Zachary del Rosario

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Education

PhD	Stanford University	Aeronautical and Astronautical Engineering	2020
	Co-advisors:	*Gianluca Iaccarino and Art B. Owen*	
MS	Stanford University	Aeronautical and Astronautical Engineering	2018
BS	Olin College of Engineering	Mechanical Engineering	2014

PhD Thesis

"Precision Margin: First-Principles Margins for Aircraft Design Under Uncertainty"

Competitive aircraft design walks a fine line, balancing weight reduction with aircraft safety. Design tends to lean conservative, with cascaded margins to address uncertainties. This thesis introduces design margins that *provably* yield minimal weight penalties at desired levels of safety. Comparisons against industry standards, tractable approximations, and ramifications for both conceptual and detailed design are considered.

Grants and Fellowships

Source	**State**	**Size**	
Towards Data-Capable Engineers with a Variability-Capable Mindset *Proposed to NSF Engineering Research Initiation*	Proposed	$148,189	2021
Empowering Public Libraries as Ambassadors of PIT *Proposed to Public Interest Technology (PIT) University Network*	Proposed	$89,927	2021
Improving User Understanding of the Catalyst Game *Grant from Toyota Research Institute to fund student summer research*	Awarded	~$20,000	2021
Integrated Project Fund *Grant to develop TA training workshop, Olin internal*	Awarded	~$2,530	2021
Diversifying Academia, Recruiting Excellence (DARE) Fellowship *Competitive fellowship for promising faculty candidates, Stanford internal*	Complete	~$116,000	2018
NSF Graduate Research Fellowship	Complete	~$300,000	2015

Honors and Awards

Patricia Cross Future Leaders Award 2020
Competitive award for graduate students with promise as future leaders of higher education; administered by the Association of American Colleges & Universities

Stanford MECON Oral Presentation award, 1st place 2017
Mechanical Engineering Department-sponsored speaker competition

AIAA Jefferson Goblet Best Student Paper 2017
Highest honor for student papers at AIAA SciTech annual conference

Publications

Books

1. del Rosario, Z. and G. Iaccarino (Forthcoming). *All Models are Uncertain: Case Studies with a Python Grammar of Model Analysis*. Cambridge Scholar Press.

Peer-reviewed research papers

2. del Rosario, Z. (2021a). Precision Materials Indices: Materials Selection with Statistically-rigorous Reliability Analysis. *AIAA Journal*. eprint: https://arc.aiaa.org/doi/full/10.2514/1.J060521.
3. del Rosario, Z., G. Iaccarino, and R. W. Fenrich (2021). When Are Allowables Conservative? *AIAA Journal*. eprint: https://arc.aiaa.org/doi/full/10.2514/1.J059578.
4. del Rosario, Z. (2020c). Grama: A Grammar of Model Analysis. *Journal of Open Source Software* **5**(51), 2462. eprint: https://doi.org/10.21105/joss.02462.

5. del Rosario, Z., M. Rupp, Y. Kim, E. Antono, and J. Ling (2020). Assessing the frontier: Active learning, model accuracy, and multi-objective candidate discovery and optimization. *The Journal of Chemical Physics* **153**(2), 024112. eprint: https://aip.scitation.org/doi/pdf/10.1063/5.0006124.
6. Jofre-Cruanyes, L., Z. del Rosario, and G. Iaccarino (2020). Data-driven dimensional analysis of heat transfer in irradiated particle-laden turbulent flow. *International Journal of Multiphase Flow*. eprint: https://doi.org/10.1016/j.ijmultiphaseflow.2019.103198.
7. del Rosario, Z., G. Iaccarino, and R. W. Fenrich (2019). Fast Precision Margin with the First-Order Reliability Method. *AIAA Journal*. eprint: https://doi.org/10.2514/1.J058345.
8. del Rosario, Z., M. Lee, and G. Iaccarino (2019). Lurking Variable Detection via Dimensional Analysis. *SIAM / ASA Journal on Uncertainty Quantification*. eprint: https://doi.org/10.1137/17M1155508.

Papers in conference proceedings

9. del Rosario, Z., R. Aggarwal, C. Coffey, A. Sadler, S. Matsumoto, A. Wood, P. Ruvolo, and J. Woodard (2021). Work in Progress: Crafting a Virtual Studio: Some Models and Implementations. In: *ASEE Annual Conference and Exposition, Conference Proceedings*.
10. del Rosario, Z., R. W. Fenrich, and G. Iaccarino (2020). When are Design Allowables Conservative? In: *AIAA SciTech 2020 Forum*.
11. del Rosario, Z., R. W. Fenrich, and G. Iaccarino (2019a). Beyond Basis Values: Fast Precision Margin with FORM. In: 21st AIAA Non-Deterministic Approaches Conference.
12. del Rosario, Z., R. W. Fenrich, and G. Iaccarino (2019b). Margin as Model: Some Answers to "How Many Tests Should I Perform?". In: *AIAA Aviation 2019 Forum*.
13. del Rosario, Z., A. Towne, and G. Iaccarino (2018b). Dimension Reduction for Shape Design Insight. In: 20th AIAA Non-Deterministic Approaches Conference.

Pre-prints and Submissions

14. Hegde, V. I., C. K. Borg, Z. del Rosario, Y. Kim, M. Hutchinson, E. Antono, J. Ling, P. Saxe, J. E. Saal, and B. Meredig (2020). Reproducibility in high-throughput density functional theory: a comparison of AFLOW, Materials Project, and OQMD. *arXiv preprint arXiv:2007.01988*.
15. Jofre-Cruanyes, L., Z. del Rosario, and G. Iaccarino (2019). Dimension reduction of thermo-fluid mechanisms in irradiated particle-laden turbulence. *Center for Turbulence Research Annual Research Briefs*.
16. Constantine, P. G., Z. del Rosario, and G. Iaccarino (2017). Data-driven dimensional analysis: algorithms for unique and relevant dimensionless groups. *arXiv preprint arXiv:1708.04303*. Forthcoming in JCP.
17. Constantine, P. G., Z. del Rosario, and G. Iaccarino (2016). Many physical laws are ridge functions. *arXiv preprint arXiv:1605.07974*.

PhD thesis

18. del Rosario, Z. (2020). "Precision Margin: First-principles Margins for Aircraft Design Under Uncertainty". PhD thesis. Stanford University. eprint: https://purl.stanford.edu/xy114jv5352. https://purl.stanford.edu/xy114jv5352.

Articles and Columns

19. del Rosario, Z. (2021d). We're Not Going to Build It: Why STEM students need to learn design refusal. *Liberal Education*. eprint: https://www.aacu.org/liberaleducation/2021/spring/delRosario.
20. del Rosario, Z. (2020b). Closing the Gap: Perspectives from a Cross Scholar on Advancing Diversity, Equity, and Inclusion. *AAC&U News, Perspectives*. eprint: https://www.aacu.org/aacu-news/newsletter/closing-gap-perspectives-cross-scholar-advancing-diversity-equity-and-inclusion.
21. del Rosario, Z. (2020e). Olin "Faux-mencement": A Case Study in Cocreation. *AAC&U Blog*. eprint: https://www.aacu.org/blog/olin-%E2%80%9Cfaux-mencement%E2%80%9D-case-study-cocreation.
22. Yegnashankaran, K. and Z. del Rosario (2020). 10 Strategies for Collegial Videoconferencing. *Stanford Center for Teaching and Learning*. eprint: https://docs.google.com/document/d/1raLzjieDcVtvLU6-6wi5rS81Odm0UWLGlUeH2RECdDo/edit#heading=h.ej4ozbwqqyvk.

Presentations

Invited talks

23. del Rosario, Z. (Apr. 2021c). Studio Teaching Online: Lessons learned from a mixed-methods study. In: Stanford University.

24. del Rosario, Z. (Nov. 2020a). Assessing the Frontier. In: Cambridge Cheminformatics Meeting. http://www.c-inf.net/.
25. del Rosario, Z. (Feb. 2020d). Grammar and Margins. In: Toyota Research Institute.
26. del Rosario, Z. (Oct. 2019a). Aircraft Design Under Uncertainty. In: Harvey Mudd College Seminar.
27. del Rosario, Z. (Oct. 2019d). The Curse of Dimensionality: Problems and Strategies. In: NATO/STO Lecture Series: Uncertainty Quantification in Computational Fluid Dynamics. https://we.stanford.edu/LSUQ.
28. del Rosario, Z., R. Fenrich, and G. Iaccarino (July 2019b). Principled Margin. In: Arevo, Inc.
29. del Rosario, Z. (Sept. 2018a). Lost in Hyperspace: The Curse of Dimensionality. In: Wellesley College student seminar.
30. del Rosario, Z. (Oct. 2018b). The Curse of Dimensionality: Problems and Strategies. In: von Karman Institute: Uncertainty Quantification in Computational Fluid Dynamics (STO-AVT 326).
31. del Rosario, Z., A. Towne, and G. Iaccarino (2018c). Dimension Reduction for Shape Design Insight. In: Aerospace Computational Design Lab (ACDL) seminar, MIT.

Conference panel appearances

32. del Rosario, Z. (May 2021b). Scientific Teaching Institute Alumni Panel. In: SEPAL Lab.
33. del Rosario, Z. (Aug. 2020f). Project Based Learning at the College/University Level. In: Strive Virtual College Exploration STEM Days, Cachet / StriveScan. https://www.strivescan.com/virtual/stem/.

Conference talks

34. del Rosario, Z. and G. Iaccarino (2020). Physics-informed Inference: Dimensional Analysis as Dimension Reduction. In: SIAM UQ (Conference Cancelled).
35. del Rosario, Z. (2019b). Machine Learning for Materials Property Prediction. In: North American Solid State Chemistry Conference.
36. del Rosario, Z. (2019c). Stanford SeeME: Student-driven research within an R1 institution. In: National Alliance for Broader Impacts (NABI) Summit.
37. del Rosario, Z., A. Banko, A. Horwitz, and G. Iaccarino (2018). Data-Driven Physical Inquiry: Discovering Relevant Dimensionless Numbers With Physics-Constrained Machine Learning. In: 71th Annual Meeting of the American Physical Society, Division of Fluid Dynamics.
38. del Rosario, Z., A. Towne, and G. Iaccarino (2018a). Dimension Reduction for Shape Design Insight. In: Thermal, Fluid science Sponsors, and Affiliates conference (TFSA).
39. del Rosario, Z., P. Constantine, and G. Iaccarino (2017a). Algorithm-Driven Insight. In: Thermal and Fluid Science Affiliates Conference.
40. del Rosario, Z., P. Constantine, and G. Iaccarino (2017b). Data-Driven Dimensional Analysis. In: CompFest.
41. del Rosario, Z., M. Lee, and G. Iaccarino (2017). Discovering Hidden Controlling Parameters using Data Analytics and Dimensional Analysis. In: 70th Annual Meeting of the American Physical Society, Division of Fluid Dynamics.
42. del Rosario, Z., A. Towne, and G. Iaccarino (2017). Handling Classes of Variables in Dimension Reduction. In: SIAM Workshop on Parameter Space Dimension Reduction (DR17).

Poster presentations

43. del Rosario, Z. and G. Iaccarino (2017). Hidden Parameter Hypothesis Testing. In: Statistical Perspectives on Uncertainty Quantification.
44. Torres, H., Z. del Rosario, and G. Iaccarino (2017). MCRT. In: WEST Conference.

Reviewing

I am a reviewer for the following journals:

- Progress in Materials Science
- American Institute of Aeronautics and Astronautics Journal
- Physics of Fluids

Teaching Experience

Course Instruction

Probabilistic Design Optimization, (ENGR 3299) Olin — Spring

Teaching a unique undergraduate course on the fundamentals of optimization and probability for design: multi-objective, constrained optimization, copula probability modeling, Monte Carlo and FORM approximation.

Quantitative Engineering Analysis, (ENGR 2005) Olin — Spring

Teaching a flipped, studio-based class on engineering analysis fundamentals: linear algebra, multivariable calculus, statics, optimization.

Data Science, (MTH 2131) Olin — Fall

Teaching a flipped, studio-based class on data fundamentals: extract-transform-load operations, exploratory data analysis (EDA), inferential statistics, regression analysis. https://github.com/zdelrosario/data-science-curriculum

Modeling and Simulation of the Physical World, (MTH 1111) Olin — Fall

Teaching a studio-based class on scientific modeling. Students learn how to build models at multiple levels of abstraction, anchor those models to scientific questions, and implement those models in software. Students also practice working in teams and communicating scientific conclusions.

Summer Data Science, Olin — Summer 2020

Taught a five-week summer course for Olin alumni. Designed open-source self-paced curriculum, reinforced with team-based data challenges. Created remote learning environment around team cohorts using Discord. https://github.com/zdelrosario/data-science-curriculum

Uncertainty Quantification, (ME 470) Stanford — Spring 2019

Designed, implemented, and delivered graduate-level elective course for 9 advanced students. Taught using a mixture of lecture and evidence-based methods.

Teaching Competencies

Engineering	Fluid Dynamics, Solid Mechanics, Aerodynamics, Human-centered Design
Statistics	Probability, Estimation, Design of (Computer) Experiments, Regression, EDA
Mathematics	Linear Algebra, Ordinary/Partial Differential Equations, Optimization
Computing	Python (Numpy/Scipy, Pandas, Matplotlib), R (Tidyverse)

Academic Workshops

Materials Informatics Workshop, (Olin College) Georgia Tech 2021

Designing and facilitating an annual four-day workshop on materials informatics at Georgia Tech, sponsored by the Institute for Materials. Approximately 30 participants paid to attend the 2021 offering.
https://zdelrosario.github.io/mi101/intro.html

Qualitative Data Workshop, (Stanford CTL) SABER WEST 2020

Co-designed and facilitated a short workshop on qualitative data coding methods (verbal analysis) for ~ 30 *participants.*
https://sites.google.com/uci.edu/saberwest2020/program?authuser=0

Materials Informatics Workshop, (Citrine Informatics) Georgia Tech 2019

Designed and facilitated a two-day workshop on materials informatics at Georgia Tech, sponsored by the Institute for Materials. Led a team of 7 TA's to teach ~ 15 *participants.*
https://citrineinformatics.github.io/ga-tech-workshop/

Teacher Workshops, (SeeME) Stanford 2019

Developed and delivered workshops on the fundamentals of teaching, including lessons on learning goals and The 5E Model. Ran workshops for audiences of ~ 10.

Groupwork Workshop, (VPTL Consultant) Stanford 2018-2019

Co-developed and delivered workshop on evidence-based best-practices for groupwork in the classroom. Digested, summarized, and applied education literature, designed hands-on activities, co-facilitated workshop on several occasions for audiences of ~ 16.

External Outreach

Intro to Exploratory Data Analysis, (SeeME) Stanford 2016

Introductory hands-on class to introduce students to principles of visualization, exploring data, understanding trends, and basic causal reasoning.
https://github.com/zdelrosario/teaching-eda

"What the heck is engineering?", (Splash) Stanford 2014-2015

Introductory discussion-based class meant to introduce middle- and high-school aged students to engineering as a profession.

Mentoring

PhD Defense Examiner	Institution, Department	Year
Gitanjali Bhattacharjee	Stanford University, Civil and Environmental Engineering	2021

Mentee(s)	Project advised	
Qingmu (Josh) Deng	Co-advised with Rebecca Belisle (Wellesley); helped student develop a sequential design of experiment (DOE) pipeline using gaussian processes with well-calibrated uncertainties. Student used pipeline to guide experimental synthesis of perovskites for tandem solar cells. Student presented work at MRS 2021 Conference.	2020-2021
Riya Aggarwal, Caitlin Coffey, Arwen Sadler	Undergraduate research team conducted interviews and thematic analysis to study online studio-based courses. Published results in peer-reviewed conference paper (ASEE Annual Conference).	2020-2021
Gitanjali Bhattacharjee	Former student (ME 470) used sensitivity analysis to study transit network reliability and bridge retrofitting. Focused on modeling decision processes and uncertainty arising from bridge fragility. Student project led to peer-reviewed publication (Bhattacharjee and Baker 2021; *Structure and Infrastructure Engineering*).	2019
Sita Syal	Former student (ME 470) performed soft cost analysis for solar farm leasing. Focused on modeling cost uncertainties and advised student on how to strategically leverage her NREL contacts in her research agenda.	2019
Mark Benjamin	Rotation student investigated reliability-based design optimization strategies, focusing on comparing various density-matching approaches.	2018

Writing Consultee	Outcome	
Paul Nadan	NASA NSTGRO; CMU, Robotics Institute	2020
Cindy Nguyen	NSF GRFP; Stanford, Electrical Engineering	2019
Larissa Little	NDSEG; Harvard, Materials Science	2018
Mason del Rosario	NSF GRFP Honorable Mention; UC Davis, Electrical Engineering	2018
Rongfei Lu	Stanford, Aeronautics and Astronautics	2018
Emma (Zeyan) Xu	NSF GRFP; Columbia, Material Science	2017

Service and Leadership

Selection Committee (AAC&U) Fall 2021
Will help select the recipients of the 2022 Patricia Cross Future Leaders award, administered by the AAC&U.

TA Training Workshop (Olin College) 2021 – Present
Co-designing and teaching a workshop on the fundamentals of teaching for TA's. Focused on active learning, problem solving, and the affective dimensions of teaching.

Racial Justice Discussion Organizer (Olin College) Summer 2020
Co-organized a 10-week series of discussions about racial justice at Olin College. Designed a session around BlackInTheIvory, highlighting Black voices in the academy. Facilitated difficult conversations about race in higher education.

Search Committee Member (Stanford Career Center, BEAM) 2020
Served on executive hiring committee for Stanford's career center (BEAM). Interviewed BEAM staff to gain perspective; advocated for evidence-based structured interview process to reduce bias; co-wrote search criteria and rubric.

Co-Chair (ASEE, Task Force on Graduate Student Affairs) 2019-Present
Appointed by the president of the American Society for Engineering Education (ASEE) national organization to co-chair a task force studying how our professional society can serve graduate students.

President (American Society for Engineering Education, Stanford Chapter) 2018-2019
Led and served on a 5-person organizing team. Organized a seminar sequence with internal and external speakers. Directed a Colloquium event attended by 70 persons, featuring workshops on "The Fundamentals of Teaching."

Founder and Director of Curriculum (SeeME) 2017-2020
Co-founded Stanford Mechanical Engineering's student-run research outreach program SeeME. Developed and delivered workshops to train grad student instructors. Wrote grants to support operations and conference travel. Served as program leader and interfaced with the Department Chair.

Financial Officer (American Society for Engineering Education, Stanford Chapter) 2017-2018
Served on 4-person organizing team. Wrote and won grants to fund speaker series and Colloquium. Point person on organizing seminar sequence.

Chair of Teacher Development (Stanford Splash) 2014-2016
Served on 20-person organizing team serving thousands of high school students. Owned our teacher training program; co-facilitated workshops to introduce Stanford students to the basics of teaching. Enhanced teacher evaluations by introducing new survey system.

Employment

Visiting Assistant Professor (Olin College) September 2020-Present

Teaching first-year and upper-division courses on engineering and statistics. Conducting collaborative research on data science applied to materials development. Mentoring students in research projects.

Statistical Consultant (Citrine Informatics) October 2019-Present

Supporting government-funded research projects with numerical and graphical statistical analyses. Co-author on resulting publications.

Instructional Designer and Data Scientist (Citrine Informatics) Summer 2019

Developed and delivered 2-day workshop at Georgia Tech on Materials Informatics. Developed novel strategies for active learning in support of materials discovery.

Teaching Consultant (Stanford VPTL) 2018-2020

Professional teaching consultant, employed by the office of the Vice Provost for Teaching and Learning (VPTL). Used training in pedagogy and mentorship to carry out consultations with fellow graduate students. Co-facilitated various workshops, and co-developed novel workshop material on Groupwork.

Research intern (Northrop Grumman Corporation) Summer 2017

Developed statistical methods to identify anomalies in time series data. Supported exoplanet detection research team.

Media Appearances

- DrugDiscovery.net, August 2020
- ASEE Prism, October 2019
- Stanford Daily, January 2019
- Stanford News, April 2018

The Analyst's Entreaty:
"Grant me the insight to neglect the terms I do not need,
Tenacity to understand strange interactions,
And wisdom to know the (significant) difference."