Igor Kadota

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Research Interests

Theory: network modelling and optimization, scheduling algorithms with performance guarantees, age-of-information, multi-armed bandits, Lyapunov optimization, renewal theory, stochastic coupling, machine learning, and regret analysis.

Systems: design and implementation of ultra-low latency wireless networks, full-duplex wireless, mmWave systems, spectrum sharing, Software Defined Radios (SDR), 5G networks, Internet-of-Things (IoT), and Smart-Cities.

Education

2016–2020 **Massachusetts Institute of Technology** (MIT), USA
Ph.D. in Communication Networks from MIT LIDS
Affiliated with the MIT Institute for Data, Systems, and Society (IDSS)
Thesis: Age of Information in Wireless Networks - Theory and Implementation
Advisor: Prof. Eytan Modiano
Committee: Prof. Mohammad Alizadeh, Prof. Mor Harchol-Balter, Prof. Yin Sun, and Prof. Moe Win

2014–2016 **Massachusetts Institute of Technology**, USA
S.M. in Communication Networks from MIT LIDS
Thesis: Transmission Scheduling of Periodic Real-Time Traffic in Wireless Networks
Advisor: Prof. Eytan Modiano

2011–2013 **Technological Institute of Aeronautics** (ITA), Brazil
S.M. in Telecommunications
Thesis: Kalman Filtering - Estimate of the Numbers of Active Queues in an 802.11e EDCA WLAN
Advisor: Prof. Alessandro Anzaloni

2005–2010 **Technological Institute of Aeronautics**, Brazil
B.Sc. in Electrical Engineering

Research Experience

2020–Present **Postdoctoral Research Scientist**, Columbia University, USA
Department of Electrical Engineering and affiliated with the Data Science Institute
Host: Prof. Gil Zussman

- **Develops network control algorithms** for emerging wireless technologies (in particular *full-duplex*, *mmWave*, and *spectrum sharing*) using theory-based and data-driven approaches. For example, [R1] employs RNN, Model Predictive Control, and data provided by Ericsson from a real-world wireless backhaul network in Sweden to develop a predictive network reconfiguration algorithm;
- **Implements network control algorithms** in the NSF PAWR COSMOS *city-scale wireless testbed*. For example, an enhanced version of the algorithm presented in [C5] to dynamically configure a full-duplex microchip (developed by our collaborators in the area of integrated circuits) aiming to minimize the self-interference measured by the SDR is being tested and integrated into COSMOS;
- **Develops machine learning models that leverage wireless communication signals for sensing**. For example, an ongoing project that employs deep learning to sense wind using signals received from a mmWave radar that operates at 77GHz frequency.

2014–2020 **Graduate Research Assistant**, MIT LIDS, USA

- **Developed network control algorithms** with provable performance guarantees (in terms of latency, throughput, and/or information freshness) for wireless networks that carry time-sensitive information using tools such as reinforcement learning, multi-armed bandits, Lyapunov optimization, renewal theory, and stochastic coupling. Papers based on this research received the Best Paper Award at IEEE INFOCOM 2018 [C9] and the Best Paper Award Finalist at ACM MobiHoc 2019 [C7];
- **Built a SDR wireless testbed from the ground up**. The testbed was composed of 11 research-grade FPGA-enabled SDRs, 25 Raspberry Pis, and 3 GPU workstations. Selected and purchased the equipment, assembled the testbed, and implemented my novel network control algorithms.

Work Experience in Industry

2013–2014 **R&D Network Engineer**, Mectron - Defense and Technology, Brazil
- Optimized network layer and data link layer algorithms for a Mobile Ad-hoc NETwork (MANET) using cross-layer techniques. Collaborated with the Radio Frequency (RF) and the Application teams.

Awards

2020 **MIT School of Engineering (SoE) Graduate Student Extraordinary Teaching and Mentoring Award** given annually by the MIT SoE to a single graduate student in "recognition of demonstrated extraordinary teaching and mentoring efforts as a teaching or research assistant".

2019–2020 **Thomas G. Stockham Jr. Fellowship** awarded annually by the MIT SoE to a single graduate student in "recognition of outstanding academic record, exceptional background, and promising future".

2019 **Best Paper Award Finalist at ACM MobiHoc 2019** among 156 paper submissions.

2018 **Best Paper Award Winner at IEEE INFOCOM 2018** among 1,606 paper submissions. This work was featured at MIT News, ACM TechNews, Science Daily, Campus Technology, etc.

2018 **MIT AeroAstro Graduate Teaching Assistantship Award** given annually by the MIT Department of Aeronautics and Astronautics to a single graduate student "who has demonstrated conspicuous dedication and skill in helping fulfill a subject's educational objectives".

2017 & 2020 Two **Best Presentation Awards** at the MIT LIDS Student Conference in 2017 and in 2020.

2011–2013 **CAPES Fellowship** from the Brazilian federal agency throughout the S.M. in ITA.

2010 **Best Senior Thesis** of the Department of Electrical Engineering of ITA in 2010. This senior thesis was developed in collaboration with researchers from *University of Rome - La Sapienza* and led to the journal publication in [J5].

Mentoring and Teaching

2017–Present **Directly supervised the work of 10+ MEng and undergraduate students** both at MIT and Columbia University. Two of these students have graduated from MIT and are now pursuing a Ph.D. degree: Lilly Clark (USC) and Lisa Zahray (Georgia Tech).

2016–2019 **Gave multiple lectures** for graduate and undergraduate students as part of the MIT courses: 16.363 Communication Systems & Networks and 6.263 Data-Communication Networks.

Spring 2017 **Created a Teaching Radio Laboratory** (from the ground up) for the MIT course Communication Systems & Networks to complement the theoretical lectures with hands-on experiments. Selected and purchased 16 teaching SDRs, and designed 5 customized experiments that closely follow the lectures.

Spring 2019 **Teaching Assistant (TA) for the Radio Lab**, Communication Systems & Networks, MIT
Spring 2018
Spring 2017
- Conducted the laboratory, developed laboratory scripts, and graded assignments;
- Student evaluation of the TA was (on average) 6.9 out of 7.0;
- Received the **MIT TA award of 2018** for creating and conducting the Radio Lab;
- Received the **MIT SoE Teaching and Mentoring award of 2020**.

Summer 2017 Completed the **Kaufman Teaching Certificate Program** offered by the Teaching and Learning Lab at MIT. Some of the topics were: Designing a Course and Constructing a Syllabus, Interactive Teaching & Active Learning, and Teaching Inclusively.

Spring 2016 **Teaching Assistant**, Communication Systems & Networks, MIT
- Held weekly office hours, offered exam review sessions, and assisted in the design of problem sets and exams. Student evaluation of the TA was 6.9 out of 7.0.

2011–2012 **Math Teacher**, Brazilian local government
- Prepared and delivered weekly classes for a talented class of underprivileged middle school students.

Publications

Citations: Total number of citations is 892, the most cited publication has 240 citations, and the average number of citations per publication is 46.9 (source: Google Scholar on 11/24/2021).

Conference Proceedings

[C1] D. Stojadinovic, P. Netalkar, C. Bastidas, **I. Kadota**, G. Zussman, I. Seskar, and D. Raychaudhuri, "A Spectrum Consumption Model-based Framework for DSA Experimentation on the COSMOS Testbed," to appear in Proc. of ACM MobiCom WiNTECH Workshop, 2022.

[C2] E. Atay, **I. Kadota**, and E. Modiano, "Aging Wireless Bandits: Regret Analysis and Order-Optimal Learning Algorithm," in Proc. of WiOpt, Oct. 2021, pp. 1–8.

[C3] **I. Kadota**, M. S. Rahman, and E. Modiano, "WiFresh: Age-of-Information from Theory to Implementation," in Proc. of IEEE ICCCN, Aug. 2021, pp. 1–11. [Invited paper]

[C4] **I. Kadota** and E. Modiano, "Age of Information in Random Access Networks with Stochastic Arrivals," in Proc. of IEEE INFOCOM, May 2021, pp. 1–10. **[Acceptance rate 19.9% (252/1,266)]**

[C5] A. Nagulu, S. Garikapati, M. Essawy, **I. Kadota**, T. Chen, A. Natarajan, G. Zussman, and H. Krishnaswamy, "Full-Duplex Receiver with Wideband Multi-Domain FIR Cancellation Based on Stacked-Capacitor, N-path Switched-Capacitor Delay Lines Achieving >+54dB SIC Across 80MHz BW and >+15dBm TX Power Handling," in Proc. of IEEE ISSCC, Feb. 2021, pp. 100–102.

[C6] **I. Kadota**, M. S. Rahman, and E. Modiano, "Poster: Age of Information in Wireless Networks: from Theory to Implementation", in Proc. of ACM MobiCom, Sept. 2020, pp. 1–3.

[C7] **I. Kadota** and E. Modiano, "Minimizing the Age of Information in Wireless Networks with Stochastic Arrivals," in Proc. of ACM MobiHoc, July 2019, pp. 221–230. **[Best Paper Award Finalist] [Acceptance rate 23.7% (37/156)]**

[C8] R. Talak, **I. Kadota**, S. Karaman, and E. Modiano, "Scheduling Policies for Age Minimization in Wireless Networks with Unknown Channel State," in Proc. of IEEE ISIT, June 2018, pp. 2564–2568.

[C9] **I. Kadota**, A. Sinha, and E. Modiano, "Optimizing Age of Information in Wireless Networks with Throughput Constraints," in Proc. of IEEE INFOCOM, April 2018, pp. 1844–1852. **[Best Paper Award Winner] [Acceptance rate 19.2% (308/1,606)]**

[C10] **I. Kadota**, E. Uysal-Biyikoglu, R. Singh, and E. Modiano, "Minimizing Age of Information in Broadcast Wireless Networks," in Proc. of IEEE Allerton, Sept. 2016, pp. 844–851.

[C11] K. Kim, C. Li, **I. Kadota**, and E. Modiano, "Optimal Scheduling of Real-Time Traffic in Wireless Networks with Delayed Feedback," in Proc. of IEEE Allerton, Sept. 2015, pp. 1143–1149.

Journals

[J1] T. Chen, S. Garikapati, A. Nagulu, A. Gaonkar, M. Kohli, **I. Kadota**, H. Krishnaswamy, and G. Zussman. "A Survey and Quantitative Evaluation of Integrated Circuit-based Antenna Interfaces and Self-Interference Cancellers for Full-Duplex," IEEE Open Journal of the Communications Society, Special issue on Full-Duplex Transceivers for Future Networks: Theory and Techniques, vol. 2, pp. 1753–1776, July 2021.

[J2] **I. Kadota** and E. Modiano, "Minimizing the Age of Information in Wireless Networks with Stochastic Arrivals," IEEE Transactions on Mobile Computing, vol. 20, no. 3, pp. 1173–1185, Mar. 2021.

[J3] **I. Kadota**, A. Sinha, and E. Modiano, "Scheduling Algorithms for Optimizing Age of Information in Wireless Networks with Throughput Constraints," IEEE/ACM Transactions on Networking, vol. 27, no. 4, pp. 1359–1372, Aug. 2019.

[J4] **I. Kadota**, A. Sinha, E. Uysal-Biyikoglu, R. Singh, and E. Modiano, "Scheduling Policies for Minimizing Age of Information in Broadcast Wireless Networks," IEEE/ACM Transactions on Networking, vol. 26, no. 6, pp. 2637–2650, Dec. 2018.

[J5] **I. Kadota**, A. Baiocchi, and A. Anzaloni, "Kalman Filtering: Estimate of the Numbers of Active Queues in an 802.11e EDCA WLAN," Elsevier Computer Communications, vol. 39, pp. 54–64, Feb. 2014.

Under Review

[R1] **I. Kadota**, D. Jacoby, H. Messer, G. Zussman, and J. Ostrometzky, "Switching in the Rain: Predictive Wireless x-haul Network Reconfiguration." [Submitted].

[R2] P. Netalkar, A. Zahabee, C. Bastidas, D. Stojadinovic, **I. Kadota**, G. Zussman, I. Seskar, and D. Raychaudhuri, "Large-Scale Dynamic Spectrum Access with Spectrum Consumption Models." [Submitted].

Theses

[T1] **I. Kadota**, "Age of Information in Wireless Networks: Theory and Implementation," Ph.D. thesis, Dept. of Aeronautics and Astronautics, MIT, Sept. 2020.

[T2] **I. Kadota**, "Transmission Scheduling of Periodic Real-Time Traffic in Wireless Networks," S.M. thesis, Dept. of Aeronautics and Astronautics, MIT, Sept. 2016.

Book

[B1] Y. Sun, **I. Kadota**, R. Talak, and E. Modiano, *Age of Information: A New Metric for Information Freshness*. Morgan & Claypool, 2019.

Patent

[P1] J. Ostrometzky, G. Zussman, H. Messer-Yaron, D. Jacoby, and **I. Kadota**. (2021). Predictive Weather-Aware Communication Network Management. U.S. Patent pending.

Grants

2021 **NSF-RINGS**, "RINGS: Enabling Wireless Edge-cloud Services via Autonomous Resource Allocation and Robust Physical Layer Technologies"
- Result: Pending
- Role: Senior Personnel (PIs: Eytan Modiano and Gil Zussman)
- Contribution: Assisted PIs Prof. Eytan Modiano and Prof. Gil Zussman in writing and preparing the grant proposal.

2019 **ARO-DURIP**, "Wireless Networking Testbed for Low Latency Mission Critical Communications"
- Result: Awarded by the Army Research Office (ARO) in 2019
- Contribution: Assisted PI Prof. Eytan Modiano in writing the proposal.

Talks

2019–2022 WiFresh: Age-of-Information from Theory to Implementation
- (Upcoming) invited talk at UM6P (Morocco), CS Research Seminars, hosted by Prof. El Mehdi Amhoud and Prof. Karima Echihabi, 2022
- Invited talk at METU (Turkey), EE Graduate Seminar, hosted by Prof. Elif Uysal-Biyikoglu, 2021
- Talk at IEEE ICCCN, 2021
- Invited talk at MIT LIDS Student Conference, 2020 [**Best Presentation Award**]
- Invited talk at UPenn, hosted by Prof. Shirin Bidokhti, 2020
- Invited talk at Harvard ISS Seminar, hosted by Prof. Flavio du Pin Calmon, 2019
- Invited talk at WPI ECE Graduate Seminar, hosted by Prof. D. Richard Brown, 2019
- Invited talk at MIT, hosted by the Society for Applied and Industrial Mathematics, 2019

2021 Wireless Networks for Emerging Time-Sensitive Applications: Theory and Systems
- Invited talk at Yale, hosted by Prof. Steve Morse

2021 Aging Wireless Bandits: Regret Analysis and Order-Optimal Learning Algorithm
- Talk at WiOpt

2021 Age of Information in Random Access Networks with Stochastic Arrivals
- Talk at IEEE INFOCOM

2016 & 2020 Index Policies: Gittins and Whittle Indices
- Invited talk at CMU SQUALL Seminar, hosted by Prof. Mor Harchol-Balter, 2020
- Tutorial at MIT CNRG group meeting, hosted by Prof. Eytan Modiano, 2016

2020 Age-of-Information in Wireless Networks: Theory and Implementation
- MIT Ph.D. doctoral thesis defense

2019 Minimizing the Age of Information in Wireless Networks with Stochastic Arrivals
- Talk at ACM MobiHoc

2017 & 2018 Optimizing Age of Information in Wireless Networks with Throughput Constraints
- Talk at IEEE INFOCOM, 2018
- Invited talk at CMU SQUALL Seminar, hosted by Prof. Mor Harchol-Balter, 2017

2017 Minimizing Age of Information in Broadcast Wireless Networks
- Talk at MIT LIDS Student Conference [**Best Presentation Award**]

2017 Lyapunov Optimization applied to the Age of Information minimization problem
- Invited Talk at MIT LIDS Tea Talk

2015 Optimal Scheduling of Real-Time Traffic in Wireless Networks with Delayed Feedback
- Talk at IEEE Allerton

Service

2019–2021 Technical Program Committee (TPC) Member:
- WiOpt
- IEEE INFOCOM Workshop on AoI
- IEEE Globecom Workshop on experimental wireless platforms and testbeds
- IEEE VTC

2016–2021 Reviewed 100+ papers and articles for 15+ journals, magazines, and conferences in the field, including:
- IEEE/ACM Transactions on Networking
- IEEE Transactions on Information Theory
- IEEE Transactions on Mobile Computing
- IEEE Transactions on Communications
- IEEE Transactions on Wireless Communications
- IEEE Internet of Things Journal
- Journal of Communications and Networks
- IEEE Journal on Selected Areas in Communications
- IEEE Network Magazine
- IEEE Wireless Communications Letters
- IEEE Communications Letters
- IEEE Networking Letters
- IEEE INFOCOM Workshop
- IEEE ISIT
- IEEE Vehicular Technology Conference
- IFIP Performance
- ACM SIGMETRICS
- IEEE ICC: Communication Theory Symposium

2014–2020 Served in multiple committees, one or two per term, during the Ph.D. at MIT:
- Co-Chair of the MIT Westgate Executive Committee, 2019-2020
- Co-Chair of the MIT LIDS Social Committee, twice, 2014-2015 & 2018-2019
- Member of the MIT LIDS Mentoring Committee, twice, 2017-2019
- Co-Chair of the MIT LIDS Student Conference, 2017-2018
- Host of MIT Ashdown's monthly roundtable discussions, twice, 2015-2017