning. IEEE Transactions on Information Theory, vol. 65, no. 4, pp. 2322-2342, Apr. 2019.

[J4] Navid Naderializadeh, Aly El Gamal, A. Salman Avestimehr: Fundamental Limits of Non-Coherent Interference Alignment via Matroid Theory. IEEE Transactions on Information Theory, vol. 63, no. 10, pp. 6573-6586, Oct. 2017.

[J3] Aly El Gamal, V. Sreekanth Annapureddy, Venugopal V. Veeravalli: Interference Channels with CoMP Transmission: Degrees of Freedom, Message Assignment, and Fractional Reuse. IEEE Transactions On Information Theory, vol. 60, no. 6, pp. 3483-3498, May. 2014.

[J2] Aly El Gamal, Onur Ozan Koyluoglu, Moustafa Youssef, Hesham El Gamal: Achievable Secrecy Rate Regions for the Two-Way Wiretap Channel. IEEE Transactions On Information Theory, vol. 59, no. 12, pp. 8099-8114, Dec. 2013.

[J1] V. Sreekanth Annapureddy, Aly El Gamal, Venugopal V. Veeravalli: Degrees of Freedom of Interference Channels with CoMP Transmission and Reception. IEEE Transactions On Information Theory, vol. 58, no. 9, pp. 5740-5760, Sep. 2012.

Conference Papers (Submitted)

[C31] Wei-Cheng Hsu, Akshita Gupta, Inseok Hwang, James Goppert, Aly El Gamal: Cyber-attack Intrusion Detection System for Unmanned Aerial Vehicles using Simple Recurrent Units. Submitted to the American Institute of Aeronautics and Astronautics (AIAA) Science and Technology Forum, Jun. 2021.

Conference Publications

[C30] Aanis Ahmad, Dharmendra Saraswat, Aly El Gamal, Gurmukh S Johal : Comparison of Deep Learning Models for Corn Disease Identification, Tracking, and Severity Estimation Using Images Acquired From UAV-Mounted and Handheld Sensors, American Society of Agricultural and Biological Engineers (ASABE) Information Technology, Sensors, and Control Systems (ITSC) Annual International Meeting (AIM), Jul. 2021.

[C29] Shakti Wadekar, Ben Schwartz, Shyam Kannan, Manuel Mar, Rohan Manna, Vishnu Chellapandi, Daniel Gonzalez, Aly El Gamal: Towards End-to-End Deep Learning for Autonomous Racing: On Data Collection and a Unified Architecture for Steering and Throttle Prediction. 2021 ICRA Workshop on Opportunities and Challenges with Autonomous Racing, May 2021.

[C28] Ahmed Mohamed, Shafin Jameel, Aly El Gamal: Knowledge Distillation for Wireless Edge Learning. IEEE Statistical Signal Processing Workshop (SSP), Jul. 2021.

[C27] Teng-Hui Huang, Aly El Gamal: A Provably Convergent Information Bottleneck Solution via ADMM. IEEE International Symposium on Information Theory (ISIT), Jul. 2021.

[C26] Rathziel Roncancio, Jupyoung Kim, Aly El Gamal, Jay P. Gore: Data-driven Analysis of Turbulent Flame Images. American Institute of Aeronautics and Astronautics (AIAA) Science and Technology Forum, Jan. 2021.

[C25] Yousef Alhassoun, Faisal Alotaibi, Aly El Gamal, Hesham El Gamal: Efficient Coded Caching with Limited Memory. Allerton Conference on Communications, Control, and Computing, Oct. 2019.

[C24] Xiwen Zhang, Tolunay Seyfi, Shengtai Ju, Sharan Ramjee, Aly El Gamal, Yonina Eldar: Deep Learning for Interference Identification: Band, SNR, and Sample Selection. IEEE Workshop on Signal Processing Advances in Wireless Communications (SPAWC), Jul. 2019.

[C23] Yousef Alhassoun, Faisal Alotaibi, Aly El Gamal, Hesham El Gamal: Towards Jointly Optimal Placement and Delivery: To Code or Not to Code in Wireless Caching Networks. IEEE International Symposium on Information Theory (ISIT), Jul. 2019.

[C22] Eleftherios Lampiris, Aly El Gamal, Peteros Elia: Wyner's Network on Caches: Combining Receiver Caching with a Flexible Backhaul. IEEE International Symposium on Information Theory (ISIT), Jul. 2019.

[C21] Rajeev Sahay, Rehana Mahfuz, Aly El Gamal: Combatting Adversarial Attacks through Denoising and Dimensionality Reduction: A Cascaded Autoencoder Approach. Conference on Information Sciences and Systems (CISS), Mar. 2019.

[C20] Manik Singhal, Aly El Gamal: Optimal Cell Associations and Degrees of Freedom of Locally Connected Interference Networks with Message Passing Decoding. IEEE International Symposium on Information Theory (ISIT), Jun. 2018.

[C19] Xiaoyu Liu, Diyu Yang, Aly El Gamal: Deep Neural Network Architectures for Modulation Classification. Asilomar Conference on Signals, Systems, and Computers, Nov. 2017

[C18] Yasemin Karacora, Tolunay Seyfi, Aly El Gamal: The Role of Transmitter Cooperation in Linear Interference Networks with Block Erasures. Asilomar Conference on Signals, Systems, and Computers, Nov. 2017

[C17] Manik Singhal, Aly El Gamal: Joint Uplink-Downlink Cell Associations in Interference Networks with Local Connectivity. Allerton Conference on Communications, Control, and Computing, Oct. 2017

[C16] Aly El Gamal: Topological Interference Management: Linear Cooperation is not useful for Wyner's Networks. IEEE International Symposium on Information Theory (ISIT), Aachen, Jun. 2017.

[C15] Aly El Gamal: Cell Associations that Maximize the Average Uplink-Downlink Degrees of Freedom. IEEE International Symposium on Information Theory (ISIT), Barcelona, Jul. 2016.

[C14] Aly El Gamal: Cloud-Based Topological Interference Management: A Case with No Cooperative Transmission Gain. IEEE International Workshop on Signal Processing Advances in Wireless Communications (SPAWC), Edinburgh, Jul. 2016.

[C13] Meghana Bande, Aly El Gamal, Venugopal V. Veeravalli: Flexible Backhaul Design with Cooperative Transmission in Cellular Interference Networks. International Symposium on Information Theory (ISIT 2015), Hong Kong, Jun. 2015.

[C12] Aly El Gamal, Navid Naderializadeh, A. Salman Avestimehr: When Does an Ensemble of Matrices with Randomly Scaled Rows Lose Rank?. International Symposium on Information Theory (ISIT 2015), Hong Kong, Jun. 2015.

[C11] Navid Naderializadeh, Aly El Gamal, A. Salman Avestimehr: Topological Interference Management with just Retransmission: What are the Best Topologies. International Conference on Communications (ICC 2015), London, Jun. 2015.

[C10] Aamir Anis, Aly El Gamal, A. Salman Avestimehr, Antonio Ortega: Asymptotic Justification for Band-Limited Interpolation of Graph Signals for Semi-Supervised Learning. International Conference on Acoustics, Speech, and Signal Processing (ICASSP 2015), Brisbane, Apr. 2015.

[C9] Aly El Gamal, Venugopal V. Veeravalli: Flexible Backhaul Design and Degrees of Freedom for Linear Interference Channels. International Symposium on Information Theory (ISIT), Hawai'i, Jun. 2014

[C8] Aly El Gamal, Venugopal V. Veeravalli: Dynamic Interference Management, Asilomar Conference on Signals, Systems, and Computers, Nov. 2013

[C7] Aly El Gamal, V. Sreekanth Annapureddy, Venugopal V. Veeravalli: Degrees of Freedom of Locally Connected Interference Channels with Cooperating Multiple-Antenna Transmitters. International Symposium on Information Theory (ISIT), MIT, Cambridge, Jul. 2012

[C6] Aly El Gamal, V. Sreekanth Annapureddy, Venugopal V. Veeravalli: Degrees of Freedom of Locally Connected Interference Channels with Coordinated Multi-Point (CoMP) Transmission. International Conference on Communications (ICC), Ottawa, Jun. 2012

[C5] Aly El Gamal, V. Sreekanth Annapureddy, Venugopal V. Veeravalli: On Optimal Message Assignments for Interference Channels with CoMP Transmission. 46th Annual Conference on Information Sciences and Systems (CISS), Princeton, NJ, Mar. 2012

[C4] V. Sreekanth Annapureddy, Aly El Gamal, Venugopal V. Veeravalli: Degrees of Freedom of Cooperative Interference Networks. International Symposium on Information Theory (ISIT), Saint Petersburg, Aug. 2011

[C3] V. Sreekanth Annapureddy, Aly El Gamal, Venugopal V. Veeravalli: Degrees of Freedom of the K-user Interference Channel with Transmitter Cooperation. International Symposium on Information Theory (ISIT), Austin, Jun. 2010

[C2] Aly El Gamal, Onur Ozan Koyluoglu, Moustafa Youssef, Hesham El Gamal: New Achievable Secrecy Rate Regions for the Two Way Wiretap Channel. Information Theory Workshop (ITW), Cairo, Jan. 2010

[C1] Aly El Gamal, Moustafa Youssef, Hesham El Gamal: Randomization for Security in Half-Duplex Two-Way Gaussian Channels. Global Communcations Conference (Globecom), Hawaii, Dec. 2009

TALKS

"Relational Data Mining"
Simplilearn Online Webinar, Jun. 2021

"Wireless Communication Systems: From Information Theory to Deep Learning"
Purdue Electrical and Computer Engineering Seminar Series, Apr. 2021

"FAMILY: Foundations and Applications of Machine Intelligence Lab for societY"
Purdue Electrical and Computer Engineering Seminar Series, Sep. 2020
University of Minnesota, Oct. 2020
University of Notre Dame, Nov. 2020
University of Michigan, Nov. 2020

"Information Theory and Deep Learning for Future Wireless Networks: Delivering the Promise of Efficiency and Security"
University of California, Berkeley, Feb. 2020.

"Deep Learning in Wireless: From Source Identification to Spectrum Understanding"
Information Theory and Applications Workshop (ITA), San Diego, Feb. 2020

"Recent Advances in Deep Learning: Feature Selection, Adversarial Attacks, Applications in Wireless Communications, and Educational Efforts at Purdue Engineering"
Sorbonne University, Paris, Jul. 2019
EURECOM, Sophia Antipolis, Jul. 2019
Ruhr-University Bochum, Bochum, Jul. 2019
Imperial College, London, Jul. 2019
King's College, London, Jul. 2019
University of Sheffield, Sheffield, Jul. 2019

"Tutorial on Interference Management in Wireless Networks"
IEEE International Symposium on Information Theory (ISIT), Paris, Jul. 2019
IEEE Global Communications Conference (Globecom), Abu Dhabi, Dec. 2018
IEEE 1ˢᵗ 5G World Forum, Santa Clara, Jul. 2018
"Deep Neural Network Architectures for Modulation Classification"
Information Theory and Applications Workshop (ITA), San Diego, Feb. 2018
"Information Theory of Cloud-Based Cooperative Interference Management"
  University of Padova, Padova, Jul. 2017
  EURECOM, Sophia Antipolis, Jul. 2017
"Topological Interference Management: Linear Cooperation is not useful for Wyner's Networks."
  International Symposium on Information Theory (ISIT), Aachen, Jun. 2017
"Cooperation in Large Cellular Networks: Insights and Fundamental Limits"
  Information Theory and Applications Workshop (ITA), San Diego, Feb. 2017
"Cell Associations that Maximize the Average Uplink-Downlink Degrees of Freedom."
  International Symposium on Information Theory (ISIT), Barcelona, Jul. 2016
"Cloud-Based Topological Interference Management: A Case with No Cooperative Transmission Gain."
  Workshop on Signal Processing Advances in Wireless Communications (SPAWC), Edinburgh, Jul. 2016
"Cloud-Based Cell Associations"
  Information Theory and Applications Workshop (ITA), San Diego, Feb. 2016
"Cellular Interference Management and Spectral Graph Learning"
  Purdue University, Apr. 2015
"Cellular Interference Management and Spectral Graph Learning"
  Worcester Polytechnic Institute, Mar. 2015
"Two Recent Results in Random Matrix Theory and their Applications in Wireless Interference Management and Semi-Supervised Learning"
  University of Texas, Austin, Feb. 2015
"Two Recent Results in Random Matrix Theory and their Applications in Wireless Interference Management and Semi-Supervised Learning"
  Control, Communications and Networks Seminar, University of Southern California, Oct. 2014
"Flexible Backhaul Design and Degrees of Freedom for Linear Interference Networks"
  International Symposium on Information Theory (ISIT), Hawai'i, Jul. 2014
"Flexible Backhaul Design for Locally Connected Interference Networks"
  Information Theory and Applications Workshop (ITA), San Diego, Feb. 2014
 "Dynamic Interference Management"
  Asilomar Conference on Signals, Systems, and Computers, Monterey, Nov. 2013
 "Interference Channels with Coordinated Multi-Point Transmission"
  Massachusetts Institute of Technology (MIT), Oct. 2013
 "Interference Channels with Coordinated Multi-Point Transmission"
  Télécom ParisTech, Paris, Jul. 2013
 "Dynamic Interference Management"
  International Symposium on Information theory (ISIT), Istanbul, Jul. 2013

"Locally Connected Interference Channels with CoMP: Degrees of Freedom, Message Assignment and Fractional Reuse"
International Symposium on Information theory (ISIT), MIT, Jul. 2012

"Degrees of Freedom of Locally Connected Interference Channels with Coordinated Multi-Point Transmission"
International Conference on Communications (ICC), Ottawa, Jun. 2012

"Degrees of Freedom of Interference Channels with CoMP Transmission and Reception"
Communication Theory Workshop (CTW), Hawai'i, May 2012

"On Optimal Message Assignments for Interference Channels with CoMP Transmission"
Conference on Information Sciences and Systems (CISS), Princeton, Mar. 2012

"Degrees of Freedom of Cooperative Interference Networks"
International Symposium on Information theory (ISIT), Saint Petersburg, Aug. 2011

"Degrees of Freedom (DoF) of Locally Connected Interference Channels with Coordinated Multi-Point (CoMP) Transmission"
North American School of Information theory, UT Austin, May 2011

"On the connection between expander bipartite graphs and the degrees of freedom of the K-user Interference Channel with transmitter cooperation"
Midwestern Conference on Combinatorics, Cryptography and Computing, Illinois State University, Sep., 2010

"Degrees of Freedom of the K-user Interference Channel with transmitter cooperation"
North American School of Information theory, USC, Aug. 2010

"New Achievable Secrecy Rate Regions for the Two Way Wiretap Channel"
Information theory Workshop, Cairo, Jan. 2010

"Randomization for Security in Half-Duplex Two-Way Gaussian Channels"
North American School of Information theory, Northwestern University, Aug. 2009

TEACHING EXPERIENCE

> **Purdue University,** Department of Electrical and Computer Engineering,
> ECE 595 Introduction to Deep Learning, Fall 2020, Instructor (Online and On-Campus)
> Autonomous Motorsports Purdue (AMP) Vertically Integrated Projects Class, Fall 2020, Spring 2021.
> ECE 595 Machine Learning II, Fall 2019, Instructor
> ECE 270 Introduction to Digital System Design, Spring 2017, Instructor
> ECE 301 Signals and Systems, Fall 2015, Fall 2016, Fall 2017, Spring 2018, Fall 2018, Spring 2019, Instructor
> ECE 368 Data Structures, Spring 2016, Instructor
> **University of Illinois at Urbana-Champaign,** Department of *Electrical and Computer Engineering*, ECE 563 Information Theory, Fall 2010, Teaching Assistant
> **Cairo University,** Department of *Computer Engineering*
> Database Systems, Fall 2007, Teaching Assistant
> Logic Design, Fall 2007, Teaching Assistant

Operating System Design, Fall 2007, Teaching Assistant

Microprocessors, Fall 2007, Teaching Assistant

COURSE WORK

University of Illinois at Urbana-Champaign

Department of *Electrical and Computer Engineering*

Random Processes, Coding Theory, Detection and Estimation Theory, Introduction to Optimization, Control System Theory and Design, Vector Space Signal Processing, Statistical Learning and Pattern Recognition

Department of *Mathematics*

Real Analysis 1, Real Analysis 2, Combinatorial Mathematics, Mathematical Logic

Department of *Computer Science*

Computational Complexity, Distributed Algorithms

Department of *Psychology*

Models of Decision and Choice

Nile University

Wireless Intelligent Networks Center

Stochastic Processes, Information Theory, Circuits for Wireless Communications, Design of Communication Systems, Antenna Theory, Fundamentals of Wireless Communications, Computer Networks, Wireless Networks

PROFESSIONAL SERVICE

- Associate Editor in the Area of Machine Learning and AI for Wireless at the IEEE Transactions on Wireless Communications
- Guest Editor for a Special Issue on Machine Learning in the Physical Layer at the IEEE Transactions on Cognitive Communications and Networking
- TPC Member for the IEEE Global Communications Conference (Globecom '21)
- TPC Member for the IEEE 5G-World Forum (5G-WF '21)
- TPC Member for the International Symposium on Information Theory (ISIT '20)
- TPC Member for the Communication Theory Symposium at IEEE ICC '20
- Faculty Advisor for Autonomous Motorsports Purdue (AMP)
- Reviewer for American Mathematical Society (AMS) Mathematical Reviews
- TPC Member for IEEE 5G-WF'18, WCNC'17, WPMC'17, ICNC'18, SPAWC '19
- Proposal Reviewer for the National Science Foundation (NSF).
- Proposal Reviewer for the Natural Sciences and Engineering Research Counsel of Canada (NSERC)
- Proposal Reviewer for the Chilean National Science and Technology Commission (FONDECYT)
- Reviewer for IEEE Transactions on Information Theory, IEEE Transactions on Wireless Communications, IEEE Transactions on Communications, IEEE Transactions on Signal Processing, IEEE Journal on Selected Areas in Communications - Signal Processing (JSAC), and several conferences including Allerton, IEEE ISIT, IEEE ICC, IEEE Globecom, IEEE CAMSAP, and IWCIT
- Organizing Committee Member for 2012 Coordinated Science Lab (CSL) Student Conference

- On-Site registration for 2010 IEEE Information Theory Workshop (ITW) in Cairo

PROGRAMMING LANGUAGES
Java, C++, nesC, SQL, Assembly (8086 Family), Python, MATLAB