

# Raul Garcia

Houston, TX  
☎ (209)-354-1242  
✉ [rjgarcia@rice.edu](mailto:rjgarcia@rice.edu)  
📄 [raulgarcia66.github.io](https://github.com/raulgarcia66)

## Education

- 2020–2025 **Rice University.**  
PhD Computational and Applied Mathematics  
Advisor: Dr. Andrew J. Schaefer
- 2014–2018 **University of California, Davis.**  
BS Applied Mathematics  
Cum laude

## Interests

Mixed-integer programming, optimization under uncertainty, mathematical software, operations research, deep learning applications

## Experience

- Fall 2022 **Research Mentor**, *Data to Knowledge Lab*, Rice University, Houston TX.  
Mentored a team of students on a capstone data science project focusing on forecasting yearly battery replacements for medical devices (sponsored by LivaNova). Team took 1st place in showcase.
- Summer 2022 **Research Intern**, *MIT Lincoln Laboratory*, Lexington MA.  
Group 42 - Surveillance Systems  
Contributed algorithm analysis tool for development of the Airborne Collision Avoidance System X and its variants.
- 2019–2020 **Quality Product Auditor**, *Pacific Southwest Container*, Modesto CA.  
Performed daily testing and data collection of products. Assisted in development of experiments for analysis of product quality. Conducted internal process audits.
- 2017–2018 **Reader**, *Dept. of Mathematics*, UC Davis, Davis CA.  
Undergraduate grader for courses in Real Analysis and Ordinary Differential Equations.
- Summer 2017 **Orientation Leader**, *Student Housing*, UC Davis, Davis CA.  
Advised and mentored incoming students with course scheduling, degree requirements, campus resource navigation, and student life.

## Awards and Fellowships

- 2022–2025 **NIH Research Supplement to Promote Diversity in Health-Related Research**, National Cancer Institute (NCI).  
Full financial support.
- 2022–2025 **GEM Fellowship**, MIT Lincoln Laboratory.
- 2022 **NSF AGEP STRIDES Scholar**.
- 2022 **Research Mentoring Fellowship**, *Data to Knowledge Lab*, Rice University.

2020–2024 **Computational Science and Engineering Recruiting Fellowship**, *Ken Kennedy Institute*, Rice University.

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## Publications

### **A combinatorial disjunctive constraint approach to optimal path planning.**

Raul Garcia, Illya V. Hicks, Joey Huchette, Miles Olson

*In preparation.*

### **Deep object detection for waterbird monitoring using aerial imagery.**

Krish Kabra, Alexander Xiong, Wenbin Li, Minxuan Luo, William Lu, Raul Garcia, Dhananjay Singh Vijay, Jiahui Yu, Maojie Tang, Tianjiao Yu, Hank Arnold, Anna Vallery, Richard Gibbons, Arko Barman

*To appear in IEEE International Conference on Machine Learning and Applications 2022.*

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## Software

Summer 2022 **Airborne Collision Avoidance System X (ACAS X)**, Software for generating airborne collision avoidance advisories for manned and unmanned aircraft. Implemented in C++, Julia and MATLAB.

- Logic formulated as a Markov decision process. Computational strategies employed for handling large state space, including parallel computing and multilinear interpolation
- Contributed visualization tool for analysis of policy evolution through the course of the value iteration algorithm
- Developed by Group 42 at MIT Lincoln Laboratory

Spring 2022 **Audubon\_F21**, Python package for identifying and censusing various colonial waterbird species from aerial UAV imagery.

- Sponsored by Houston Audubon for their waterbird population monitoring studies
- Employs Faster R-CNN object detection model (Detectron2) with data augmentation and Bayesian optimization hyperparameter tuning
- Led experimentation of custom implementation utilizing a DenseNet backbone
- Co-developer with various students from the Rice Data to Knowledge Lab

2021–Present **ClutteredEnvPathOpt.jl**, Julia package employing various MIP approaches to optimal path planning of robots and drones in cluttered environments.

- Implemented the independent branching scheme to formulate obstacle avoidance disjunctive constraints, including an algorithm for obtaining the necessary biclique covers on a special class of graphs
- Includes infrastructure for creating obstacles, generating obstacle-free regions, and constructing the associated graphs
- Co-developer with Joey Huchette and Miles Olson

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## Teaching

### [Rice University](#)

Department of Computational Applied Mathematics & Operations Research

**Grader**, CAAM 519: Computational Science I.

Fall 2022

**Grader**, CAAM 378: Introduction to Operations Research and Optimization.

Spring 2022

**Grader**, CAAM 335/334: Matrix Analysis/Matrix Analysis for Data Science.

Fall 2021, Spring 2021, Fall 2020

University of California, Davis

Department of Mathematics

**Teaching Assistant**, MAT 17ABC: Calculus for Bioscience Students.

Spring 2017, Fall 2016, Spring 2016

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## Presentations

**"Leveraging Machine Learning to Develop Collision Avoidance Systems for Manned and Unmanned Aircraft"**.

- TAPIA Conference in Computing, Sep 2022

**"A Combinatorial Disjunctive Constraint Approach to Optimal Path Planning"**.

- INFORMS Annual Meeting, Oct 2022
- MIP Workshop (poster), May 2022
- Kavraki Lab, Apr 2022

**"Deep Learning for Precision Waterbird Monitoring"**.

- Rice D2K Showcase (poster), Apr 2021

**"On the Value of Binary Expansions for General Mixed-Integer Programs"**, Paper Presentation.

- Rice SIAM Journal Club, Feb 2021

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## Service, Outreach & Activities

2020–Present **Society for Industrial and Applied Mathematics (SIAM) Student Chapter**, Rice University.

- Treasurer, 2022-2023
- Doctoral Program Recruitment Representative, 2022-2023
- Graduate Seminar Chair, 2021-2022
- Grill Master, 2020-2021

2021–Present **Julia Users of Rice Group**, Co-founder, Rice University.

Summer 2021 **Instructor**, *Tapia STEM Camp*, Rice University.

Guided high school students from underrepresented backgrounds on projects focusing on computational thinking and equity

2020–2021 **Mentor**, *Association of Women in Mathematics (AWM)*, Rice University.

Served as mentor to a group of first-year Rice students interested in mathematics

2020–Present **Rice Graduate Education for Minorities**, *Tapia Center for Excellence and Equity in Education*, Rice University.

2020–Present **LatinGrads**, Rice University.

2020–Present **Graduate Student Association Soccer Club**, Rice University.

- Treasurer, 2022-2023

2015–2018 **Chicano and Latino Engineers and Scientists Society**, UC Davis.

**Memberships.**

- Institute for Operations Research and the Management Sciences (INFORMS)
- Society for Industrial and Applied Mathematics (SIAM)

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## Relevant Coursework

Linear and Integer Programming; Stochastic Optimization; Online Optimization and Decision Making Under Uncertainty; Stochastic Simulation; Applied Machine Learning Projects; Intro to Machine Learning; Iterative Methods for Systems of Equations and Unconstrained Optimization; Advanced Numerical Analysis; Computational Science; Object-Oriented Programming

## ■ Programming Languages and Software

Programming & Software Julia, Python, C++, C, Gurobi, MATLAB, Rust

Libraries Proficient: JuMP  
Experience with: Detectron2, PyTorch, scikit-learn

## ■ Languages

English, Spanish