Gabriel David Patrón

Citizenship: Canadian, Colombian
Languages: English, Spanish
Modelling environments: Aspen Plus/HYSYS, GAMS, gPROMS, MATLAB, Python (Pyomo)

Department of Chemical Engineering, University of Waterloo
E6-3104, 259 Phillip St, Waterloo, ON, CA, N2L 3W8
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Vision: Postdoctoral fellow in modelling, control, and optimization of process systems. Interests in sustainable processes, food production, carbon capture, and energy generation, as well as methods to deal with process uncertainty.

Academic Positions

Department of Chemical Engineering, University of Waterloo, CA *2023–*

Postdoctoral fellow

- Supervisor: Luis Ricardez-Sandoval
- Research topics:
  - Chemical looping combustion/gasification
  - Machine learning based real-time optimization
  - Recirculating aquaculture systems

Education

Department of Chemical Engineering, University of Waterloo, CA *2018–2023*

PhD, Process Systems Engineering

- Supervisor: Luis Ricardez-Sandoval
  - Thesis: New approaches for the real-time optimization of process systems under uncertainty.

Department of Chemical Engineering, Imperial College London, UK *2017–2018*

MSc, Process Systems Engineering

- Supervisor: Amparo Galindo
  - *Thesis: An Application of Residual Entropy Scaling to Calculate and Predict Viscosity Using the SAFT-γ Mie Equation of State.*

Department of Chemical and Biomolecular Engineering, National University of Singapore, SG *2016*

Research exchange

- *Supervisors: Ning YAN, Jiaguang ZHANG (now at the University of Lincoln, UK)*
  - *Thesis: Formic Acid-Mediated Pyrolysis of Woody Biomass.*

Department of Chemical Engineering and Applied Chemistry, University of Toronto, CA *2013–2017*

BASc, Chemical Engineering

- Minor in sustainable energy.

Peer-Reviewed Publications

Patrón, G.D. and Ricardez-Sandoval, L. (2023). Robust real-time optimization and parameter estimation of post-combustion CO_2 capture under economic uncertainty. Chemical Engineering Science: 281; 119124.

Patrón, G.D. and Ricardez-Sandoval, L. (2023). Directional modifier adaptation based on input selection for real-time optimization. Computers & Chemical Engineering: 177; 108351.

Patrón, G.D. and Ricardez-Sandoval, L. (2022). Low-Variance Parameter Estimation Approach for Real-Time Optimization of Noisy Process Systems. Industrial & Engineering Chemistry Research: 61(45); 16780–16798.

Patrón, G.D. and Ricardez-Sandoval, L. (2022). An integrated real-time optimization, control, and estimation scheme for post-combustion CO_2 capture. Applied Energy: 308; 118302.

Patrón, G.D. and Ricardez-Sandoval, L. (2020). A robust nonlinear model predictive controller for a post-combustion CO_2 capture absorber unit. Fuel: 265; 116932.

Patrón, G.D. and Ricardez-Sandoval, L. (2020). Real-Time Optimization and Nonlinear Model Predictive Control for a Post-Combustion Carbon Capture Absorber. IFAC-PapersOnLine: 53(2); p. 11595–11600.

Active projects

Patrón, G.D. and Ricardez-Sandoval, L. Economic Model Predictive Control of a Recirculating Aquaculture System.

- The recirculating aquaculture system (RAS) is treated as a batch process. An economic model predictive controller (EMPC) is and moving horizon estimator (MHE) are developed for RAS, which use a mechanistic model that considers fish growth, oxygenation, and waste accumulation. The batch length and optimal control actions are found subject to various temperatures and their potential fluctuations.

Patrón, G.D. and Ricardez-Sandoval, L. Economic Model Predictive Control of a chemical looping combustion and gasification systems.

- A reactor network model was developed for online decision making in chemical looping combustion (CLC) and chemical looping gasification (CLG). The reduction stage in both processes are treated as batches, where energy and syngas production are optimized, respectively, with respect to steam and/or biomass inputs.

Patrón, G.D. and Ricardez-Sandoval, L. Symbolic regression for the real-time optimization of process systems.

- Deploys a grey-box approach for steady-state optimization, which corrects structurally imperfect process model with symbolic regressors. The resulting hybrid approach can reconcile plant and model mismatch universally given sufficient data.

Conference presentations

Patrón, G and Ricardez-Sandoval, L. (2023). Economic Model Predictive Control of a Recirculating Aquaculture System. 22nd IFAC world congress, WeB16.4.

Patrón, G and Ricardez-Sandoval, L. (2022). Partial Modifier Adaptation for Economic Optimization of Process Systems Under Frequent Disturbances and Structural Model Uncertainty. AICHE annual meeting 2022, 434d.

Patrón, G and Ricardez-Sandoval, L. (2022). Parameter Estimation for Real-Time Optimization Under Model Uncertainty and Measurement Noise. AICHE annual meeting 2022, 434g.

Patrón, G and Ricardez-Sandoval, L. (2020). Towards an integrated approach for real-time economic optimization, state estimation, and control for a post-combustion carbon capture absorber section. AICHE annual meeting 2020, 596c.

Patrón, G and Ricardez-Sandoval, L. (2020). Real-Time Optimization and Nonlinear Model Predictive Control for a Post-Combustion Carbon Capture Absorber. 21st IFAC world congress, VI161-09.9.

Awards and grants

Doctoral Thesis Completion Award 2022
University of Waterloo

Faculty of Engineering Domestic Doctoral Student Award 2018–2022
University of Waterloo

Graduate Research Studentship 2018–2022
University of Waterloo

Centre for International Experience Award 2016
University of Toronto

Cross-Disciplinary Program Summer Grant 2016
University of Toronto

University of Toronto Entrance Scholarship 2013
University of Toronto

Teaching and mentoring

Undergraduate teaching assistantship 2019, 2020
University of Waterloo, CHE420: Introduction to Process Control with Prof. Hector Budman

Undergraduate student supervision

University of Waterloo, final year design project: Design of a Chemical Looping Combustion Model for Reducing Carbon Footprint *2021*

University of Waterloo, final year design project: Modelling and Optimization of Chemical Looping Combustion (CLC) Process *2020*

Professional membership

American Institute of Chemical Engineers (AIChE) - *Graduate Student Member* *2022–*
Canadian Society for Chemical Engineering (CSChE) - *Graduate Student Member* *2022–*
International Federation of Automatic Control (IFAC) - *Affiliate Member* *2022–*

Professional service

Peer reviewer for:

- *AIChE Journal*
- *Journal of Process Control*
- *The 13th IFAC Symposium on Dynamics and Control of Process Systems, including Biosystems (DYCOPS) in Busan, Republic of Korea, June 14-17, 2022.*

Industrial experience

EllisDon Corporation *2015*

M.E.I.T. Intern, New Oakville Trafalgar Memorial Hospital

- Worked with specialty teams - Mechanical, Electrical, and Information Technology - during the commissioning of the project.
- Performed calibration, testing, and troubleshooting for hospital communications and emergency systems - to meet strict hospital regulations and standards.
- Identified system deficiencies and liaised with subcontractors to find solutions.
- Modified drawings for hoarding permit applications using Autodesk.

EllisDon Corporation *2014*

Estimating Intern

- Was a part of the proposal team that formed an estimate for - and won - the Eglinton Light Rail Transit (ELRT) Project.
- Management of several project-specific tender packages, including assessment of requirements based on specifications, qualification process, management of quotes, quantity takeoffs, and estimates.

References available upon request