Zachary del Rosario

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 NSF Engineering Research Initiation Award Number 2138463	Awarded	\$148,189	2022
Building and Sustaining a Diverse Academic Community in the NE US Stanford Alumni Association	Complete	\$5,370	2021
Improving User Understanding of the Catalyst Game Grant from Toyota Research Institute to fund usability study	Complete	~\$20,000	2021
Integrated Project Fund Grant to develop TA training workshop, Olin internal	Complete	~\$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 Competitive award for graduate students with promise as future leaders of k administered by the Association of American Colleges & Universities	iigher educa	2 tion;	020
Stanford MECON Oral Presentation award, 1st place Mechanical Engineering Department-sponsored speaker competition		2	017
AIAA Jefferson Goblet Best Student Paper Highest honor for student papers at AIAA SciTech annual conference		2	017

Publications

Books

1. <u>del Rosario</u>, 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. <u>del Rosario</u>, Z. (2022a). An Open-Source Active Learning Curriculum for Data Science in Engineering. *Journal of Open Source Education* 5(49), 117. eprint: https://doi.org/10.21105/jose.00117.
- 3. <u>del Rosario</u>, Z. (2021a). Precision Materials Indices: Materials Selection with Statistically-rigorous Reliability Analysis. *AIAA Journal*. eprint: <u>https://arc.aiaa.org/doi/full/10.2514/1.J060521</u>.
- 4. <u>del Rosario</u>, 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.
- 5. <u>del Rosario</u>, Z. (2020c). Grama: A Grammar of Model Analysis. *Journal of Open Source Software* 5(51), 2462. eprint: https://doi.org/10.21105/joss.02462.

- <u>del Rosario</u>, 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.
- 7. Jofre-Cruanyes, L., Z. <u>del Rosario</u>, 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.
- 8. <u>del Rosario</u>, Z., G. Iaccarino, and R. W. Fenrich (2019). Fast Precision Margin with the First-Order Reliability Method. *AIAA Journal*. eprint: <u>https://doi.org/10.2514/1.J058345</u>.
- 9. <u>del Rosario</u>, 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

- del Rosario, Z. (2022d). Enabling Active Learning Pedagogy and Insight Mining with a Grammar of Model Analysis. In: *Proceedings of the 21st Python in Science Conference*. Ed. by M. Agarwal, C. Calloway, D. Niederhut, and D. Shupe, pp.209–216. eprint: https://conference.scipy.org/proceedings/scipy2022/ pdfs/zachary_delrosario.pdf.
- 11. Aggarwal, R., M. Flynn, S. Daitzman, D. Lam, and Z. <u>del Rosario</u> (2021). A Qualitative Study of Engineering Students' Reasoning About Statistical Variability. In: *ASEE Middle Atlantic Section, Conference Proceedings*.
- 12. <u>del Rosario</u>, 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*.
- 13. <u>del Rosario</u>, Z., R. W. Fenrich, and G. Iaccarino (2020). When are Design Allowables Conservative? In: *AIAA SciTech 2020 Forum*.
- 14. <u>del Rosario</u>, Z., R. W. Fenrich, and G. Iaccarino (2019a). Beyond Basis Values: Fast Precision Margin with FORM. In: 21st AIAA Non-Deterministic Approaches Conference.
- 15. <u>del Rosario</u>, 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*.
- 16. <u>del Rosario</u>, Z., A. Towne, and G. Iaccarino (2018b). Dimension Reduction for Shape Design Insight. In: 20th AIAA Non-Deterministic Approaches Conference.

Pre-prints and Submissions

- Fox, E., A. Evans, K. Vo, E. Ramos, M. Stites, and Z. <u>del Rosario</u> (2022). Context-Engaged Engineering Data Analysis: A Grounded Theory of Engineers Targeting the Consequences of Variability. *PsyArxiv*. eprint: <u>https://psyarxiv.com/q6a3j/</u>.
- Hegde, V. I., C. K. Borg, Z. <u>del Rosario</u>, 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*.
- 19. Jofre-Cruanyes, L., Z. <u>del Rosario</u>, and G. Iaccarino (2019). Dimension reduction of thermo-fluid mechanisms in irradiated particle-laden turbulence. *Center for Turbulence Research Annual Research Briefs*.
- 20. Constantine, P. G., Z. <u>del Rosario</u>, and G. Iaccarino (2017). Data-driven dimensional analysis: algorithms for unique and relevant dimensionless groups. *arXiv preprint arXiv:1708.04303*. Forthcoming in JCP.
- 21. Constantine, P. G., Z. <u>del Rosario</u>, and G. Iaccarino (2016). Many physical laws are ridge functions. *arXiv preprint arXiv*:1605.07974.

PhD thesis

22. 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

- 23. <u>del Rosario</u>, Z. and M. del Rosario (2022). Synthesizing domain science with machine learning. *Nature Computational Science*. eprint: https://www.nature.com/articles/s43588-022-00358-2.
- 24. <u>del Rosario</u>, 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.

- 25. <u>del Rosario</u>, 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.
- 26. <u>del Rosario</u>, 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.
- 27. Yegnashankaran, K. and Z. <u>del Rosario</u> (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

- 28. <u>del Rosario</u>, Z. (2022b). Beyond Aleatory—A Taxonomy of Uncertainty for Reduction and Consequence. In: Stanford University. eprint: https://icme.stanford.edu/events/seminar/beyond-aleatory-taxonomyuncertainty-reduction-and-consequence.
- 29. <u>del Rosario</u>, Z. (Apr. 2021c). Studio Teaching Online: Lessons learned from a mixed-methods study. In: Stanford University.
- 30. <u>del Rosario</u>, Z. (Nov. 2020a). Assessing the Frontier. In: Cambridge Cheminformatics Meeting. <u>http://www.c-inf.net/</u>.
- 31. del Rosario, Z. (Feb. 2020d). Grammar and Margins. In: Toyota Research Institute.
- 32. <u>del Rosario</u>, Z. (Oct. 2019a). Aircraft Design Under Uncertainty. In: Harvey Mudd College Seminar.
- 33. <u>del Rosario</u>, Z. (Oct. 2019d). The Curse of Dimensionality: Problems and Strategies. In: NATO/STO Lecture Series: Uncertainty Quantification in Computational Fluid Dynamics. <u>https://we.stanford.edu/LSUQ</u>.
- 34. del Rosario, Z., R. Fenrich, and G. Iaccarino (July 2019b). Principled Margin. In: Arevo, Inc.
- 35. <u>del Rosario</u>, Z. (Sept. 2018a). Lost in Hyperspace: The Curse of Dimensionality. In: Wellesley College student seminar.
- 36. <u>del Rosario</u>, Z. (Oct. 2018b). The Curse of Dimensionality: Problems and Strategies. In: von Karman Institute: Uncertainty Quantification in Computational Fluid Dynamics (STO-AVT 326).
- 37. <u>del Rosario</u>, Z., A. Towne, and G. Iaccarino (2018c). Dimension Reduction for Shape Design Insight. In: Aerospace Computational Design Lab (ACDL) seminar, MIT.

Conference panel appearances

- 38. del Rosario, Z. (Jan. 2022e). Professors for the Future. In: UC Davis.
- 39. del Rosario, Z. (May 2021b). Scientific Teaching Institute Alumni Panel. In: SEPAL Lab.
- 40. <u>del Rosario</u>, Z. (Aug. 2020f). Project Based Learning at the College/University Level. In: Strive Virtual College Exploration STEM Days, Cachet / StriveScan. <u>https://www.strivescan.com/virtual/stem/</u>.

Conference talks

- 41. <u>del Rosario</u>, Z. (2022c). Coding to Learn: Reframing Programming in Teaching. In: *BOW Forum on Innovative Teaching*.
- 42. <u>del Rosario</u>, Z., L. Jofre, and G. Iaccarino (2022). Uncovering the link between dimensional analysis and causality. In: *Causality in Turbulence and Transition*. Universidad Politécnica Madrid. eprint: <u>https://torroja.dmt.upm.es/causturb/static/assets/abstracts/Iaccarino.pdf</u>.
- 43. <u>del Rosario</u>, Z. and G. Iaccarino (2020). Physics-informed Inference: Dimensional Analysis as Dimension Reduction. In: SIAM UQ (Conference Cancelled).
- 44. <u>del Rosario</u>, Z. (2019b). Machine Learning for Materials Property Prediction. In: North American Solid State Chemistry Conference.
- 45. <u>del Rosario</u>, Z. (2019c). Stanford SeeME: Student-driven research within an R1 institution. In: National Alliance for Broader Impacts (NABI) Summit.
- 46. <u>del Rosario</u>, 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.
- 47. <u>del Rosario</u>, Z., A. Towne, and G. Iaccarino (2018a). Dimension Reduction for Shape Design Insight. In: Thermal, Fluid science Sponsors, and Affiliates conference (TFSA).

- 48. <u>del Rosario</u>, Z., P. Constantine, and G. Iaccarino (2017a). Algorithm-Driven Insight. In: Thermal and Fluid Science Affiliates Conference.
- 49. <u>del Rosario</u>, Z., P. Constantine, and G. Iaccarino (2017b). Data-Driven Dimensional Analysis. In: CompFest.
- 50. <u>del Rosario</u>, 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.
- 51. <u>del Rosario</u>, 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

- 52. <u>del Rosario</u>, Z. and G. Iaccarino (2017). Hidden Parameter Hypothesis Testing. In: Statistical Perspectives on Uncertainty Quantification.
- 53. Torres, H., Z. del Rosario, and G. Iaccarino (2017). MCRT. In: WEST Conference.

Reviewing

I am a reviewer for the following journals:

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

Teaching Experience Course Instruction

Probabilistic Design Optimization, (ENGR 3299) Olin Teaching a unique undergraduate course on the fundamentals of optimization and prob- ability for design: multi-objective, constrained optimization, copula probability modeling, Monte Carlo and FORM approximation.	Spring
Quantitative Engineering Analysis, (ENGR 2005) Olin Teaching a flipped, studio-based class on engineering analysis fundamentals: linear algebra, multivariable calculus, statics, optimization.	Spring
Data Science, (MTH 2131) Olin 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	Fall
Modeling and Simulation of the Physical World, (MTH 1111) Olin Teaching a studio-based class on scientific modeling. Students learn how to build mod- els at multiple levels of abstraction, anchor those models to scientific questions, and imple- ment those models in software. Students also practice working in teams and communicat- ing scientific conclusions.	Fall
Summer Data Science, Olin Taught a five-week summer course for Olin alumni. Designed open-source self-paced curriculum, reinforced with team-based data challenges. Created remote learning envi- ronment around team cohorts using Discord. https://github.com/zdelrosario/data- science-curriculum	Summer 2020
Uncertainty Quantification, (ME 470) Stanford Designed, implemented, and delivered graduate-level elective course for 9 advanced students. Taught using a mixture of lecture and evidence-based methods.	Spring 2019

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

Data Science for Engineers, (Olin College) Ran a 6-week professional development course for practicing engineers. Fifteen participants joined the course; five completed self-directed projects. Funded by NSF ERI grant. https://zdelrosario.github.io/evc-course/frontmatter/home.html	2022
Materials Informatics Workshop, (Olin College) Wellesley College Adapted my MI Workshop materials for an undergraduate audience. Offered at Wellesley College in the Spring of 2022. https://zdelrosario.github.io/mi101/intro.html	2022
 Materials Informatics Workshop, (Olin College) Georgia Tech 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 	2021
Qualitative Data Workshop, (Stanford CTL) SABER WEST 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	2020
Materials Informatics Workshop, (Citrine Informatics) Georgia Tech 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/	2019
Teacher Workshops, (SeeME) Stanford Developed and delivered workshops on the fundamentals of teaching, including lessons on learning goals and The 5E Model. Ran workshops for audiences of ~ 10 .	2019
Groupwork Workshop, (VPTL Consultant) Stanford 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	2018-2019
Teacher Development Workshop, (Individual) Olin Interactive lesson on data visualization for the teaching staff at High Rock Middle School in Needham, MA.	2022
Intro to Exploratory Data Analysis, (SeeME) Stanford 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	2016
"What the heck is engineering?", (Splash) Stanford Introductory discussion-based class meant to introduce middle- and high-school aged stu- dents to engineering as a profession.	2014-2015

PhD Defense Examiner Institution, Depart	ment	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. Pub- lished results in peer-reviewed confer- ence paper (ASEE Annual Conference).	2020-2021
Gitanjali Bhattacharjee	Former student (ME 470) used sensi- tivity analysis to study transit network reliability and bridge retrofitting. Fo- cused on modeling decision processes and uncertainty arising from bridge fragility. Student project led to peer- reviewed publication (Bhattacharjee and Baker 2021; <i>Structure and Infrastructure</i> <i>Engineering</i>).	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 strategi- cally 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) Will help select the recipients of the 2022 Patricia Cross Future Leaders award, admin- istered by the AAC&U.	Fall 2021
TA Training Workshop (Olin College) Co-designing and teaching a workshop on the fundamentals of teaching for TA's. Fo- cused on active learning, problem solving, and the affective dimensions of teaching.	2021 – Present
Racial Justice Discussion Organizer (Olin College) Co-organized a 10-week series of discussions about racial justice at Olin College. De- signed a session around BlackInTheIvory, highlighting Black voices in the academy. Facilitated difficult conversations about race in higher education.	Summer 2020
Search Committee Member (Stanford Career Center, BEAM) Served on executive hiring committee for Stanford's career center (BEAM). Interviewed BEAM staff to gain perspective; advocated for evidence-based structured interview pro- cess to reduce bias; co-wrote search criteria and rubric.	2020
Co-Chair (ASEE, Task Force on Graduate Student Affairs) 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.	2019-Present
President (American Society for Engineering Education, Stanford Chapter) 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."	2018-2019
Founder and Director of Curriculum (SeeME) 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 inter- faced with the Department Chair.	2017-2020
Financial Officer (American Society for Engineering Education, Stanford Chap- ter) Served on 4-person organizing team. Wrote and won grants to fund speaker series and Colloquium. Point person on organizing seminar sequence.	2017-2018
Chair of Teacher Development (Stanford Splash) 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.	2014-2016

Employment	
Assistant Professor (Olin College)	September 2022-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.	
Visiting Assistant Professor (Olin College)	September 2020-December 2021
Statistical Consultant (Citrine Informatics)	October 2019-December 2021
Supporting government-funded research projects with numerical	
and graphical statistical analyses. Co-author on resulting publica-	
tions.	
Instructional Designer and Data Scientist (Citrine Informatics) Developed and delivered 2-day workshop at Georgia Tech on Ma- terials Informatics. Developed novel strategies for active learning in support of materials discovery.	Summer 2019
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 peda-	
gogy 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."