

I am a Fulbright scholar, a researcher, and an educator with 10 years of experience doing research in the intersections between renewable energies, design, artificial intelligence, biomimicry, and behavioral economics.

EDUCATION

Ph.D. in Mechanical Engineering

08/2018-05/2023

Carnegie Mellon University. GPA 4.0/4.0

Pittsburgh, United States

Thesis: Solar harvesting swarms in dynamic and 3D urban environments: modeling and simulation

Thesis Committee: Professors Philip LeDuc as the main advisor, John Cagan, Allen Robinson, and Burcu Akinci

Relevant Coursework: Machine learning, creative AI, AI and humanity, climate change, and numerical methods

Master's Degree in Engineering, Research modality

07/2014-09/2017

Universidad EAFIT. GPA 4.88/5.0

Medellín, Colombia

With Honors: First in class rank; Thesis awarded the Highest Honor and graded 5.0/5.0

Thesis: Solar beam radiation modeling for the design and simulation of V-Trough photovoltaic applications

Relevant Coursework: Research in design, statistics and experimental design, academic writing, and research skills

Bachelor's Degree in Product Design Engineering

07/2009-12/2014

Universidad EAFIT. GPA 4.74/5.0

Medellín, Colombia

With Honors: First in class rank; awarded a Postgraduate Scholarship due to undergraduate research recognition

Thesis: Design and development of a solar energy device for rural families in Colombia

Relevant Coursework: Physics, calculus, prototyping, manufacturing, 3D modeling, mechanisms, and eight projects in which products like land and water vehicles were designed from conceptualization to functional prototypes

RESEARCH EXPERIENCE

Postdoctoral Research as an Independent Contractor

05/2023-Present

Carnegie Mellon University - (see 1)

- In collaboration with Arthur K. Wheelock, world-renowned Rembrandt expert and former curator at the National Gallery of Art in Washington, developing AI algorithms to identify and analyze the unique aspects of the styles of highly influential painters, including brushstroke structure, light management, and features like faces and hands
- Modeling and simulating the potential of using Swarm Intelligence in dense populations of solar devices for urban or agrivoltaic systems
- Deriving an economic model of how societies react to technological paradigms that pose potential existential risks

Ph.D. Candidate and Research Assistant

08/2018-05/2023

Carnegie Mellon University - (see a., 2-6 & 13-15)

- Created a comprehensive modeling framework for dynamic and freely-defined solar arrays in urban environments, seeking to balance accuracy, efficiency, and practicality based on tens of thousands of simulations
- Developed and characterized shadow modeling approaches with new capabilities regarding geometrical flexibility in complex settings and the inclusion of anisotropic phenomena
- Proposed a new model of radiation transmittance at the covering of solar panels based on statistical analysis
- Evaluated solar radiation View Factor modeling approaches through new mathematical derivations, numerical surface integrations, and stochastic ray simulations
- Developed and evaluated *Shapi*, an open-ended AI tool for boosting creativity during shape exploration sketching

Graduate Research Assistant

12/2014-08/2018

Design Engineering Research Group, Universidad EAFIT - (see b., 7-8 & 10)

Awarded two Grants: Young Researchers and Innovators, Colciencias: 12/2014-12/2015 and 05/2017-05/2018

- Developed a wind turbine comparison method based on the statistical analysis of nominal specifications

- Led a team of research interns and undergraduate research assistants to develop *Albatros Create* (Copyright-registered), a software for designing horizontal axis wind turbines with a bioinspired wavy-leading-edge
- Explored statistical adjustments to the logarithmic wind extrapolation model for the Colombian context
- Designed a new wind turbine blade concept; under development for a future Patent application
- Performed a thorough classification of the wind turbine types and sub-systems
- Modeled the series-parallel topological effects on the performance of solar car battery packs
- Worked as a system integrator and main designer in developing a stratospheric-balloon platform for testing sounding-rocket components; in collaboration with the *Applied Mechanics Research Group, Universidad EAFIT*

Master's Graduation Project

03/2015-09/2017

Design Engineering Research Group, Universidad EAFIT - (see c., 9, 11-12 & 16)

- Proposed and experimentally validated an optical model of beam radiation for V-Trough solar concentrators
- Developed *VTDesign* (Copyright-registered), a software for the design and simulation of solar V-Troughs
- Created a new type of interactive genetic algorithm and assessed its performance in solar V-Trough case studies

Undergraduate Research Assistant

06/2014-12/2014

Collaborative Design Research Incubator, Universidad EAFIT - (see d.)

- Led an undergraduate team in the analysis and selection of a small wind turbine for its implementation in the field

Undergraduate Research Intern

02/2013-12/2013

Design Engineering Research Group, Universidad EAFIT - (see e., f., i. & 17)

Project to develop Colombia's first solar car, "*Primavera*", to compete in the World Solar Challenge 2013. This pioneering and multidisciplinary project involved a large team of faculty, undergraduate and graduate students from various universities, and technical and financial support from *Empresas Públicas de Medellín* (EPM).

- Developed a high concentrating (>1,000 suns) photovoltaic system for *Primavera*
- Increased solar generation by up to 15% with a photovoltaic area of only 0.03% of the main panel
- Engineered the internal ribs of the vehicle and the assemblies between the chassis and the bodywork, and led a team to install these parts in the vehicle
- Planned, coordinated, and led the deployment and use of the solar concentrators during the competition in Australia
- Based on the technical and leadership skills demonstrated, I was offered (but had to decline) to lead the second iteration of the project

AWARDS AND HONORS

- a. Grantee of the *Colciencias-Fulbright Scholarship* for Doctoral studies, cohort 2018
- b. *Cover* of International Journal of Energy Research, Volume 41, Issue 12, 2017
- c. *Best Presentation Award*; Conference on Mechanical, Materials and Manufacturing, Savannah U.S., 2016
- d. *Award for Outstanding Undergraduate Students for their Involvement in Research*, from Medellín's Mayor, 2014
- e. *National Engineering Award*, from the Colombian Society of Engineers, 2014 (*Primavera* project)
- f. *Antioquia's Engineering Distinction*, from the Antioquia's Society of Engineers, 2014 (*Primavera* project)
- g. *SABER PRO results* among the 5% best of Colombia (national test for graduate education), 2014
- h. *Universidad EAFIT Honor Scholarship* (highest GPA), awarded twice: 2013 and 2014
- i. *Universidad EAFIT Award for the Research Project of the Year*, 2013 (*Primavera* project)
- j. *ICFES results* among the best 100 of Colombia (national test for secondary education), 2008

JOURNAL PUBLICATIONS

1. Arias-Rosales, A., Erol, S. & LeDuc, P. (Working Paper). Social and institutional dynamics in the face of technological growth with uncertain catastrophic potential.
2. Arias-Rosales, A., & LeDuc, P. (2023). Urban solar harvesting: the importance of diffuse shadows in complex environments. *Renewable and Sustainable Energy Reviews*, 175, 113155.
3. Arias-Rosales, A. (2022). The perceived value of human-AI collaboration in early shape exploration: An exploratory assessment. *PloS ONE*, 17(9), e0274496.

4. Arias-Rosales, A., & LeDuc, P. (2022). Shadow modeling in urban environments for solar harvesting devices with freely defined positions and orientations. *Renewable and Sustainable Energy Reviews*, 164, 112522.
5. Arias-Rosales, A., & LeDuc, P. (2020). Comparing View Factor modeling frameworks for the estimation of incident solar energy. *Applied Energy*, 277, 115510.
6. Arias-Rosales, A., & LeDuc, P. (2020). Modeling the transmittance of anisotropic diffuse radiation towards estimating energy losses in solar panel coverings. *Applied Energy*, 268, 114872.
7. Arias-Rosales, A., & Osorio-Gómez, G. (2020). Albatros Create: an interactive and generative tool for the design and 3D modeling of wind turbines with wavy leading edge. *International Journal on Interactive Design and Manufacturing*, 14(2), 631-650.
8. Arias-Rosales, A., & Osorio-Gómez, G. (2018). Wind turbine selection method based on the statistical analysis of nominal specifications for estimating the cost of energy. *Applied Energy*, 228, 980-998.
9. Arias-Rosales, A., & Mejía-Gutiérrez, R. (2018). Optimization of V-Trough photovoltaic concentrators through genetic algorithms with heuristics based on Weibull distributions. *Applied Energy*, 212, 122-140.
10. Fernández-Montoya, M., Arias-Rosales, A., Osorio-Gómez, G., & Mejía-Gutiérrez, R. (2017). Nominal energy optimisation method of constrained battery packs through the iteration of the series-parallel topology. *International Journal of Energy Research*, 41(12), 1709-1729.
11. Arias-Rosales, A., & Mejía-Gutiérrez, R. (2016). Modelling and simulation of direct solar radiation for cost-effectiveness analysis of V-Trough photovoltaic devices. *International Journal on Interactive Design and Manufacturing*, 10(3), 257-273.
12. Arias-Rosales, A., & Mejía-Gutiérrez, R. (2016). VTDesign: Implementation of a Direct Radiation Model in an Interactive Software for Designing V-Trough Photovoltaic Devices. *International Journal of Computer and Electrical Engineering*, 8(5), 288-293.

CONFERENCE TALKS AND PROCEEDINGS

13. Arias-Rosales, A., & LeDuc, P. (2022). Solar Swarms for Urban Energy Harvesting: A Modeling Approach. *Society of Engineering Science (SES) Annual Technical Meeting*. Oral Presentation.
14. Arias-Rosales, A., & LeDuc, P. (2022). Dynamic urban solar harvesting: anisotropic shadows in energy estimation. *SPIE Photonics West. Proc. SPIE 11996, Physics, Simulation, and Photonic Engineering of Photovoltaic Devices XI* (Vol. 11996, pp. 95-105). DOI: 10.1117/12.2609987
15. Arias-Rosales, A., & LeDuc, P. (2019). Modeling the transmittance of anisotropic diffuse radiation for solar panels toward optimizing energy based on the angle of incidence. *2nd International Conference on Energy, Electrical and Power Engineering, CEEPE at University of California, Berkeley*. Oral Presentation.
16. Arias-Rosales, A., & Mejía-Gutiérrez, R. (2016). Modelling and simulation of direct solar radiation for the design of V-Trough devices with Tracking. *Proc. of the International Virtual Concept Workshop on Major Trends in Product Design*. ISBN: 978-2-954 8927-3-3
17. Arias-Rosales, A., Barrera-Velásquez, J., Osorio-Gómez, G., & Mejía-Gutiérrez, R. (2014). Designing a concentrating photovoltaic (CPV) system in adjunct with a silicon photovoltaic panel for a solar competition car. *Proc. SPIE 9115, Energy Harvesting and Storage: Materials, Devices, and Applications V* (Vol. 9115, pp. 146-160). DOI: 10.1117/12.2050830

PEER REVIEWER EXPERIENCE

- Direct invitations to review manuscripts from prestigious Journals like *Applied Energy* and *Solar Energy*
- 21 Reviewer Assignments completed on topics related to: Optical performance in concentrating and non-concentrating devices, economic and engineering analysis of renewable energies, wind-solar-hydro complementary systems, applied machine learning methods, wind energy uncertainty, building-integrated PV, and agrivoltaics

TEACHING EXPERIENCE

Teaching Assistant
 Mechanical Engineering course *Engineering Design I: Skills and Methods*

2021
 Carnegie Mellon University

- 2021 Fall: As Lead TA, prepared class material (presentations, exercises, and demonstrations), conducted recitations, graded over 35 design projects, and provided guidance and feedback to more than 40 teams - Based on more than 60 responses: “Understanding of the subject matter”, “Preparedness”, and “Overall TA performance” were highly scored (≥ 4 out of 5) in 94%, 85%, and 90% of the responses, respectively
- 2021 Spring: As TA, helped prepare class material (presentations and demonstrations), provided assistance in recitations and lectures, graded 40 design projects, held weekly office hours, and provided technical advice and general feedback in design engineering for applied cases

Adjunct Lecturer

ITM Institución Universitaria. Invited by Darwin Energía Solar.

05/2017-05/2017
Medellín, Colombia

- Designed, prepared, and taught an 8h *Wind Energy Introductory Module* for a short course; 14 students

Teaching Assistant

Universidad EAFIT

- Advisor and grader for a *Special Research Project* on wind turbines; 1 undergraduate student 06/2017-11/2017
- Gave a course on *Kinematics and Kinetics*, including grading and the design, preparation, and teaching of class material (presentations, exercises, evaluations, and demonstrations); 30 undergraduate students 09/2016-11/2016

Training and Certification

Carnegie Mellon University

- Completed 3 seminar courses from the *Eberly Center for Teaching Excellence and Educational Innovation*: 2021
Working Well One-on-One with Students, Teaching Problem-Solving in Recitations, and Conducting Productive and Engaging Discussions.

TECHNICAL SKILLS

Research	Applied Statistics	Design Methods/Tools	Product Design
Modeling & Simulation	Experimental Design	Academic Writing	Conceptualization
Data Analytics	Numerical Methods	Proficient in English	CAD modeling
Data Visualization	Optimization	Public Speaking	Sketching
Programming	Machine Learning	Teaching & Mentoring	Prototyping

SOFT SKILLS

Problem-solving	Decision-making	Insatiable curiosity	Leadership
Critical thinking	Dependability	Passion	Communication
Creative thinking	Self-discipline	Fast learner	Resourcefulness

ADDITIONAL COURSEWORK AND COMPLEMENTARY EDUCATION

- Introduction to *Computer Science and Programming Using Python*. Course, Grade 98/100, MITx, 2015
- *Renewable Energies; applications and tools for projects development*. Seminar, Universidad EAFIT, 2015
- *Automotive Design*. Course, Taller Arte Digital, Medellín, 2013
- English Proficiency: TOEFL iBT 2017 (Reading 30/30, Listening 29/30, Speaking 24/30, Writing 30/30). In 2020, I passed the *ITA English Language Certification* from the Intercultural Communication Center at *Carnegie Mellon University* with a “Strong” proficiency level without restrictions. Also, five years living in the United States.
- French Level: DELF B1. Six Months in ILSC Language School, Montreal, 2009

REFERENCES

- Philip LeDuc, Full Professor at *Carnegie Mellon University*: prl@andrew.cmu.edu
Main advisor during my Ph.D. studies (2018-2023)
- Ricardo Mejía-Gutiérrez, Research Director at *Universidad EAFIT*: rmejiag@eafit.edu.co
Main advisor during my Undergraduate and Master's studies (2013-2017)
- Gilberto Osorio-Gómez, Full Professor at *Universidad EAFIT*: gosoriog@eafit.edu.co
Advisor while I was a Graduate Research Assistant at *Universidad EAFIT* (2014-2018)