Laurent Lessard, Ph.D.

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Academic appointments

Associate Professor — Aug. 24, 2020 – Present — Northeastern University
Mechanical & Industrial Engineering
Electrical & Computer Engineering (by courtesy)
Khoury College of Computer Sciences (by courtesy)

Assistant Professor — Sep. 2015 – Aug. 2020 — University of Wisconsin–Madison
Electrical and Computer Engineering
Charles Ringrose Assistant Professorship
Faculty member of the Wisconsin Institute for Discovery
Affiliate appointment in Computer Science

Postdoctoral Researcher — Nov. 2012 – Aug. 2015 — University of California, Berkeley
Andrew Packard (ME) and Benjamin Recht (EECS)

Postdoctoral Researcher — Oct. 2011 – Oct. 2012 — Lund University, Sweden
Anders Rantzer, dept. of Automatic Control

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

- IEEE Senior Member, 2021.

- 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.

Teaching

ME 7247: *Advanced Control Systems* — fa21, Northeastern
Graduate-level course covering Kalman filtering, LQR/LQG control, model-predictive control, and an introduction to robust control.
laurentlessard.com/teaching/7247-advanced-control-engineering

ME 4555: *System Analysis and Control* — fa20, sp21, sp22, Northeastern
Undergrad-level classical controls course. Modeling and response of dynamical systems, PID control, root locus and frequency-domain design techniques.
laurentlessard.com/teaching/4555-system-analysis-and-control

ECE 204: *Data Science & Engineering* — fa19, sp19, UW–Madison
Undergrad-level hands-on intro to data science using the Python data science stack. Data manipulation/visualization, dimensionality reduction, clustering, classification, regression. Issues of bias and privacy.
laurentlessard.com/teaching/204-data-science-engineering

CS/ECE/ISyE 524: *Introduction to Optimization* — sp18, sp17, sp16, UW–Madison
Advanced undergrad level course covering optimization modeling, linear/convex/mixed-integer, modeling using Julia/JuMP.
laurentlessard.com/teaching/524-intro-to-optimization

ECE/ME/CS 532: *Matrix Methods in Machine Learning* — fa16, fa15, UW–Madison
Graduate-level introductory course on the linear algebraic foundations of machine learning. Least squares, regularization, PCA, SVM, clustering.
laurentlessard.com/teaching/532-matrix-methods

ECE 717: *Linear Systems* — fa19, fa17, UW–Madison
Graduate-level linear systems course. State-space models, linearization, controllability/observability, Lyapunov theory, observers, LQR.
laurentlessard.com/teaching/717-linear-systems

Invited talks (excluding conference/workshop/poster presentations)

- Lund University, Controls Seminar, Jan 21, 2022
- University of Michigan, Controls Seminar, Nov 12, 2021
- 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
  Itnl. 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), 2020 and 20201.
  Date of conference: June 11–12, 2020 (held virtually)
  Date of conference: June 7–8, 2021 (ETH, Zurich)

- Senior Member of IEEE, Member of SIAM and 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 *fivethirtyeight.com*, and has hosted over 600 interactions with readers in the form of questions/answers/comments. Since its inception in 2016, the site has seen over 65,000 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. G. Zhang, X. Bao, **L. Lessard**, and R. Grosse. A unified analysis of first-order methods for smooth games via integral quadratic constraints. *Journal of Machine Learning Research (JMLR)*, 22(103):1–39, 2021.

2. B. Hu, P. Seiler, and **L. Lessard**. Analysis of biased stochastic gradient descent using sequential semidefinite programs. *Mathematical Programming*, 187(1):384–408, 2021.

3. X. Zhang, X. Zhu, and **L. Lessard**. Online data poisoning attacks. *Conference on Learning for Dynamics and Control (L4DC)*, PMLR 120:201-210, 2020.

4. 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.

5. 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.

6. 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.

7. B. Hu and **L. Lessard**. Dissipativity theory for Nesterov's accelerated method. *International Conference on Machine Learning (ICML)*, pp. 1549–1557, 2017.

8. **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.

9. 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

10. M.P. Chapman, **L. Lessard**. Toward a Scalable Upper Bound for a CVaR-LQ Problem. *IEEE Control Systems Letters*, 6:920–925, 2021.

11. A. Sundararajan, B. Van Scoy, and **L. Lessard**. Analysis and design of first-order distributed optimization algorithms over time-varying graphs. *IEEE Transactions on Control of Network Systems*, 7(4):1597–1608, 2020.

12. **L. Lessard** and S. Lall. Convexity of decentralized controller synthesis. *IEEE Transactions on Automatic Control*, 6(10):3122–3127, 2016.

13. C. Meissen, **L. Lessard**, M. Arcak, and A. Packard. Compositional performance certification of interconnected systems using ADMM. *Automatica*, 61:55–63, 2015.

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14. A. Lamperski and **L. Lessard**. Optimal decentralized state-feedback control with sparsity and delays. *Automatica*, 58:143–151, 2015.

15. **L. Lessard** and S. Lall. Optimal control of two-player systems with output feedback. *IEEE Transactions on Automatic Control*, 60(8):2129–2144, 2015.

16. **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.

Systems and control theory – refereed conference papers

17. M. Kashyap and **L. Lessard**. Agent-level optimal LQG control of dynamically decoupled systems with processing delays. *IEEE Conference on Decision and Control*, pp. 5980–5985, 2020.

18. B. Van Scoy and **L. Lessard**. Systematic Analysis of Distributed Optimization Algorithms over Jointly-Connected Networks. *IEEE Conference on Decision and Control*, pp. 3096—3101, 2020.

19. **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.

20. 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.

21. 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.

22. 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.

23. B. Van Scoy and **L. Lessard**. Distributed optimization of nonconvex functions over time-varying graphs. *IFAC NecSys Workshop*, pp. 357–362, 2019.

24. A. Sundararajan, B. Van Scoy, and **L. Lessard**. A canonical form for first-order distributed optimization algorithms. *American Control Conference*, pp. 4075–4080, 2019.

25. 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.

26. B. Hu and **L. Lessard**. Control interpretations for first-order optimization methods. *American Control Conference*, pp. 3114–3119, 2017.

27. 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.

28. 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.

29. A. Nayyar and **L. Lessard**. Structural results for partially nested LQG systems over graphs. *American Control Conference*, pp. 5457–5464, 2015.

30. **L. Lessard**. State-space solution to a minimum-entropy $\mathcal{H}_\infty$ optimal control problem with a nested information constraint. *IEEE Conference on Decision and Control*, pp. 4026–4031, 2014.

31. C. Meissen, **L. Lessard**, M. Arcak, and A. Packard. Performance certification of interconnected

nonlinear systems using ADMM. *IEEE Conference on Decision and Control*, pp. 5131–5136, 2014.

32. C. Meissen, **L. Lessard**, and A. Packard. Performance certification of interconnected systems using decomposition techniques. *American Control Conference*, pp. 5030–5036, 2013.

33. **L. Lessard**. A separation principle for decentralized state-feedback optimal control. *Allerton Conference on Communication, Control, and Computing*, pp. 528–534, 2013.

34. **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.

35. **L. Lessard**, M. Kristalny, and A. Rantzer. On structured realizability and stabilizability of linear systems. *American Control Conference*, pp. 5694–5700, 2013.

36. **L. Lessard**. Decentralized LQG control of systems with a broadcast architecture. *IEEE Conference on Decision and Control*, pp. 6241–6246, 2012.

37. **L. Lessard**. Optimal control of a fully decentralized quadratic regulator. *Allerton Conference on Communication, Control, and Computing*, pp. 48–54, 2012.

38. A. Lamperski and **L. Lessard**. Optimal state-feedback control under sparsity and delay constraints. *IFAC NecSys Workshop*, pp. 204–209, 2012.

39. **L. Lessard** and S. Lall. Optimal controller synthesis for the decentralized two-player problem with output feedback. *American Control Conference*, pp. 6314–6321, 2012.

40. **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.

41. **L. Lessard** and S. Lall. Quadratic invariance is necessary and sufficient for convexity. *American Control Conference*, pp. 5360–5362, 2011.

42. **L. Lessard** and S. Lall. An algebraic framework for quadratic invariance. *IEEE Conference on Decision and Control*, pp. 2698–2703, 2010.

43. **L. Lessard** and S. Lall. Internal quadratic invariance and decentralized control. *American Control Conference*, pp. 5596–5601, 2010.

44. **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

45. K. Mukherjee, B. Yin, B.E. Sherman, **L. Lessard**, and K.B. Schloss. Context Matters: A Theory of Semantic Discriminability for Perceptual Encoding Systems. *IEEE Trans. on Visualization and Computer Graphics*, 28(1):697–706, 2022.

46. K.B. Schloss, Z. Leggon, and **L. Lessard**. Semantic discriminability for visual communication. *IEEE Trans. on Visualization and Computer Graphics*, 27(2):1022–1031, 2021.

47. S.C. Sibrel, R. Rathore, **L. Lessard**, and K.B. Schloss. The relation between color and spatial structure for interpreting colormap data visualizations. *Journal of Vision*, 20(12):7, 2020.

48. R. Rathore, Z. Leggon, **L. Lessard**, and K.B. Schloss. Estimating color-concept associations from image statistics. *IEEE Trans. on Visualization and Computer Graphics*, 26(1):1226–1235, 2019.

49. 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.

50. 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.

51. K.B. Schloss, **L. Lessard**, C. Racey, and A.C. Hurlbert. Modeling color preference using color space metrics. *Vision Research*, 151:99–116, 2017.

52. **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.

53. **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.

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