

Victor Alves

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SUMMARY AND SKILLS

I am currently a postdoctoral fellow at Carnegie Mellon University, holding a Ph.D. in chemical engineering at West Virginia University. My expertise encompasses Process Systems Engineering (PSE), in which I have developed advanced algorithms for process modeling, control, and nonlinear constrained optimization. Additionally, I possess expertise in supervised machine learning techniques applied to industrial applications. My background is further enriched by hands-on industry experience in the oil and gas, petrochemical, and energy sectors.

Expertise: Advanced process control, process simulation, plantwide control, process operability analysis, supervised machine learning, nonlinear constrained optimization (NLP)

Programming: Python, MATLAB, markdown, restructuredText, LaTeX and exposure to R

Technologies: Git, GitHub, Simulink

Process simulation: Aspen Plus, Aspen Plus Dynamics, Aspen Custom Modeler, HYSYS, AVEVA Process Simulation, PRO/II, Dynsim

Languages: English and Portuguese

EDUCATION

West Virginia University

Ph.D., Chemical Engineering;

GPA: 3.80/4.00

Morgantown, WV, USA

2020–2024

Federal University of Campina Grande

M.Sc., Chemical Engineering;

Academic Coefficient: 10.00/10.00

Campina Grande, Paraiba, Brazil

2017 –2020

University of Birmingham

B.Sc., Chemical Engineering (Exchange Student);

British Degree Classification: Upper Second

Birmingham, United Kingdom

2014–2015

Federal University of Campina Grande

B.Sc., Chemical Engineering;

Academic Coefficient: 8.69/10.00

Campina Grande, Paraiba, Brazil

2012–2017

RESEARCH EXPERIENCE

Carnegie Mellon University

Postdoctoral Fellow (Ph.D.)

Pittsburgh, PA, USA

2024– Currently

- Working with Dr. Carl D. Laird and Dr. John R. Kitchin on the development of hybrid modeling approaches and differentiable programming methods for PSE applications.

West Virginia University

Graduate Research Assistant (Ph.D.)

Morgantown, WV, USA

2020–2024

- Worked with Dr. Fernando V. Lima on the development of emerging techniques for process operability calculations, involving mainly supervised machine-learning, constrained nonlinear programming (NLP) and automatic differentiation (AD) for efficient algorithm development.
- Development of an open-source Python package for process operability calculations, for ease-of-use and dissemination of operability algorithms in academia and industry.

- Control, Optimization and Design for Energy and Sustainability (CODES) research group leader, supervising the group's activities, as well as organizing the semester schedule, workshops, weekly meetings and relevant announcements.

Federal University of Campina Grande

Campina Grande, Paraiba, Brazil

Graduate Research Assistant (M.Sc.)

2017–2020

- M.Sc. thesis: “Metamodel-based Numerical Techniques for Self-Optimizing Control”: Developed a methodology capable of using Gaussian Process Regression (GPR) to aid the optimal selection of controlled variables (CVs) in industrial processes, following the Self-Optimizing Control (SOC) methodology.

University of Birmingham

Birmingham, United Kingdom

Undergraduate Researcher (B.Sc.)

2014–2015

- Project: “Development of User-Friendly Labs and Simulations for Undergraduate Teaching”.
- Undergraduate research project done while studying abroad at the UK.
- Funded by the Brazilian National Council for Scientific and Technological Development (CNPq).

Federal University of Campina Grande

Campina Grande, Paraiba, Brazil

Undergraduate Researcher (B.Sc.)

2013–2014

- Project: “Simulation of the Catalytic Hydrotreating Process of Petroleum Fractions in Fixed Bed Reactors”.
- Funded by the Brazilian National Council for Scientific and Technological Development (CNPq).

Federal University of Campina Grande

Campina Grande, Paraiba, Brazil

Undergraduate Researcher (B.Sc.)

2012–2013

- Project: “Use of the Computational Approaches in Solving Chemical Engineering Problems”.
- Funded by the Brazilian National Council for Scientific and Technological Development (CNPq).

WORK EXPERIENCE

Carnegie Mellon University

Pittsburgh, PA, USA

Postdoctoral Fellow (Ph.D.)

2024–Currently

- Working with Dr. Carl D. Laird and Dr. John R. Kitchin on the development of hybrid modeling approaches and differentiable programming methods for PSE applications.

West Virginia University

Morgantown, WV, USA

Graduate Research Assistant (Ph.D.)

2020–2024

- Tutored undergraduate students at the senior level, allowing them to be introduced to scientific research in process systems engineering, process modeling (steady-state/dynamics), process operability concepts and control.
- Collaborated with Dr. Fernando V. Lima as his Teaching Assistant for the Chemical Process Control course, undergraduate senior-level. Prepared lectures, tutorials in MATLAB/Simulink and problem sets for students, in a problem-based learning fashion.

Federal University of Campina Grande

Campina Grande, Paraiba, Brazil

Graduate Research Assistant (M.Sc.) and Developer

2017–2020

- Research and development of BRPWC for PETROBRAS: An automated software capable of easily selecting the most promising self-optimizing control structures in industrial processes.
- Worked on developing the calculation engine in Python for BRPWC, based on the research results from my Master's thesis.
- Conceptualized the user interface for BRPWC, generating mock-ups that were sent to the computer science team to develop the front-end interface.

- Worked as a process engineering intern in Vinyl Chloride Monomer (VCM) and Polyvinyl Chloride (PVC) production plants.
- Developed simulations in Aspen Plus and Aspen Plus Dynamics to investigate operating regions of the VCM/PVC plants.

PROJECTS - SOFTWARE PRODUCTS

Opyrability: Process Operability Analysis in Python | [Website](#)

- Opyrability - A Python-based package for process operability analysis - is an open-source project for advanced process operability analyses. The opyrability codebase includes the main operability algorithms, supplementary analysis and visualization methods to allow for the assessment of simultaneous design and control objectives early in the conceptual phase.

Metacontrol | [Website](#)

- Metacontrol is a Python-based software that assembles several methodologies into a single bundle so that a fast implementation of the Self-Optimizing Control (SOC) technique can be achieved. Metacontrol's calculation engine and main steps were conceptualized during my Master's thesis.

SELECTED RESEARCH PUBLICATIONS - COMPLETE LIST ON MY [GOOGLE SCHOLAR](#).

Alves, Victor, Dinh, San, Kitchin, John R. Gazzaneo, Vitor, Carrasco, Juan C. Lima, Fernando V. "Opyrability: A Python package for process operability analysis". In: *Journal of Open Source Software* 9.94 (2024), p. 5966.

Alves, Victor, Gazzaneo, Vitor, Lima, Fernando V. "A machine learning-based process operability framework using Gaussian processes". In: *Computers & Chemical Engineering* 163 (2022), p. 107835.

Alves, Victor, Kitchin, John R, Lima, Fernando V. "An inverse mapping approach for process systems engineering using automatic differentiation and the implicit function theorem". In: *AIChE Journal* (2023), e18119.

Alves, Victor, Lima, Felipe S, Silva, Sidinei K, Araujo, Antonio CB. "Metamodel-based numerical techniques for self-optimizing control". In: *Industrial & Engineering Chemistry Research* 57.49 (2018), pp. 16817–16840.

Lima, Felipe Souza, **Alves, Victor**, Araujo, Antonio Carlos Brandao. "Metacontrol: A Python based application for self-optimizing control using metamodels". In: *Computers & Chemical Engineering* 140 (2020), p. 106979.

Sweeney, Dean M. **Alves, Victor**, Sakhal, Savannah, Dinh, San, Lima, Fernando V. "Techno-economic analysis and optimization of intensified, large-scale hydrogen production with membrane reactors". In: *Industrial & Engineering Chemistry Research* 62.46 (2023), pp. 19740–19751.

CONFERENCE PRESENTATIONS AND SEMINARS

Alves V., Seminar: Recent Developments and Implementations in Process Operability Analysis, Carnegie Mellon University, Pittsburgh, PA. 2023.

Alves V., Dinh, S, Kitchin J. R. and Lima F. V. An Implicit Mapping Approach for Process Systems Engineering Applications Using Automatic Differentiation and the Implicit Function Theorem. AIChE Annual Meeting, Orlando, FL. 2023.

Sweeney D., **Alves V.**, Sakhal S., Dinh S. and Lima F. V. Techno-economic Optimization of a Palladium Membrane Reactor for Steam Methane Reforming Industrial Process. AIChE Annual Student Conference (*3rd place award*), Phoenix, AZ. 2022.

Alves V., Dinh S. and Lima F. V. An Open-Source Python-Based Toolbox for Enabling User-Friendly Process Operability Calculations. AIChE Annual Meeting, Phoenix, AZ. 2022.

Alves V. and Lima F. V. A Gaussian Process-Based Process Operability Framework and a Python Toolbox for Operability Calculations. Bio Processes, Control, Optimization, and Industry 4.0 Online Conference. 2022.

Sakhai S., **Alves V.** and Lima F. V. Modeling and Optimization of a Membrane Reactor for the Steam Methane Reforming Process. AIChE Annual Meeting, Boston MA. 2021.

Alves. V, Dinh S. and Lima F.V. Dynamic Operability Analysis Employing Kriging-Based Surrogate Models. AIChE Annual Meeting, Boston MA. 2021.

Alves. V, Gazzaneo V., Lima F.V. A Framework for Steady-State Process Operability Analysis Using Kriging-Based Surrogate Models. AIChE Annual Meeting, Boston MA. 2021.

COMPLEMENTARY COURSES

West Virginia University: Transport Phenomena; Advanced Chemical Engineering Thermodynamics; Chemical Reaction Engineering; Mathematical Methods in Chemical Engineering; Statistical Methods; Oil and Gas Refining; Teaching Practicum; Dynamic Simulations; Linear Control Systems; Advanced Optimization.

University of Birmingham: Reactors and Catalysis; Process Systems; Principles of Process Control; Mass, Heat and Momentum Transport; Process Integration and Unit Operations; Computing for Design.

Federal University of Campina Grande: Probability and Statistics; Transport Phenomena; Introduction to Plantwide Control; Reactor Analysis.

TEACHING

Chemical Process Control
Teaching Assistant

West Virginia University
Spring, 2023

MENTORING

Undergraduate Research Mentor
Graduate Research Assistant

West Virginia University
May 2021 - May 2023

Description: Mentored two senior undergraduate chemical engineering students, introducing them to research practices related to simulation projects in hydrogen production and membrane reactor modeling.

SERVICE

CODES Research Group Leader

West Virginia University
May 2021 - May 2023

Description: Student Leader of the Control, Optimization, and Design for Energy and Sustainability (CODES) Group, responsible for overseeing the group's activities, organizing workshops, and planning the group's semester schedule.

Aspen Plus Equation Oriented Workshop

CODES Research Group
Jan 2024

LaTeX Workshop

CODES Research Group
July 2023

GitHub Workshop

CODES Research Group
Feb 2023

Python Workshop

CODES Research Group
June 2021