

PERSONAL INFORMATION

Born in Colombia, 23 September 1983

email felipe.valencia@sercchile.cl

phone (M) +56 9 7585 7459 · (W) +59 (2) 2978 4203

RESEARCH AREAS

Game theory, optimal control design, large-scale systems modelling and control, microgrids and power systems analysis.

WORK EXPERIENCE

2013–Present Postdoctoral fellow, SOLAR ENERGY RESEARCH CENTER, SERC-CHILE

SERC-Chile

Research on Solar Energy Coordination Systems for Urban and Rural Communities, focused on the integration of distributed solar energy for local energy solutions. Aiming to develop cost-effective “smart” power microgrids based on solar energy that add intelligent coordination capabilities to microgrids, including all available solar resources.

Reference: Rodrigo Palma · +59 (2) 2978 4203 · rodpama@cec.uchile.cl

2010–2013 Part-time professor, UNIVERSIDAD NACIONAL DE COLOMBIA — Medellín

UNAL-MED

Lecturer of the undergrad courses: Model predictive control, Digital electronics (lab practices)

Reference: Jairo Espinosa +57 (4) 425 5295 · jjespino@unal.edu.co

2012–2013 Part-time professor, UNIVERSIDAD NACIONAL DE COLOMBIA — Manizales

UNAL-MAN

Lecturer of the grad courses: Optimization for systems and control, Electric power systems modeling, stability, and control.

Reference: Ernesto Pérez +57 (4) 425 5295 · eperezg@unal.edu.co

EDUCATION

2009–2012 Universidad Nacional de Colombia, Medellín

Doctorate of Engineering–Energetic Systems

Summa Cum Laude · School: Process and Energy

Thesis: *Game theory based distributed model predictive control: An approach to large scale systems control.*

Description: This thesis explored the idea that distributed model predictive control defines a set of controllers whose behaviour can be analysed as a bargaining game.

Advisor: Prof. Jairo Espinosa

2007–2009 Universidad Nacional de Colombia, Manizales

Masters of Engineering–Industrial Automation

School: Faculty of Engineering and Architecture

Thesis: *Effect of the dynamic load behaviour in the voltage stability*

Description: This thesis explored the idea that the dynamic load behaviour is a mechanism for instability in power systems. With this insight a voltage collapse indicator was proposed.

Advisors: Prof. Rosa E. Correa & Prof. Juan M. Ramírez

PUBLICATIONS

April 2009 Decentralized non-linear control for improving
the electromechanical transient behaviour of multi-machine
power systems

Electric Power
Components &
Systems

A Hamiltonian multi-machine formulation is utilized for designing
non-linear controllers with the purpose of helping to alleviate the
electromechanical transient behaviour after large disturbances. The
controllers' design is based on a tracking problem, where the excitation
voltage and the mechanical torque are employed as inputs.
Authors: Juan M. Ramirez, Rosa E. Correa, Felipe Valencia.

August 2010 Transient stability improvement by non-linear
controllers based on tracking

Electrical Power
and Energy
Systems

This paper deals with the control problem in multi-machine electric power
systems. These systems are subjected to different perturbations. Then, the
utilization of controllers which guarantee good performance under those
perturbations is required in order to provide electrical energy to the loads
with admissible stability margins. The proposed controllers are based on a
systematic strategy, which calculate non-linear controllers for generating units
in a power plant, both for voltage and velocity regulation.
Authors: Juan M. Ramirez, Felipe Valencia, Rosa E. Correa.

March 2011 A comparative analysis of distributed MPC
techniques applied to the HD-MPC four-tank benchmark

Journal of Process
Control

The objective of this paper is to design and implement in a four-tank process
several distributed control algorithms that are under investigation in the
research groups of the authors within the European project HD-MPC. The
tested controllers are centralized and decentralized model predictive
controllers schemes for tracking and several distributed MPC schemes based
on (i) cooperative game theory, (ii) sensitivity-based coordination mechanisms,
(iii) bargaining game theory, and (iv) serial decomposition of the centralized
problem.
Authors: J. M. Maestre, M. A. Ridao, A. Kozma, C. Savorgnan, M. Diehl, M. D.
Doan, A. Sadowska, T. Keviczky, B. De Schutter, H. Scheu, W. Marquardt, F.
Valencia, J. Espinosa.

December
2014 A comparison of distributed MPC schemes on a
hydro power plant benchmark

Optimal Control,
Applications and
Methods

In this paper we analyse and compare five DMPC schemes using a hydro
power plant benchmark. Besides being one of the most important sources of
renewable power, hydro power plants present very interesting control
challenges. The operation of a hydro power valley involves the coordination
of several subsystems over a large geographical area in order to produce the
demanded energy while satisfying constraints on water levels and flows.
Authors: I. Alvarado, D. Limona, D. Muñoz de la Peña, J.M. Maestre, M.A.
Ridao, H. Scheu, W. Marquardt, R.R. Negenborn, B. De Schutter, F. Valencia, J.
Espinosa.

June 2015 Robust Energy Management System Based on Interval-Fuzzy Models

IEEE Transactions
on Control
Systems
Technology

In this paper, a scenario-based robust EMS is proposed. The scenarios are generated by means of fuzzy interval models. These models are used for solar power, wind power, and load forecasting. Since interval fuzzy models provide a range rather than a trajectory, upper and lower boundaries for these variables are obtained. Such boundaries are used to formulate the EMS as a robust optimization problem. In this sense, the solution obtained is robust against any realization of the uncertain variables inside the intervals defined by the fuzzy models. The proposed EMS is tested in the microgrid installed in Huatacondo, a settlement located at the north of Chile.

Authors: F. Valencia, D. Sáez, J. Collado, F. Ávila, A. Marquez, J. Espinosa.

– 2015 Robust Energy Management System for a Microgrid Based on a Fuzzy Prediction Interval Model

IEEE Transactions
on Smart Grids

The aim of this paper is to formulate a robust energy management system for a microgrid that uses model predictive control theory as the mathematical framework. The robust energy management system is formulated using a fuzzy prediction interval model as the prediction model. This model allows us to represent both the non-linear dynamic behaviour and the uncertainty in the available energy from non-conventional energy sources. In particular, the uncertainty in wind-based energy sources can be represented. In this way, upper and lower boundaries for the trajectories of the available energy are obtained. These boundaries are used to derive a robust formulation of the energy management system.

Authors: F. Valencia, J. Collado, D. Sáez, L. Marín.

June 2012 Bargaining game based distributed model predictive control. Chapter of the book: Distributed Model Predictive Control Made Easy

Springer-Verlag
London, Series
Advances in
Industrial Control,
England

In this chapter a bargaining game based DMPC scheme is proposed. This allows to deal with the cooperation issues of the DMPC problem. Additionally, the bargaining game framework allows to formulate solutions where the subsystems do not have to solve more than one optimization at each time step. This also reduces the computational burden of the local optimization problems.

Authors: F. Valencia, J. D. Lopez, J. A. Patiño, J. J. Espinosa.

June 2014 Congestion Management in Motorways and Urban Networks Through a Bargaining Game Based Coordination Mechanism. Chapter of the book: Game Theoretic Analysis of Congestion, Safety and Security

Springer-Verlag
London, Series
Advances in
Industrial
Control, England

In this chapter, game theory based DMPC is developed and tested for control of urban and motorway networks. Distributed strategies decompose the whole traffic network into different sub-networks with local optimal controllers. However, sub-networks are interacting elements of the whole traffic network. Hence, the DMPC traffic problem can be treated as a game where the rules are provided by the physical system, the players are the local optimal controllers, their strategies are the control sequences, and the pay-offs are the local performance indexes

Authors: F. Valencia, J. D. López, A. Núñez, C. Portilla, L. G. Cortes, J. J. Espinosa, B. De Schutter.

- 2012 · Summa Cum Laude mention to the Doctoral Thesis
- 2007 · Honors Degree, Control Engineering undergrad program
- 2008 · Research scholarship: Jóvenes Investigadores e Innovadores Virginia Gutiérrez de Pineda, Departamento Administrativo de Ciencia y Tecnología (Colciencias).
- 2007 · Technological innovation mention by the project: Diseño de un analizador dinámico de fisuras (ADC) entre las uniones entre los polos de los generadores sincrónicos de la central hidroeléctrica Guadalupe IV, Departamento Administrativo de Ciencia y Tecnología (Colciencias).
- 2006 · Technological innovation mention by the project: Diseño y construcción de un medidor de energía en modalidad prepago, Departamento Administrativo de Ciencia y Tecnología (Colciencias).

Conference papers

- 2015 · F. Ávila, C. Cañizares, D. Sáez, F. Valencia. "Load Modelling Using Affine Arithmetic for Demand Side Management". Innovative Smart Grid Technologies Latin America (IEEE/PES ISGT-LA), 5-7 October, Uruguay.
- 2014 · J. Espinosa; M. Arboleda; N. Duque; J. Gomez; W. Amador; N. Ortiz; J. Tobon; E. Perez; F. Valencia; M. Cifuentes; M. Giraldo; S. Salazar. "Hierarchical and Distributed State Estimation for Power Systems: The Colombia Case". 45 CIGRE Session: International Council on Large Electric Systems, 24-29 August, Brazil.
- 2014 · Raúl Morales, Felipe Valencia, Doris Sáez, Matías Lacalle. "Supervisory Fuzzy Predictive Control for a Concentrated Solar Power Plant". In IFAC 2014 19th World Congress of The International Federation of Automatic Control, 24 August - 29 August 2014 Cape Town, South Africa.
- 2014 · Leonel Gutiérrez, Felipe Valencia, Doris Sáez, Alejandro Márquez. "New Fuzzy Model with Second Order Terms for the Design of a Predictive Control Strategy". In 2014 IEEE World Congress on Computational Intelligence, July 6-11, Beijing, China.
- 2013 · Nunez, Alfredo; Ocampo-Martinez, Carlos; De Schutter, Bart; Valencia, Felipe; Lopez, Jose David; Espinosa, Jairo. "A Multiobjective-Based Switching Topology for Hierarchical Model Predictive Control Applied to a Hydro-Power Valley". 3rd IFAC International Conference on Intelligent Control and Automation Science, Sichuan Tennis International Hotel, Chengdu, China.
- 2013 · F. Valencia, J. D. Lopez, J. A. Patiño, and J. J. Espinosa. "Game theory based distributed model predictive control for a hydro-power valley control". In Large Scale Complex Systems: Theory and Applications, 13th IFAC Symposium on.
- 2012 · M. Giraldo, F. Valencia, J. D. Lopez, J. J. Espinosa. "Actuator delay compensation by variable structure moving horizon estimator". OPTEC workshop on Moving Horizon Estimation and system identification, Leuven, Belgium.
- 2012 · C. Portilla, F. Valencia, J. D. Lopez, J. J. Espinosa, A. Nuez, B. De Schutter. "Non-Linear Model Predictive Control Based on Game Theory for Traffic Control on Highways", IFAC Conference on Nonlinear Model Predictive Control, Noorwijkerhout, The Netherlands.
- 2012 · J. D. Lopez, F. Valencia, J. J. Espinosa "Análisis del efecto de parámetros informativos en la reconstrucción de imágenes cerebrales con MEG/EEG", Memorias del VI seminario de ingeniería Biomédica, Colombia.
- 2011 · J. D. Lopez, F. Valencia, J. J. Espinosa "EEG brain imaging based on Kalman filtering and subspace identification", IEEE Second Latin American Symposium on Circuits and Systems (LASCAS), Bogotá, Colombia.

- 2011 · F. Valencia, L. D. Lopez, A. Marquez, J. J. Espinosa "Moving horizon estimator for measurement delay compensation in model predictive control schemes", 50th IEEE Conference on Decision and Control and European Control Conference (CDC-ECC), Orlando, Florida.
- 2011 · F. Valencia, K. Stankova, J. J. Espinosa, B. De Schutter "Feasible-Cooperation Distributed Model Predictive Control Scheme Based on Game Theory", Proceedings of the 18th IFAC World Congress, Milan, Italy, pp. 386391, Aug.Sept.
- 2010 · J. M. Ramirez, R. E. Correa, F. Valencia "Robust Power System Controllers based on Differential Geometric Tools", IEEE 2010 Proceedings of the International Symposium of Modern Electric Power Systems, Poland.
- 2008 · F. Valencia, R. E. Correa, J. J. Espinosa, "Modelo Dinámico de Carga con Parámetros Adaptables en un Sistema Eléctrico de Potencia para Análisis de Estabilidad, XIII Congreso Latinoamericano de Control Automático y VI Congreso Venezolano de Automatización y Control, Venezuela.
- 2007 · R. E. Correa, H. A. Botero, F. Valencia "Análisis de estabilidad de Voltaje con base en un modelo periódico del generador sincrónico, VIII Congreso de la asociación Colombiana de Automática (ACA), Pontificia Universidad Javeriana, Colombia.
- 2007 · F. Valencia, R. E. Correa, A. Vélez. "Diagnóstico de Fallas con Base en Modelos", ALTAE 2007, Mexico.
- 2007 · F. Valencia, R. E. Correa, A. Vélez, H. D. Escobar "Detección de Fallas Utilizando Inyección de señales", ALTAE 2007, Mexico.

Research Projects

- 2015–Now · Energía Solar para el Desarrollo Sustentable de la Región de Arica y Parinacota. Project supported by BHP Billiton Foundation. Researcher. Research area: Microgrids and technological solutions based on solar energy.
- 2013–2015 · Solar Energy Research Center, SERC-Chile. Project supported by the Fourth National Competition for Research Centers of Excellence in Priority Areas 2011. Postdoctoral fellow. Research area: Solar Energy Coordination Systems for Urban and Rural Communities, focused on the integration of distributed solar energy for local energy solutions.
- 2014–2015 · Microgrid Emulator for the Design and Validation of Novel Control Strategies. Project founded by the FONDEQUIP program of Comisión Nacional de Investigación Científica y Tecnológica, CONICYT, Chile, grant number EQM130058. Researcher. Research area: Microgrids design and control.
- 2009–2011 · Hierarchical and Distributed Model Predictive Control for Large-Scale Systems (HD-MPC). Project belonging to the Seventh Framework Program of the European Union. Doctorate researcher. Research area: Distributed model predictive control
- 2009 · Control Jerárquico para Optimizar los Recursos de Control de Voltaje en el Ámbito del Área Oriental del Sistema Interconectado Mejicano. Proyecto financiado por el Consejo Nacional de Ciencia y Tecnología de México, a través de un proyecto sectorial auspiciado por Comisión Federal de Electricidad. Invited researcher. Research area: Power systems modeling and control.
- 2006 · Diseño y construcción de un medidor de energía en modalidad prepago. Researcher. Project funded by Empresas Públicas de Medellín. Research area: Electronics and control.
- 2004–2007 · Diseño de un analizador dinámico de fisuras (ADC) entre las uniones entre los polos de los generadores sincrónicos de la central hidroeléctrica Guadalupe IV. Researcher. Research area: Power systems modeling and control; System identification.

2014 · Waterloo Institute for Sustainable Energy, University of Waterloo, Waterloo, Canada, September–December. Research stay on topics related with the design of an optimal secondary control strategy for microgrids. This work was lead by Professor Dr. Claudio Cañizares, and founded by the cooperation project Control and Management of Energy Storage Systems for Traction and Distributed Generation, grant number REDES130029.

2010 · Delft Center of Systems and Control, Delft University of Technology, Delft, The Netherlands, March–September. Research stay on topics related with the analysis of distributed model predictive control as a bargaining game. This work was lead by Profesor Dr. Ir. Bart De Schutter and founded by the project Hierarchical and Distributed Model Predictive Control for Large-Scale Systems.

2009 · Centro de Investigación y Estudios Avanzados del Instituto Politécnico Nacional, CINVESTAV-IPN, Unidad Guadalajara, Mexico, January–March. Research stay on topics related with coordinated secondary voltage regulation in power systems. This work was lead by Professor Dr. Juan Manuel Ramírez Arredondo and founded by the project Control Jerárquico para Optimizar los Recursos de Control de Voltaje en el Ámbito del Área Oriental del Sistema Interconectado Mejicano.

2008 · Centro de Investigación y Estudios Avanzados del Instituto Politécnico Nacional, CINVESTAV-IPN, Unidad Guadalajara, Mexico, September. Research stay on topics related with the analysis of the effect of the dynamic voltage behavior in voltage stability. This work was lead by Professor Dr. Juan Manuel Ramírez Arredondo and founded by Universidad Nacional de Colombia.

*Advised/Co-
advised
Theses*

2015 · Leonel Guitierrez Álvarez, "A novel procedure for the parameter identification in fuzzy systems with assured controllability", Master thesis, University of Chile, Santiago.

2014 · Oscar Núñez, "Metodología pra el monitoreo de microrredes por medio de indicadores de resiliencia". Mater thesis, University of Chile.

2014 · Christian Roviro Portilla, "Modelo Multimodal de Tráfico Urbano con Fines de Control", Master thesis, Universidad Nacional de Colombia, Medellín.

2014 · Luis Gabriel Cortés, "Coordinación de Semáforos Unimodales y Multimodales en Redes de Transporte Urbano", Master thesis, Universidad Nacional de Colombia, Medellín.

2013 · Jorge Collado. "Diseño de estrategias de control predictivo robusto basado en intervalos difusos para la operación de microrredes". Undergrad thesis, University of Chile

2013 · Raúl Morales. "Diseño de una estrategia de control predictivo supervisor para centrales solares termoeléctricas de colectores cilindro-parabólicos". Undergrad thesis, University of Chile.

2012 · Esteban Bedoya, Andrés Felipe Rodríguez Restrepo, "Control predictivo basado en Modelo reducido para la regulación de la velocidad de las unidades de generación en un valle de Generación de energía eléctrica", Undergrad thesis, Universidad Nacional de Colombia, Medellín.

2012 · Milton David Bedoya Pulgarín, "Control Predictivo Aplicado a Sistemas de Conversión de Energía Eléctrica a Partir de la Generación Mediante el Uso de Fuentes Renovables de Energía", Undergrad thesis, Universidad Nacional de Colombia, Medellín.

2012 · Jorge Andrés Barrientos Gil, "Estimador de Estados Distribuido con Aplicacin en Sistemas de Potencia", Undergrad thesis, Universidad Nacional de Colombia, Medellín.

2011 · Christian Roviro Portilla, "Control Predictivo No-Lineal Basado en Teoría de Juegos para el Control de Tráfico en Autopistas", Undergrad thesis, Universidad Nacional de Colombia, Medellín.

Ongoing · Edwin Herlyt Lopera Mazo, "Metodología para mejorar el desempeño del lazo de control secundario de voltaje en sistemas de potencia: una aproximación usando esquemas de control jerárquico y distribuido", Doctorate thesis, Universidad Nacional de Colombia, Medellín.

Ongoing · Leonel Guitierrez Álvarez, "A novel procedure for the parameter identification in fuzzy systems with assured controllability", Master thesis, University of Chile, Santiago.

Ongoing · Julián Patiño, "Frequency control in power systems with high penetration of non-conventional energy resources", Doctorate thesis, Universidad Nacional de Colombia, Medellín.

Ongoing · Oscar Núñez, "Model-based protection schemes for PV-based isolated microgrids", Doctorate thesis, University of Chile, Santiago.

Languages

SPANISH · Mothertongue

ENGLISH · Intermediate (conversationally fluent)

JAPANESE · Basic (simple words and phrases only)

Interests

Piano · Music · Trekking · Literature

July 22, 2015