Curriculum Vitae

Personal Information

Daniel J. Calderone, PhD
Postdoctoral Researcher
University of Washington
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Education

08/2010-05/2017 **Ph.D., Electrical & Computer Engineering**
University of California, Berkeley (UCB)
Thesis: Models of Competition for Intelligent Transportation Infrastructure: Parking, Ridesharing, and External Factors in Routing Decisions
Advisor: S. Shankar Sastry

08/2006–05/2010 **B.Sc., Mechanical Engineering**
University of Maryland, College Park (UMD)
Summa Cum Laude

Academic Experience

01/2018–12/2020
06/2022–current **University of Washington**
Position: Postdoctoral Scholar
Departments: Aerospace/electrical engineering
Supervisor: Lillian J. Ratliff, Behcet Ackimese
Projects: (see below)
Markov decision process congestion games, multi-dimensional continuous-type population games, stability of learning dynamics in games, consistent conjectural variations equilibria, multi-agent path planning and task assignment, sequential convex programming (hyperparameter tuning).

04/2019–06/2022 **University of Washington**
Position: Lecturer
Departments: Aerospace/electrical engineering
Courses: (see below)

Linear algebra/linear systems, SISO/MIMO/Robust control, estimation, convex optimization, network dynamics, statics

Industry/Work Experience

eBay Advertising	Role: Internship Dates: May-Dec 2014 Description: Developed regression models for predicting the impact of advertising on eBay sales
Army Research Lab	Role: Internship Dates: May-Aug 2009 Description: Investigated biological systems for low power communications in small robotic platforms.
Johns Hopkins Applied Physics Lab	Role: Internship Dates: May-Aug 2008 Description: Finite element modeling of human torso for studying blast trauma.
Alfred Gessow Rotorcraft Center (UMD)	Role: Internship Dates: May-Aug 2007 Description: Assisted with fabrication of experimental helicopter rotors for hover-stand test.

Research Projects

(also see publication list below)

Autotuning Hyperparameters For Successive Convex Programming	**Overview:** Developed algorithm for automatically tuning obstacle avoidance weights using dual variable information. **Applications:** Hypersonic reentry, quadrotor dynamics **Webpage:** danjcalderone.github.io/projects/scvx **Papers:** Hyper-parameter Autotuning for Trajectory Planning via Successive Convex Programming Using Dual Variables (UNDER REVIEW) LCSS 2024
Robot Planning + Task Assignment	**Overview:** Developed Dantzig-Wolfe based decomposition scheme for dividing large grid world into smaller spatial regions. Implemented deep neural net architectures (CNN, GCN, LSTM) to learn congestion models within subregions based on conflict based search solutions. Developed Frank-wolfe based scheme for generating global matching + path planning solution using subregion data. **Applications:** Multi-agent pathfinding and task assignment for large scale robot distributions centers. **Webpage:** danjcalderone.github.io/projects/matchingrouting **Papers:** Bipartite Matching and Routing with Congestion Costs: A convex approach to

robot task assignment and the multi-agent pathfinding problem (UNDER REVIEW) CDC 2024
Decomposition and Learning Congestion For Multi-Agent Path Finding and Task Assignment (UNDER REVIEW) CDC 2024

Consistent Conjectural Variations Equilibria

Overview: Characterized existence, uniqueness, and stability of CCVE for 2-player quadratic games with vector strategies. Developed computation algorithm via eigenvalue solns to coupled ricatti eqns. Fully characterized nonlinear best response dynamics in cases of both global stability and non-convergent asymptotic behavior.
Applications: Multi-agent learning in competitive environments.
Webpage: danjcalderone.github.io/projects/ccve
Papers:
Consistent Conjectural Variations Equilibrium: Characterization and Stability for a Class of Continuous Games. LCSS 2023
Consistent Conjectural Variations Equilibrium: Dynamic Decompositions and Asymptotic Behavior. (UNDER REVIEW) LCSS 2024

Continuous-Type Population Games

Overview: Developed equilibrium concept and potential function for population games with preferences modeled as multi-dimensional mass distribution. Applied to model multi-modal transportation in Chattanooga, TN (with CARTA).
Applications: general non-homogeneous population preferences, transportation choice problems.
Webpage: danjcalderone.github.io/projects/carta
Papers:
Multi-dimensional continuous type population potential games (UNDER REVIEW) LCSS 2024
Multi-dimensional continuous type population potential games CDC 2019
External-cost continuous-type Wardrop equilibria in routing games CDC 2017

Markov Decision Process Congestion Games

Overview: Developed a version of routing games where individual agents solve a Markov decision process as opposed to a shortest path problem.
Applications: ride-sharing, urban parking, air traffic control management.
Papers:
Markov decision process routing games ICCPS 2017
Infinite-horizon average-cost markov decision process routing games ITSC 2017
Congestion-Aware Path Coordination Game With Markov Decision Process Dynamics. LCSS 2023
Adaptive Constraint Satisfaction for Markov Decision Process Congestion Games: Application to Transportation Networks. Automatica 2022
Variable Demand and Multi-commodity Flow in Markovian Network Equilibrium Automatica 2022
Sensitivity Analysis for Markov Decision Process Congestion Games. CDC 2019

	Tolling for Constraint Satisfaction in Markov Decision Process Congestion Games ACC 2019
Braess Paradox: Algebraic Description	**Overview:** Obtained algebraic characterization of Braess paradox in routing games and MDP congestion games. **Papers:** Sensitivity analysis for markov decision process congestion games CDC 2019
Stability of Game Learning Dynamics	**Overview:** Stability of gradient play in continuous-action two-player games. **Applications:** learning in neural networks, generative-adversarial networks, multi-agent optimization **Papers:** Stability of gradient learning dynamics in continuous games: Scalar action spaces 2020 Gradient Learning Dynamics in Continuous Games: Vector Action Spaces 2020
Parking Routing Games	**Overview:** Formulated a version of routing games where agents consider street parking choice as well as travel time. **Applications:** urban street parking **Papers:** Understanding the impact of parking on urban mobility via routing games on queue-flow networks. CDC 2016

Papers

1. Mceowen, S., Calderone, D.J., Ackimese, B., Hyperparameter Autotuning for Sequential Convex Programming Using Duality (UNDER REVIEW) LCSS 2024
   danjcalderone.github.io/projects/scvx

2. Calderone, D.J., Ho. K., Ratliff, L.J., Bipartite Matching and Routing with Congestion Costs: A convex approach to robot task assignment and the multi-agent pathfinding problem. (UNDER REVIEW) LCSS 2024
   Project webpage: danjcalderone.github.io/projects/matchingrouting

3. Sullivan, J., Gonzales, J., Calderone, D.J., Burden S., Ratliff, L.J., Decomposition and Learning Congestion For Multi-Agent Path Finding and Task Assignment 2024 (UNDER REVIEW)
   Project webpage: danjcalderone.github.io/projects/matchingrouting

4. Calderone, D.J., Ratliff, L.J., Multi-Dimensional Continuous Type Population Potential Games: Primal-Dual Formulations (UNDER REVIEW) LCSS 2024

5. Calderone, D.J., Chasnov, B., Burden S., Ratliff, L.J., Consistent Conjectural Variations Equilibria: Dynamic Decompositions and Asymptotic Behavior. (UNDER REVIEW) LCSS 2024
   Project webpage: danjcalderone.github.io/projects/ccve

6. Calderone, D. J., Chasnov, B. J., Burden, S. A., and Ratliff, L. J. Consistent conjectural variations equilibria: Characterization & stability for a class of continuous games. *IEEE Control Systems Letters* (2023)
doi: doi.org/10.1109/LCSYS.2023.3289473
pdf: https://danjcalderone.github.io/papers/ccve.pdf

7. Li, S. H., Yu, Y., Miguel, N. I., Calderone, D., Ratliff, L. J., and Açikmeşe, B. Adaptive constraint satisfaction for markov decision process congestion games: Application to transportation networks. *Automatica 151* (2023), 110879
doi: doi.org/10.1016/j.automatica.2023.110879
pdf: https://danjcalderone.github.io/papers/mdpconstraints.pdf

8. Li, S. H., Calderone, D., and Acikmese, B. Congestion-aware motion planning game with markov decision process dynamics. *arXiv preprint arXiv:2203.12133* (2022)
doi: https://doi.org/10.48550/arXiv.2203.12133
pdf: https://danjcalderone.github.io/papers/mdpcoordination.pdf

9. Yu, Y., Calderone, D., Li, S. H., Ratliff, L. J., and Açikmeşe, B. Variable demand and multi-commodity flow in markovian network equilibrium. *Automatica 140* (2022), 110224
doi: https://doi.org/
pdf: https://danjcalderone.github.io/papers/mdpalgorithms.pdf

10. Mceowen, S., Sullivan, D., Calderone, D., Szmuk, M., Sheridan, O., Açikmeşe, B., and Chasnov, B. Visual modeling system for optimization-based real-time trajectory planning for autonomous aerial drones. In *2022 IEEE Aerospace Conference (AERO)* (2022), IEEE, pp. 1–9

11. de Badyn, M. H., Foight, D. R., Calderone, D., Mesbahi, M., and Smith, R. S. Graph-theoretic optimization for edge consensus. *IFAC-PapersOnLine 54*, 9 (2021), 533–538

12. Chasnov, B. J., Calderone, D., Açikmeşe, B., Burden, S. A., and Ratliff, L. J. Stability of gradient learning dynamics in continuous games: Scalar action spaces. In *2020 59th IEEE Conference on Decision and Control (CDC)* (2020), IEEE, pp. 3543–3548
doi: https://doi.org/10.1109/CDC42340.2020.9304165
pdf: https://danjcalderone.github.io/papers/stablescalar.pdf

13. Chasnov, B. J., Calderone, D., Açikmeşe, B., Burden, S. A., and Ratliff, L. J. Stability of gradient learning dynamics in continuous games: Vector action spaces. *arXiv preprint arXiv:2011.05562* (2020)

14. Chasnov, B., Ratliff, L. J., Calderone, D., Mazumdar, E., and Burden, S. A. Finite-time convergence of gradient-based learning in continuous games

15. Li, S. H., Yu, Y., Calderone, D., Ratliff, L., and Açrkmeşe, B. Tolling for constraint satisfaction in markov decision process congestion games. In *2019 American Control Conference (ACC)* (2019), IEEE, pp. 1238–1243
doi: https://doi.org/0.23919/ACC.2019.8814925
pdf: https://danjcalderone.github.io/papers/mdptolling.pdf

16. Calderone, D., and Ratliff, L. J. Multi-dimensional continuous type population potential games. In *2019 IEEE 58th Conference on Decision and Control (CDC)* (2019), IEEE, pp. 5138–5143
doi: https://doi.org/10.1109/CDC40024.2019.9029519
pdf: https://danjcalderone.github.io/papers/continoustypemd.pdf

17. Calderone, D., Dong, R., and Sastry, S. S. External-cost continuous-type wardrop equilibria in routing games. In *2017 IEEE 20th International Conference on Intelligent Transportation Systems (ITSC)* (2017), IEEE, pp. 1–6
doi: https://doi.org/10.1109/ITSC.2017.8317866
pdf: https://danjcalderone.github.io/papers/continoustype2d.pdf

18. Calderone, D., and Sastry, S. S. Markov decision process routing games. In *2017 ACM/IEEE 8th International Conference on Cyber-Physical Systems (ICCPS)* (2017), IEEE, pp. 273–280
doi: https://doi.org/10.1145/3055004.3055026
pdf: https://danjcalderone.github.io/papers/mdproutingfin.pdf

19. Calderone, D., and Shankar, S. Infinite-horizon average-cost markov decision process routing games. In *2017 IEEE 20th International Conference on Intelligent Transportation Systems (ITSC)* (2017), IEEE, pp. 1–6
doi: https://doi.org/10.1109/ITSC.2017.8317849
pdf: https://danjcalderone.github.io/papers/mdproutinginf.pdf

20. Calderone, D., Mazumdar, E., Ratliff, L. J., and Sastry, S. S. Understanding the impact of parking on urban mobility via routing games on queue-flow networks. In *2016 IEEE 55th Conference on Decision and Control (CDC)* (2016), IEEE, pp. 7605–7610
doi: https://doi.org/10.1109/CDC.2016.7799444
pdf: https://danjcalderone.github.io/papers/parkingrouting.pdf

21. Calderone, D. J., Ratliff, L. J., and Sastry, S. S. Lane pricing via decision-theoretic lane changing model of driver behavior. In *2015 54th IEEE Conference on Decision and Control (CDC)* (2015), IEEE, pp. 3457–3462
doi: https://doi.org/10.1109/CDC.2015.7402754

22. Calderone, D., Ratliff, L. J., and Sastry, S. S. Pricing for coordination in open–loop differential games. *IFAC Proceedings Volumes 47*, 3 (2014), 9001–9006
doi: https://doi.org/10.3182/20140824-6-ZA-1003.02655

23. Calderone, D., Ratliff, L., and Sastry, S. Pricing design for robustness in linear-quadratic dynamic games. In *In the Proceedings of the 52rd Annual IEEE Conference on Decision and Control* (2013)
doi: https://doi.org/10.1109/CDC.2013.6760558

24. Coogan, S., Ratliff, L. J., Calderone, D., Tomlin, C., and Sastry, S. S. Energy management via pricing in lq dynamic games. In *2013 American Control Conference* (2013),

IEEE, pp. 443–448
doi: https://doi.org/10.1109/ACC.2013.6579877

25. Ratliff, L. J., Coogan, S., Calderone, D., and Sastry, S. S. Pricing in linear-quadratic dynamic games. In *2012 50th Annual Allerton Conference on Communication, Control, and Computing (Allerton)* (2012), IEEE, pp. 1798–1805
doi: https://doi.org/10.1109/Allerton.2012.6483440

Teaching

Online Content

Summary: I am developing a collection of interactive visualizations for an online textbook teaching linear algebra, optimization, and other subjects.

WEBSITE: (under construction) https://danjcalderone.github.io/dcmath/

Select Examples—

Hypershapes	https://danjcalderone.github.io/dcmath/linalg/hypershapes
Matrices	https://danjcalderone.github.io/dcmath/linalg/matrices
Inner Products	https://danjcalderone.github.io/dcmath/linalg/innerproducts
Matrix Products	https://danjcalderone.github.io/dcmath/linalg/matrixmultiply
Inverses	https://danjcalderone.github.io/dcmath/linalg/inverses

BLOG: danjcalderone.github.io/blog

Select Examples—

Successive Convexification	danjcalderone.github.io/blog/scvx
Simplex Method	danjcalderone.github.io/blog/simplex
Algebraic Graph Theory	danjcalderone.github.io/blog/treescycles
Shortest Path LP	danjcalderone.github.io/blog/shortestpathlp

COURSES

Materials:	https://danjcalderone.github.io/teaching.html
Linear Algebra/ Linear Systems	Courses: AA510, AE510 Offerings: Winter 2020, Fall 2020, Winter 2021, Winter 2020 Level: Masters/PhD Role: Instructor Select Topics: Vectors, inner products, linear transforms/ matrices, range/nullspace, rank, Gaussian elimination, matrix inverses, systems of equations, coordinates, similarity, eigen-problem/ diagonalization, spectral mapping, Cayley Hamilton, state-space, LTI/LTV systems, transfer functions, controllability/ observability, canonical forms, pole-placement, observer design, separation principle, Grammians, SVD/ polar

SISO Control	Courses: AA447 Offerings: Spring 2021 Level: Undergraduate Role: Instructor Topics: Time/ frequency domains, Laplace transforms, transfer functions, impulse response, block diagrams, PI/PID control, disturbance rejection, internal model principle, Bode/Nyquist-plots, Nyquist stability, gain/phase/stability margins, loop shaping.
MIMO Control	Courses: AE513 Offerings: Fall 2019, Fall 2021 Level: Masters Role: Instructor Topics: Dynamical systems, linearization, open-loop and feedback control, PD matrices, Lyapunov theory/equations, Grammians, dynamic programming/ Bellman equation, LQR (DT / CT, fin / inf horizon), Riccati ODE/ ARE Hamiltonian systems,adjoint method for optimal control, intro to Kalman filter, LQG control.
Robust Control	Courses: AA594 Offerings: Winter 2022 Level: PhD Role: Instructor Topics:
Estimation	Courses: AA549,AE514 Offerings: Spring 2019, Fall 2020, Spring 2021 Level: Masters/PhD Role: Instructor Topics: Positive definite matrices, basic probability, multivariate Gaussians, covariance matrices, basis functions, weighted least squares, nonlinear least squares, maximum likelihood estimation (MLE), maximum a-posteriori estimation (MAP), Kalman filter (CT / DT), extended Kalman filter, unscented Kalman filter, particle filters
Convex Optimization	Courses: AA578 Offerings: Winter 2021 Level: Masters/PhD Role: Instructor Topics: Linear transformations of sets, affine sets - range and nullspace representations, inequality constraints, polytopes, slack variables, linear programs (LP), quadratic programs (QP) Lagrange multipliers, vector space duality, Lagrangian duality - game interpretation LP / QP duality, primal and dual visual interpretations, KKT

conditions, complementary slackness, simplex algorithm, gradient descent, Newton's method, barrier methods, interior point methods.

Network Dynamics

Courses: AA597
Offerings: Spring 2022
Level: Masters/PhD
Role: Instructor
Topics:

Undirected/ directed graphs, matrices (incidence/ adjacency/ Laplacian), matrix decompositions, Laplacian spectra, agreement protocol (undirected/ directed, CT/DT), distributed estimation, distributed optimization, formation control, input/output controllability/ observability.

Statics

Courses: AA210
Offerings: Spring 2022 Level: Undergraduate
Role: Instructor
Topics:

Free body diagrams, forces/moments/couples, distributed loads, rigid body equilibrium, static determinancy, truss methods (joints/sections), zero-force members, space-trusses, frames/machines, cables/arches,retaining walls, friction, centers of mass/ centroids, moments of inertia, Mohr's circle, shear/ bending moment diagrams.

Robotic Manipulators

Courses: EE125 (University of California Berkeley)
Offerings: Fall 2013
Level: Undergraduate
Role: Teaching Assistant
Responsibilities: Lectured in discussion section, designed homeworks, designed & implemented labs
Topics:

Coordinate transformations, rotations, skew-symmetric matrix exponential, homogeneous transformations, inverting coordinate transforms, Lie groups and lie algebras, SO(3)/so(3), SE(3)/se(3), joint transformations, product of exponentials, forward kinematics, inverse kinematics via Paden-Kahn subproblems, Lagrangian dynamics formulation

EE Intro Survey Course

Courses: EE16A (UCB)
Offerings: Fall 2015
Level: Undergraduate
Role: Teaching Assistant
Responsibilities: Lead content team (of 15 TAs) designing homeworks

Outreach

EE-Graduate Outreach Program (UCB)	Dates: May 2013-Fall 2016 Description: Develop and presented engineering interest talks at elementary, middle, and high schools.
EEGSA (UCB) Co-President	Dates: Sept 2013-Spring 2014 Description: Organized social and outreach events for UCB graduate student organization.
EEGSA (UCB) Visit-Day Coordinator	Dates: March 2013 Description: Lead team of ten students in assigning mentors, organizing accommodations, and planning social events for new students during recruitment weekend.
Resident Assistant (UMD)	Dates: Aug 2008–Spring 2010 Description: Developed community, planned educational events, maintained security, enforced policies, and provided personal support for 70 freshman on a residence hall floor. Voted RA of the Year for 2009-2010 by the fifteen other RA's in the residence hall.
Student Honor Council (UMD)	Dates: Aug 2007–Spring 2008 Description: Promoted the academic integrity of the university by educating students and adjudicating cases of academic dishonesty.

February 14, 2024