

Laurent Lessard, Ph.D.

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Academic appointments

Associate Professor

Mechanical & Industrial Engineering
Electrical & Computer Engineering (by courtesy)
Khoury College of Computer Sciences (by courtesy)

Aug. 24, 2020 – Present
Northeastern University

Assistant Professor

Electrical and Computer Engineering
Charles Ringrose Assistant Professorship
Faculty member of the Wisconsin Institute for Discovery
Affiliate appointment in Computer Science

Sep. 2015 – Aug. 2020
University of Wisconsin–Madison

Postdoctoral Researcher

Andrew Packard (ME) and Benjamin Recht (EECS)

Nov. 2012 – Aug. 2015
University of California, Berkeley

Postdoctoral Researcher

Anders Rantzer, dept. of Automatic Control

Oct. 2011 – Oct. 2012
Lund University, Sweden

Education

Stanford University

Ph.D. in Aeronautics and Astronautics, 2011
Thesis: Tractability of complex control systems
Advisor: Prof. Sanjay Lall, Co-Advisor: Prof. Matthew West

Stanford University

M.S. in Aeronautics and Astronautics, 2005

University of Toronto

B.A.Sc. with Honours, Engineering Science, Aerospace Option, 2003

Selected awards

- Charles Ringrose Assistant Professorship in the College of Engineering, UW–Madison, 2020–2023
- Gerald Holdridge Teaching Excellence Award, UW–Madison ECE, 2019
- National Science Foundation CAREER award, 2018
- American Automatic Control Council O. Hugo Schuck Best Paper Award, 2013
- Stanford University, Aeronautics and Astronautics Departmental Fellowship, 2003
- NSERC Postgraduate Scholarship-Doctoral Award (PGS D), 2003–2004
- NSERC Undergraduate Study Research Award (USRA), 2002
- University of Toronto, Engineering Science Academic Excellence Award, 2002

External grants (all as sole PI)

- *A Control-Theoretic Approach to Distributed Optimization.*
National Science Foundation (ENG/EECS). Award Number 1936648.
Sole PI. Amount: \$380,003. Dates: 09/15/2019–08/31/2022.
- *CAREER: Automated Analysis and Design of Optimization Algorithms.*
National Science Foundation (CISE/CCF). Award Number 1750162.
Sole PI. Amount: \$467,300. Dates: 02/15/2018–01/31/2023.
- *Analysis and Design of Decentralized Control Systems in the Presence of Uncertain Latency.*
National Science Foundation (ENG/EECS). Award Number: 1710892.
Sole PI. Amount: \$380,000. Dates: 08/01/2017–07/31/2020.
- *CRII: CIF: Universal Analysis of Optimization Algorithms.*
National Science Foundation (CISE/CCF). Award Number: 1656951.
Sole PI. Amount: \$175,000. Dates: 02/15/2017–01/31/2019. (+NCE)

Internal grants at UW–Madison

- *Data Science Course Development in the Electrical Engineering Curriculum.*
Education Innovation Committee, College of Engineering, UW–Madison.
Co-PI. (other Co-PIs: B. Lesieutre, B. Van Veen). Amount: \$35,000. Spring 2019.
- *Predicting Color Inferences in Visual Communication.*
Office of the Vice Chancellor for Research and Graduate Education, UW–Madison.
Co-PI. (PI: K. Schloss). Amount: \$22,081. Fall 2017.

Teaching

- ECE 379: *Data Science & Engineering*** fa19, sp19
Course created from scratch. Undergrad-level hands-on introduction to data science using the Python data science stack. Data manipulation/visualization, basic dimensionality reduction, clustering, classification, and regression problems. Issues of bias and privacy. Course content available upon request. UW–Madison
- CS/ECE/ISyE 524: *Introduction to Optimization*** sp18, sp17, sp16
Course created from scratch. Advanced undergrad level, covers optimization modeling, linear/convex/mixed-integer, modeling in Julia/JuMP. Course website: laurentlessard.com/teaching/524-intro-to-optimization UW–Madison
- ECE/ME/CS 532: *Matrix Methods in Machine Learning*** fa16, fa15
Graduate-level introductory course on the linear algebraic foundations of machine learning and matrix methods. Course website: laurentlessard.com/teaching/532-matrix-methods UW–Madison
- ECE 717: *Linear Systems*** fa19, fa17
Graduate-level course on state-space models. Linearization, controllability/observability, feedback control, and more. Course website: laurentlessard.com/teaching/717-linear-systems UW–Madison
- EE 263s: *Introduction to Linear Dynamical Systems*** su11, su10
Graduate-level course on linear dynamical systems with applications to controls and signal processing (teaching fellow position). Stanford University

Invited talks (excluding conference and poster presentations)

- University of Chicago & TTIC, ML Seminar Series, May 29, 2020
- University of Washington, ECE Research Colloquium, Mar 3, 2020
- Johns Hopkins, MINDS Seminar, Feb 18, 2020
- Vector Institute (Toronto, Canada), Invited Talk, Oct 25, 2019
- Workshop at ACC'19: "Interplay btwn control, optimization, and machine learning", Jul 9, 2019
- 8th Midwest Workshop on Control and Game Theory, WUSTL, St. Louis, Apr 26, 2019
- Cornell University, CAM Seminar, Oct 26, 2018
- Harvard University, EE Seminar, Oct 19, 2018
- Boston University, CISE Seminar, Nov 3, 2017
- CMO-BIRS Workshop: Beyond Convexity, Oaxaca, Mexico, Oct 22–27, 2017
- Northwestern University, OSL/EECS Seminar, Oct 11, 2017
- University of Illinois at Urbana–Champaign, ISE Seminar, Sep 22, 2017
- LCCC Workshop on Large-Scale and Distributed Optimization, Lund University, Jun 15, 2017
- 6th Midwest Workshop on Control and Game Theory, University of Michigan, Apr 22, 2017
- University of Maryland, ISR Seminar, Oct 30, 2015
- UC Santa Barbara, CCDC Seminar, Oct 31, 2014
- Caltech, CMS Seminar, Oct 29, 2014
- UC San Diego, Optimization and Control Seminar, Oct 28, 2014
- UCLA, Systems and Control Seminar, Oct 10, 2014
- University of Southern California, ComNetS Seminar, Oct 8, 2014
- Workshop on Uncertain Dynamical Systems (WUDS) in Amsterdam, Aug 22, 2014
- Workshop at ACC'14: "40 Years of Robust Control: 1978 to 2018", Jun 3, 2014
- Caltech, invited talk at CDS, Nov 21, 2013
- UC Santa Barbara, CCDC Seminar, Jun 7, 2013
- University of Stuttgart, Systems and Control Colloquium, Germany, Oct 23, 2012
- LCCC Workshop on Information and Control in Networks, Lund University, Oct 19, 2012
- UC Berkeley, invited talk, Aug 1, 2012
- Reglermöte (Control Systems) Workshop, Uppsala University, Sweden, Jun 13, 2012
- UC Santa Barbara, CCDC seminar, Feb 10, 2012
- UCLA, Systems and Control Seminar, Feb 7, 2012
- Caltech, invited talk at CDS, Feb 6, 2012
- Stanford University, invited talk, Jan 31, 2012
- UC Berkeley, Networking, Communications, and DSP seminar, Jan 30, 2012
- Boston University, CISE seminar, Dec 20, 2011
- MIT, invited talk at LIDS, Dec 19, 2011
- Linköping University, invited talk, Nov 30, 2011
- KTH, Stockholm, invited talk, Nov 28, 2011
- National Control Engineering Students Workshop, University of Maryland, Apr 30, 2011

Professional activities and service

■ Journal Reviewer:

IEEE Transactions on Automatic Control	IEEE Transactions on Signal Processing
IEEE Transactions on Control of Network Systems	IEEE Control Systems Letters
IEEE Transactions on Control Systems Technology	Systems and Control Letters
Intl. Journal of Robust and Nonlinear Control	Automatica
International Journal of Control	Mathematical Programming
SIAM Journal on Mathematics of Data Science	SIAM Journal of Optimization
Journal of the Optical Society of America A.	Optimization Methods and Software

■ Conference Reviewer:

IEEE Conference on Decision and Control (CDC); American Control Conference (ACC);
European Control Conference (ECC); Indian Control Conference (ICC);
International Symposium on Mathematical Theory of Networks and Systems (MTNS);
Workshop on Distributed Estimation and Control in Networked Systems (NecSys);
Allerton Conference on Control, Communication, and Computing (Allerton);
Conference on Learning for Dynamics and Control (L4DC)
Conference on Neural Information Processing Systems (NeurIPS);
International Conference on Machine Learning (ICML);

- Outstanding service as a reviewer award, IEEE Control Systems Letters (L-CSS), 2017.
- Among the top-400 highest scoring reviewers, NeurIPS conference, 2019.
- NSF award panel member, Spring 2019.
- Invited session organizer, 2014 IEEE Conference on Decision and Control.
Session title: *Topics in Decentralized and Distributed Control*
- Workshop organizer (co-organized with Bin Hu) at the 2019 American Control Conference.
Workshop title: *Interplay between Control, Optimization, and Machine Learning*
Workshop website: <https://laurentlessard.com/acc2019workshop>
- Planning Committee member, NSF workshop: “Forging Connections between Machine Learning, Data Science, and Power Systems Research”. Lead organizer: Prof. Sairaj Dhople.
Date of workshop: March 5–6, 2020 at NSF headquarters.
- Program committee, Conference on Learning for Dynamics and Control (L4DC).
Date of conference: June 11–12, 2020 (held virtually)
- Member of IEEE, SIAM, INFORMS

Outreach

- Creator and chief contributor of *Book Proofs*, a blog about mathematical riddles, puzzles, and problem-solving. The blog has been linked to by popular sites such as *fvethirtyeight.com*, and has hosted over 500 interactions with readers in the form of questions/answers/comments. Since its inception in 2016, the site has seen over 45,000 unique visitors and its readership continues to grow. Link: <https://laurentlessard.com/bookproofs>

Publications are organized by research field and publication type. Collaborative/cross-disciplinary works are listed at the end. Publications are listed reverse-chronologically within each section.

- Up-to-date publication list: <https://laurentlessard.com/publications>
- Google Scholar: <https://scholar.google.com/citations?user=5PBPqeQAAAAJ>
- ORCID iD: <https://orcid.org/0000-0001-5389-9361>

Optimization and machine learning – refereed conference and journal papers

1. B. Hu, P. Seiler, and **L. Lessard**. Analysis of biased stochastic gradient descent using sequential semidefinite programs. (in press) *Mathematical Programming*, 2020.
2. X. Zhang, X. Zhu, and **L. Lessard**. Online data poisoning attacks. *Conference on Learning for Dynamics and Control (L4DC)*, PMLR 120:201-210, 2020.
3. X. Zhang, X. Zhu, and **L. Lessard**. An optimal control approach to sequential machine teaching. *International Conference on Artificial Intelligence and Statistics (AISTATS)*, pp. 2495–2503, 2019.
4. B. Hu, S. Wright, and **L. Lessard**. Dissipativity theory for accelerating stochastic variance reduction: A unified analysis of SVRG and Katyusha using semidefinite program. *International Conference on Machine Learning (ICML)*, pp. 2038–2047, 2018.
5. A. Taylor, B. Van Scoy, and **L. Lessard**. Lyapunov functions for first-order methods: Tight automated convergence guarantees. *International Conference on Machine Learning (ICML)*, pp. 4897–4906, 2018.
6. B. Hu and **L. Lessard**. Dissipativity theory for Nesterov’s accelerated method. *International Conference on Machine Learning (ICML)*, pp. 1549–1557, 2017.
7. **L. Lessard**, B. Recht, and A. Packard. Analysis and design of optimization algorithms via integral quadratic constraints. *SIAM Journal on Optimization (SIOPT)*, 26(1):57–95, 2016.
8. R. Nishihara, **L. Lessard**, B. Recht, A. Packard, and M.I. Jordan. A general analysis of the convergence of ADMM. *International Conference on Machine Learning (ICML)*, 343–352, 2015.

Systems and control theory – journal papers

9. A. Sundararajan, B. Van Scoy, and **L. Lessard**. Analysis and design of first-order distributed optimization algorithms over time-varying graphs. (in press) *IEEE Transactions on Control of Network Systems*, 2019.
10. **L. Lessard** and S. Lall. Convexity of decentralized controller synthesis. *IEEE Transactions on Automatic Control*, 6(10):3122–3127, 2016.
11. C. Meissen, **L. Lessard**, M. Arcak, and A. Packard. Compositional performance certification of interconnected systems using ADMM. *Automatica*, 61:55–63, 2015.
12. A. Lamperski and **L. Lessard**. Optimal decentralized state-feedback control with sparsity and delays. *Automatica*, 58:143–151, 2015.
13. **L. Lessard** and S. Lall. Optimal control of two-player systems with output feedback. *IEEE Transactions on Automatic Control*, 60(8):2129–2144, 2015.
14. **L. Lessard** and S. Lall. An algebraic approach to the control of decentralized systems. *IEEE Transactions on Control of Network Systems*, 1(4):308–317, 2014.

15. M. Kashyap and **L. Lessard**. Agent-level optimal LQG control of dynamically decoupled systems with processing delays. (to appear) *IEEE Conference on Decision and Control*, 2020.
16. B. Van Scoy and **L. Lessard**. Systematic Analysis of Distributed Optimization Algorithms over Jointly-Connected Networks. (to appear) *IEEE Conference on Decision and Control*, 2020.
17. **L. Lessard** and P. Seiler. Direct synthesis of iterative algorithms with bounds on achievable worst-case convergence rate. *American Control Conference*, pp. 119–125, 2020.
18. M. Kashyap and **L. Lessard**. Explicit agent-level optimal cooperative controllers for dynamically decoupled systems with output feedback. *IEEE Conference on Decision and Control*, pp. 8254–8259, 2019.
19. B. Van Scoy and **L. Lessard**. Integral quadratic constraints: Exact convergence rates and worst-case trajectories. *IEEE Conference on Decision and Control*, pp. 7677–7682, 2019.
20. S. Cyrus and **L. Lessard**. Unified necessary and sufficient conditions for the robust stability of interconnected sector-bounded systems. *IEEE Conference on Decision and Control*, pp. 7690–7695, 2019.
21. B. Van Scoy and **L. Lessard**. Distributed optimization of nonconvex functions over time-varying graphs. *IFAC NecSys Workshop*, pp. 357–362, 2019.
22. A. Sundararajan, B. Van Scoy, and **L. Lessard**. A canonical form for first-order distributed optimization algorithms. *American Control Conference*, pp. 4075–4080, 2019.
23. S. Cyrus, B. Hu, B. Van Scoy, and **L. Lessard**. A robust accelerated optimization algorithm for strongly convex functions. *American Control Conference*, pp. 1376–1381, 2018.
24. B. Hu and **L. Lessard**. Control interpretations for first-order optimization methods. *American Control Conference*, pp. 3114–3119, 2017.
25. A. Sundararajan, B. Hu, and **L. Lessard**. Robust convergence analysis of distributed optimization algorithms. *Allerton Conference on Communication, Control, and Computing*, pp. 1206–1212, 2017.
26. R. Boczar, **L. Lessard**, B. Recht, and A. Packard. Exponential convergence bounds using integral quadratic constraints. *IEEE Conference on Decision and Control*, pp. 7516–7521, 2015.
27. A. Nayyar and **L. Lessard**. Structural results for partially nested LQG systems over graphs. *American Control Conference*, pp. 5457–5464, 2015.
28. **L. Lessard**. State-space solution to a minimum-entropy \mathcal{H}_∞ optimal control problem with a nested information constraint. *IEEE Conference on Decision and Control*, pp. 4026–4031, 2014.
29. C. Meissen, **L. Lessard**, M. Arcaç, and A. Packard. Performance certification of interconnected nonlinear systems using ADMM. *IEEE Conference on Decision and Control*, pp. 5131–5136, 2014.
30. C. Meissen, **L. Lessard**, and A. Packard. Performance certification of interconnected systems using decomposition techniques. *American Control Conference*, pp. 5030–5036, 2013.
31. **L. Lessard**. A separation principle for decentralized state-feedback optimal control. *Allerton Conference on Communication, Control, and Computing*, pp. 528–534, 2013.
32. **L. Lessard** and A. Nayyar. Structural results and explicit solution for two-player LQG systems

- on a finite time horizon. *IEEE Conference on Decision and Control*, pp. 6542–6549, 2013.
33. **L. Lessard**, M. Kristalny, and A. Rantzer. On structured realizability and stabilizability of linear systems. *American Control Conference*, pp. 5694–5700, 2013.
 34. **L. Lessard**. Decentralized LQG control of systems with a broadcast architecture. *IEEE Conference on Decision and Control*, pp. 6241–6246, 2012.
 35. **L. Lessard**. Optimal control of a fully decentralized quadratic regulator. *Allerton Conference on Communication, Control, and Computing*, pp. 48–54, 2012.
 36. A. Lamperski and **L. Lessard**. Optimal state-feedback control under sparsity and delay constraints. *IFAC NecSys Workshop*, pp. 204–209, 2012.
 37. **L. Lessard** and S. Lall. Optimal controller synthesis for the decentralized two-player problem with output feedback. *American Control Conference*, pp. 6314–6321, 2012.
 38. **L. Lessard** and S. Lall. A state-space solution to the two-player decentralized optimal control problem. *Allerton Conference on Communication, Control, and Computing*, pp. 1559–1564, 2011.
 39. **L. Lessard** and S. Lall. Quadratic invariance is necessary and sufficient for convexity. *American Control Conference*, pp. 5360–5362, 2011.
 40. **L. Lessard** and S. Lall. An algebraic framework for quadratic invariance. *IEEE Conference on Decision and Control*, pp. 2698–2703, 2010.
 41. **L. Lessard** and S. Lall. Internal quadratic invariance and decentralized control. *American Control Conference*, pp. 5596–5601, 2010.
 42. **L. Lessard** and S. Lall. Reduction of decentralized control problems to tractable representations. *IEEE Conference on Decision and Control*, pp. 1621–1626, 2009.

Interdisciplinary collaborative works – journal papers

43. R. Rathore, Z. Leggon, **L. Lessard**, and K.B. Schloss. Estimating color-concept associations from image statistics. (to appear) *IEEE Trans. on Visualization and Computer Graphics*, 26(1):1226–1235, 2019.
44. B. Gundlach, A. Shahsafi, G. Vershbow, C. Wan, J. Salman, B. Rokers, **L. Lessard**, and M. Kats. Design considerations for the enhancement of human color vision by breaking binocular redundancy. *Nature Scientific Reports*, 8, 11971, 2018.
45. K.B. Schloss, **L. Lessard**, C.S. Walmsley, and K. Foley. Color inferences in visual communication: Interpreting the meanings of colors in recycling. *Cognitive Research: Principles and Implications*, 3(5):1–17, 2018.
46. K.B. Schloss, **L. Lessard**, C. Racey, and A.C. Hurlbert. Modeling color preference using color space metrics. *Vision Research*, 151:99–116, 2017.
47. **L. Lessard**, D. MacMynowski, M. West, A. Bouchez, and S. Lall. Experimental validation of single-iteration multigrid wavefront reconstruction at the Palomar Observatory. *Optics Letters*, 33(18):2047–2049, 2008.
48. **L. Lessard**, M. West, D. MacMynowski, and S. Lall. Warm-started wavefront reconstruction for adaptive optics. *Journal of the Optical Society of America A*, 25(5):1147–1155, 2008.