

## PERSONAL INFORMATION

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## CAREER SUMMARY

I received a **B.E. degree in electrical engineering** from the **Pontifical Catholic University of Chile (PUC)** in 2009 and later in 2016 received a diploma in **sustainable energies** from the same institution. Until 2018, I've dedicated nearly a decade to promoting the development of **renewable energies** in Chile, working there in the energy industry. In 2020, I received the **M.S. degree in energy engineering** from the School of Industrial Engineering at the **Polytechnic University of Catalonia (UPC)** in Barcelona, Spain. From 2021, I'm pursuing a **Ph.D. degree** as a member of the research institution **CITCEA, UPC**, specializing in the **optimization of electrical power systems**.

## EDUCATION

**POLYTECHNIC UNIVERSITY OF CATALONIA - SPAIN**

2021 – Present

*PhD Candidate – Electrical Engineering*

*Thesis Topic: Provision of Auxiliary Services through Distributed Energy Resources*

- Developing an **energy management** framework tailored for power systems, leveraging **optimization techniques** and comprehensive **component modeling**.
- My expertise lies **power systems analysis** and in **mathematical programming** encompassing **convex** and **non-convex** optimization, including **LP, QP, SOCP, SDP, NLP, SQP**, and **Mixed Integer Programming**, alongside knowledge in **distributed optimization algorithms** such as **ADMM, APP, OCD, C+I**, and **DD**.
- My work is focused on **grid integration** of **renewable resources** through enhancing **flexibility** within power systems. This involves **demand response** mechanisms, integration of **energy storage systems**, and efficient utilization of **dispatchable generation**, considering, **environmental forecasts** and **security constraints** to ensure robustness and reliability.
- Proficient in **Python** programming language, I utilize tools such as **CVXPY, Pyomo, Pandas**, and **NumPy** for modeling purposes, and **Sphinx** for writing documentation. Additionally, I employ **PandaPower, Gridcal**, and **Matpower/Simulink**

for in-depth power system analysis, and **Git/Github** for source control. As a development environment, I currently use **VSCode** and **PyCharm**. For articles, I use **Latex** and **Quarto** for multi-format/interactive output.

- My **research interests** are in **optimizing power systems**, advanced **energy management systems**, exploring **flexibility solutions**, and delving into **real-time**, **decomposition** and **artificial intelligence** methodologies for optimization.

#### POLYTECHNIC UNIVERSITY OF CATALONIA - SPAIN

2018 - 2020

*Master's Degree – Energy Engineering*

- This program delved into various facets of energy, including **resources**, **production technologies**, **transport**, and **distribution**. Moreover, I gained insights into the **environmental impact** of energy systems, strategies for **efficiency**, **conservation**, and **rational utilization**.
- I honed the ability to **analyze case studies** and effectively **manage projects** spanning the **generation**, **transformation**, **distribution**, and **consumption** of different energy types.
- Noteworthy, I acquired knowledge on **voltage source converters** design, **power quality** analysis, **electrical market optimization** and **life cycle assessments**. Tools employed in these tasks include **Matlab/Simulink**, **GAMS**, and **Gabi**.

#### PONTIFICAL CATHOLIC UNIVERSITY OF CHILE

2016

*Postgraduate Degree in Sustainable Energies*

- This six-month program delved into **advanced energy generation** and **conversion technologies** that utilize **sustainable resources**, including their **production**, **storage**, and **distribution**, as well as tools for **analyzing** and **evaluating** complex challenges for the **energy transition**.

#### PONTIFICAL CATHOLIC UNIVERSITY OF CHILE

2003 - 2009

*Undergraduate Studies – Civil and Electrical Engineering*

- Served as a **Teaching Assistant** for "Graphic Design in Civil Works" over three consecutive terms during my academic tenure.
- Achieved **distinction** in both the **Bachelor's Examination** and the **Professional Internship**, and ranked within the **top 20% of alumni**.
- Acquired comprehensive expertise in **Power Systems Analysis**, **Electrical Machines**, **Electronics**, **Electrical Markets**, **Operations Management**, and **Project Evaluation** through rigorous coursework.
- Gained proficiency in **C** and **C++** programming languages, along with hands-on experience in **digital systems** and **Assembler** machine code for **microprocessor** programming, thereby deepening my understanding of various levels of computer system abstraction.

## WORK EXPERIENCE

### CITCEA – SPAIN

2021 - Present

*Company Activity: Research on Static Converters and Drives**Position: Researcher*

- Joined the project **H2GLASS Horizon 2020**, where I'm responsible for tasks related to **flexibility provision** using **hydrogen systems** in the glass manufacturing industry.
- **Teaching assistant** in the subject "**Integration of renewable energies into the electrical grid**" in the master of "Smart Energy; Renewable energy and digitalization".
- Currently, I'm actively involved in the development of an **Energy Management System** for Schneider Electric Spain, where I acquired skills in **PLC programming** using **Structured Text**, and bolstered my knowledge of **control theory**.

### NEOELECTRA SA. - SPAIN

2019 - 2021

*Company Activity: Development and Sale of Energy Products**Position: Renewable Energy Analyst*

- Commenced as an intern during my **Master's degree**, where I contributed to the preparation of **technical-commercial proposals** in the newly established **Renewable Energy Department**. Subsequently, I transitioned to a permanent role wherein I assumed responsibility for the development of **pre-feasibility studies** and **conceptual engineering** of photovoltaic and wind power plants.
- During this stay I bolstered my **skills** in **photovoltaic power plants design**, **PVGIS**, **SketchUp**, and **AutoCAD**.

### FREELANCER - REMOTE

2018 - 2022

- During my stay in Spain, I continued to undertake **freelance work** for **Aaktei Energía in Chile**. Primarily, I was required to conduct **economic evaluations** for **financing** purposes and to prepare the **conceptual design of photovoltaic power plants**.

### AAKTEI ENERGÍA SPA. - CHILE

2013 - 2018

*Company Activity: Development and Construction of Energy Generation Projects**Position: Project Engineer*

- As the **Head of the Engineering Department**, I led the development of **engineering studies** for **run-of-river hydroelectric power plants**.
- **Responsible** for formulating **requirements** and **assessing proposals** across all engineering phases of projects, including **pre-feasibility studies**, **conceptual/basic engineering**, **materials procurement contracts**, **detailed engineering**, **earthworks**, **civil construction**, and **electro-mechanical equipment procurement**.
- Coordinated and actively contributed to the **development of electrical transmission line engineering**, the evaluation of construction proposals, and the definition

of contracts.

- Conducted **economic evaluations** for each project under various scenarios to ensure **viability** and secure necessary **financing**.
- Oversaw the process of **obtaining permits** from regulatory authorities, including those for **water usage, construction, electrical concession, and grid connection**.
- Executed **quality assurance** by conducting visits to supply factories to ensure **quality** and adherence to **timelines**, as well as organizing **field trips** for visual inspections, measurements, and interactions with local inhabitants and contractors on-site.
- Developed proficiency in various **skills** including **AutoCAD/Lisp, Microsoft Office/Visual Basic, Microsoft Project, and Google Earth/GIS** through hands-on application in project management and engineering tasks.
- During my tenure at Aaktei, I was happy to **collaborate** with a **diverse group** of individuals with varying backgrounds and personalities. Together, we successfully managed to take projects from inception to construction in **harmony** and with **passion**.

#### **DIMACOFI S.A. - CHILE**

2010 – 2013

*Company Activity: Printers Distribution and Maintenance*

*Position: Product Manager*

- Held responsibility for **high-volume RICOH printing machines** and **Samsung office printers**, encompassing the **communication with the suppliers** along with the design of **sales packages** and **leasing contracts**.
- Led the **development** of a **remote printing app** for mobile devices within the innovation department, enhancing sales potential by introducing this additional feature to our products.
- Leveraged **Microsoft Office** and **Microsoft Access** as the primary tools for executing tasks and managing data.

#### **SPIN LTDA. - CHILE**

2009 - 2010

*Company Activity: Sport Clothing Manufacturing*

*Position: Process Engineer*

- Analyzed existing production processes to later **design, develop, and implement inventory control, order reception, and dispatch processes**, aided by **Excel macros** using **Visual Basic**.
- Implemented a recently acquired **ERP** information system, enabling the generation of reports on inventory status, order completion, and dispatches.

## ARTICLES

- **“Tools for Industry; Flexibility services provision to Aggregators” (work in progress)**  
**Abstract:** Flexibility plays a key role in the energy transition, particularly in the context of integrating distributed energy resources. With the emergence of prosumers, actors who consume and produce energy, and aggregators, actors who group prosumers to provide services as a whole, novel markets for flexibility are rapidly evolving. Understanding the frameworks that govern the trade and the measurement of flexibility is paramount. This paper presents a general overview of current research on flexibility applied to long-term strategic planning and immediate provisioning, particularly in the form of ancillary services for system operators. A synopsis of diverse flexibility services is provided, alongside a projection of future market structures and the procedural workflow associated with flexibility requests. Additionally, we offer practical tools tailored for aggregators to effectively assess the available flexibility within their clusters of prosumer clients. These tools enable informed economic decision making for day-to-day planning and real-time delivery of ancillary services to system operators, thus advancing the integration of distributed energy resources into the energy landscape.
- **“Active and reactive power centralized control for microgrids” (work in progress)**  
**Abstract:** This work presents a detailed technical description and performance analysis of a Power Management System (PMS), focusing on its two main modules; Active Power Controller (APC) and Reactive Power Controller (RPC). The PMS serves as a centralized real-time controller designed to ensure stable and efficient operation of microgrids under various conditions. The document outlines the control algorithms implemented in MATLAB Simulink, including PI structures and anti-windup mechanisms. Two main scenarios are examined: continuous tracking of active power and avoidance of injection to the AC grid. Through simulations, the controller's ability to manage distributed energy resources (DERs), respond to load disturbances, and maintain voltage stability is demonstrated. Results show that the proposed controller effectively balances power generation and consumption, meeting setpoint requirements and operational constraints. Overall, this document provides valuable insights into the functionality and performance of the microgrid controller, showcasing its suitability for real-world microgrid applications.
- **“Distributed optimization in energy communities: a focus on flexibility provision” (Conference Paper. Accepted for publication in CIRED)**  
**Abstract:** The emergence of energy communities (ECs) as new stakeholders in modern electrical grids presents an opportunity to address the challenges associated with integrating distributed energy resources, such as increased uncertainty and variability in generation, transmission grid saturation, or diminished power quality, among others. The ability of an EC to provide flexibility is therefore paramount. However, data privacy and investment costs are the main drawbacks to achieving optimal operation. This paper proposes a distributed optimization framework designed for the economic dispatch (ED) of ECs, employing the auxiliary problem principle (APP) decomposition technique. The primary focus is to study the effects of flexibility provision in real-time control while addressing data privacy concerns and minimizing communication infrastructure investments. The proposed algorithm is tested in a case study, providing insights into the selection of the control parameters of the APP framework to improve the convergence properties.
- **“Optimal Power Flow strategies for energy systems control”(work in progress)**  
**Abstract:** The optimal operation of a power system can be achieved by solving a Mixed-

Integer Nonlinear optimization problem, composed of discrete variables and non-linear functions. In this work we present a Real-Time Energy Management System (RT-EMS) that has been developed to operate a power system close to real-time by solving a relaxed version of the MINLP problem.

- **“A recipe for real-time control of Microgrids” (work in progress)**

**Abstract:** Explores real-time control with optimal power flow (RT-OPF) in microgrid systems, introducing the application of sequential quadratic programming (SQP) as a mathematical tool for addressing complex control challenges in real-time scenarios. The article emphasizes an online feedback optimization approach, advocating for the continuous adaptation of control decisions based on real-time data to ensure optimal microgrid performance under changing conditions. Through a detailed and step-by-step presentation, it provides the formulation of the optimization problem and outlines the algorithm for implementing RT-OPF in microgrids, making it a valuable resource for individuals interested in efficient real-time control strategies for microgrids.

- **“Leveraging Flexibility in Multi-Energy Systems; An Energy Management design”(work in progress)**

**Abstract:** Energy Management Systems (EMSs) utilize industrial flexibility to bolster grid stability and reliability, advancing broader sustainability goals through the seamless integration of renewable energy sources (RES). In Multi-Energy Systems (MES), encompassing electricity, heat, or hydrogen, flexibility is augmented via their adaptable energy provision capabilities, facilitated by multi-generation setups, controllable multi-energy loads, diverse aggregation levels, and participation in various power exchange markets. This work presents a Multi-Energy Management System design based on planning horizon optimization, empowering industries to actively engage in ensuring power system stability.

## SKILLS AND TOOLS

**Programming Languages:** C, C++, C#, Java, Python (NumPy, Pandas, CVXPY, Pyomo, Sphinx, PYQT6), GDScript, Visual Basic, HTML, Assembler, STX, Unix Shell

**Software and Operating Systems:** Matlab, Office, AutoCAD, PVGIS, PyCharm, VS Code, Git, GitHub, Godot, Windows, Linux

**Mathematical Programming:** LP, QP, SOCP, SDP, NLP, MI variants, SQP, ADMM, APP, OCD, C+I, DD

**Languages:** Native Spanish, Proficient English, Basic Catalan, Basic German, Basic Hungarian

**Hobbies:** Swimming, Reading, Animal care, Programming

## REFERENCES

### **Eduardo Prieto Araujo**

*Position: Associate Professor at Polytechnic University of Catalonia*

*Email: eduardo.prieto-araujo@upc.edu*

*Relation: Doctoral Thesis Supervisor*

### **Marcos Piqué**

*Position: Director of Renewable Energy Area at Neoelectra S.A.*

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*Relation: Direct Supervisor*

### **Pedro Matthei**

*Position: CEO at Aaktei Energía SpA.*

*Email: pmatthei@aaktei.com*

*Relation: Direct Supervisor*