Dr Pau Herrero Viñas

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AN OVERVIEW

My research activity over the last 5 years has been mainly centered on the development of a technological **Artificial Pancreas** and on implementation and **clinical validation** of **eHealth applications** for **diabetes management**. However, I also have a strong theoretical and practical background on **interval mathematics** and its application to **control engineering**, which is the topic of my PhD thesis.

My **multidisciplinary background** as industrial engineer, and my extensive experience on working at different **international universities, research centers, hospitals and industry**, has given me the abilities to lead research projects of different natures involving people from different backgrounds and transferring the results to the industry. With such a career background, I consider myself a strong candidate to contribute to **improving the research activities in Catalunya**, especially in these areas where, as stated by Times Higher Education World University Ranking, it is more needed (i.e. technology transfer, industry income and international outlook).

Next is an overview of my career background over the past years:

2000-2001. From Industrial Engineering to R+D on Artificial Intelligence at the Industry: Just after finishing my bachelor degree in Industrial Engineering at the Universitat de Girona, I spent 10 month doing a traineeship at the department of Artificial Intelligence at Thales Airborne Systems (Elancourt, France). The result of this stay was the implementation of an interval constraint satisfaction software (Interlog) for processing noisy signals coming from airplane radars.

2001-2006. From Research Assistant in a European Project to a PhD degree in Control Engineering: Just after my stay at at Thales Airborne Systems, I started working as a research assistant at Universitat de Girona for the European project 'CHEM: Advanced Decision Support for Petrochemical Manufacturing Processes'. My contribution to the project consisted of the implementation of robust fault detection software (Squaltrack) and its validation on different industrial chemical and petrochemical plants.
In the same period, I started a co-supervised PhD thesis at Universitat de Girona and Université d'Angers (France). During my PhD, I developed a novel technique for solving quantified constraint satisfaction problems (QSI algorithm), and I applied it to the resolution of different advanced robust control engineering problems. Another important achievement during my PhD was to facilitate the use of a novel mathematical theory (Modal Interval Analysis), developed in joint collaboration between Universitat de Girona and Universitat de Barcelona, by doing a practical implementation (f*

algorithm) of such a theory.

2006-2010. From Artificial Pancreas to Clinical Research: After finishing my PhD thesis, I did a postdoctoral stay at Doyle's Group (University of California Santa Barbara and Sansum Diabetes Research Institute), a word-leading team in the research for an artificial pancreas (AP) and member of the Artificial Pancreas consortium funded by the JDRF foundation. My contribution during this stay consisted of combining a model predictive controller with a meal detection algorithm and a meal model library by using a novel technique developed by myself.
After finishing my stay at Doyle's Group, I spent the following two years working as a research fellow at the Endocrinology Service at Hospital de Sant Pau (CIBER-BBN network), a pioneer clinical research group on diabetes technology. During this period, I was the technology coordinator of two eHealth projects, one for the prevention of type 2 diabetes (Predircam, CIBER-BBN) and another one, which application was written by myself, for the management of Type 1 diabetes (iDosing, FIS project).

2010-2012. Bio-Inspired Artificial Pancreas and Decision Support Systems: I am currently working as a research fellow at the Institute of Biomedical Engineering, Imperial College London (IBE-IC), a top class research center, which coordinates multi-disciplinary research applying new technologies (e.g. bionics, informatics, nanotechnology) to the fast growing medical devices industry. My task at the IBE-IC is to coordinate the control engineering developments of the Bio-Inspired Artificial Pancreas project, funded by the Wellcome Trust, the aim of which is to transfer this technology to initial trials and ultimately to a commercially available system. I am also coordinating two projects which aim is to apply artificial intelligence techniques to implement a mobile decision support system for diabetes management, which application was written by myself, and another one for antibiotic prescription in the intensive care unit.

I am co-author of 11 articles in peer-reviewed journal (2 under review) and 19 communications in international conferences. I am also involved in the process of patenting the Bio-Inspired Artificial Pancreas. I have co-supervised 2 master thesis and I am currently co-supervising a PhD thesis, supervising 2 master thesis and a bachelor thesis.

Next is a more detailed description of my career background and main achievements.

ACADEMIC BACKGROUND

Degree	Centre	Supervisor	Date
Bachelor in Industrial Engineering	Universitat de Girona	Dr Ningsu Luo (bachelor thesis)	09/2000
PhD in Information Technologies	Universitat de Girona	Dr Josep Vehí	12/2006
PhD in Automatique et Informatique Appliquée	Université d'Angers	Dr Luc Jaulin	12/2006

PAST SCIENTIFIC EXPERIENCE

Position	R&D Centre	Institution	Start date	End date

Research Assistant	Artificial Intelligence Service	Thales Airborne Systems (France)	10/2000	06/2001
Research Assistant	Micelab Research Group	Universitat de Girona	07/2001	31/2003
PhD Student	Micelab Research Group	Universitat de Girona	01/2003	12/2006
Postdoctoral Fellow	Doyle's Research Group	University of California Santa Barbara	01/2007	12/2007
Research Fellow	EDUAB Research Group	Hospital de Sant Pau - CIBER-BBN	12/2007	01/2010
Research Fellow	Center for Bio-Inspired Technologies	Imperial College London	02/2010	Today

LANGUAGES

Language	Speaking	Reading	Reading
Catalan	Native	Native	Native
Spanish	Native	Native	Native
English	Fluently	Good	Good
French	Fluently	Good	Good

PARTICIPATION IN RESEARCH PROJECTS

PROJECT TITLE	**CHEM: Advanced Decision Support for Chemical and Petrochemical Manufacturing Processes**
ROLE	Research Assistant
FINANCIAL ENTITY	Growth Programme (European Commission)
LENGHT	From 01/2001 to 12/2004
PRINCIPAL INVESTIGATOR	Dr Josep Lluís de la Rosa Esteva

PROJECT TITLE	**Automatización de la detección y la diagnosis de sistemas estáticos y dinámicos usando conocimiento semicualitativo (SQ Diagnosis)**
ROLE	Research Assistant
FINANCIAL ENTITY	Ministerio de Ciencia y Tecnología
LENGHT	From 12/2003 to 11/2006
PRINCIPAL INVESTIGATOR	Dr Joaquim Armengol Llobet

PROJECT TITLE	**PREDIRCAM: Plataforma Inteligente para la Monitorización, Tratamiento y PREvención**

	Personalizados de la DIabetes Mellitus y el Riesgo CArdioMetabólico
ROLE	Technology Coordinator
FINANCIAL ENTITY	CIBER-BBN, Instituto de Salud Carlos III
LENGHT	From 09/2007 to 09/2009
PRINCIPAL INVESTIGATOR	Prof Alberto de Leiva Hidalgo

PROJECT TITLE	**iDOSING: Sistema De Ayuda A La Dosificación Óptima De Insulina Para Pacientes Diabéticos Basado En Técnicas De Control Por Aprendizaje Iterativo E Integrado En Una Plataforma De Telemedicina**
ROLE	Co-Investigator
FINANCIAL ENTITY	Ministerio de Ciencia e Innovación – Fondos de Investigación Sanitaria (FIS)
LENGHT	From 10/2008 to 10/2011
PRINCIPAL INVESTIGATOR	Dr Ana Chico

PROJECT TITLE	**The Bio-inspired Artificial Pancreas**
ROLE	Control engineering expert and clinical trials coordinator
FINANCIAL ENTITY	Wellcome Trust
LENGHT	From 09/2009 to 06/2013
PRINCIPAL INVESTIGATOR	Prof Christofer Tomazou

PROJECT TITLE	**Smart-phone platform for optimal insulin dosing in diabetic subjects**
ROLE	Co-Investigator
FINANCIAL ENTITY	British Research Council
LENGHT	From 11/2010 to 05/2013
PRINCIPAL INVESTIGATOR	Dr Pantelis Georgiou

PROJECT TITLE	**ENhanced antibiotic prescribing through a CBR-based Imperial Antibiotic Prescribing Policy smartphone application (ENIAPP)**
ROLE	Co-Investigator
FINANCIAL ENTITY	Imperial College London
LENGHT	From 04/2012 to 04/2013
PRINCIPAL INVESTIGATOR	Dr Pantelis Georgiou and Dr Alison H. Holmes

STAYS IN INTERNATIONALLY RECOGNIZED CENTRES

CENTRE: Thales Airborne Systems (Artificial Intelligence Department)			
PLACE: Paris	**COUNTRY:**	**YEAR:** 2001	**LENGHT:** 10 month

	France		
POSITION: Internship		**FUNDING:** European Commission (Leonardo Da Vinci programme)	
TOPIC: Implement an interval constraint satisfaction solver in Prolog (Interlog) for processing noisy data coming from airplane radars.			

CENTRE: ISTIA, École d'Ingénieurs de l'Université d'Angers en Génie des Systèmes Industriels			
PLACE: Angers	**COUNTRY:** France	**YEAR:** 2005	**LENGHT:** 3 months
POSITION: PhD student		**FUNDING:** Ministerio de Ciencia e Innovación (FPI grant)	
TOPIC: Development of techniques for the resolution of quantified real constraint problems based on Modal Interval Analysis and finding new applications to control engineering.			

CENTRE: ENSIETA: École Nationale Supérieure des Ingénieurs des Études et Techniques d'Armement			
PLACE: Brest	**COUNTRY:** France	**YEAR:** 2006	**LENGHT:** 3 months
POSITION: PhD student		**FUNDING:** Ministerio de Ciencia e Innovación (FPI grant)	
TOPIC: Apply a novel technique for the resolution of quantified real constraint problems (QSI algorithm) developed during my PhD thesis to the control of a sailboat.			

CENTRE: Doyle's Group, University of California Santa Barbara			
PLACE: Santa Barbara	**COUNTRY:** USA	**YEAR:** 2007	**LENGHT:** 12 months
POSITION: Postdoctoral fellow		**FUNDING:** Ministerio de Ciencia e Innovación (FPI grant)	
TOPIC: In the context of a fully automated closed-loop artificial pancreas, to combine a model predictive controller with a meal detection algorithm and a meal model library by using a technique for glucose rate estimation from mixed meals developed by myself.			

CENTRE: Institute of Biomedical Engineering, Imperial College London			
PLACE: London	**COUNTRY:** UK	**YEAR:** 2010-2012	**LENGHT:** 30 months
POSITION: Research fellow		**FUNDING:** Wellcome Trust	
TOPIC: 1. In the context of an artificial pancreas, to develop a novel bio-inspired glucose controller based on the beta-cell physiology and to carry out clinical trials for its validation. 2. To develop a mobile-based decision support system for insulin dosing in type 1 diabetes based on artificial intelligence techniques and to validate it in a clinical setting. 3. To develop a mobile-based decision support system for antibiotic prescribing in the ICU.			

THESIS SUPERVISED

Master Thesis

STUDENT	**Crisostomo Barajas Solano**
TITLE	Identificación Bayesiana De Los Modelos De Absorción De Glucosa Para Comidas Mixtas
UNIVERSITY	Universitat de Girona
YEAR	2009
MARK	8 out of 10

STUDENT	**Wai Kit Yoong**
TITLE	A Bio-Inspired Insulin Bolus
UNIVERSITY	Imperial College London
YEAR	20012
MARK	Under supervision

STUDENT	**Arpan Kumar**
TITLE	A Simulator for In-Silico Testing of Bi-Hormonal Glucose Controllers for Treatment of Type 1 Diabetes
UNIVERSITY	Imperial College London
YEAR	20012
MARK	Under supervision

PhD Thesis

STUDENT	**Peter Pesl**
TITLE	Decision Support System for Insulin Dosing Based On Case-Based Reasoning
UNIVERSITY	Imperial College London
YEAR	2012
MARK	Under supervision

Bachelor Thesis

STUDENT	**Benoît Delaunay**
TITLE	Non-Linear Error-Bounded Parameter Estimation Of Metabolic Models With Applications To Artificial Pancreas
UNIVERSITY	Ensta-Bretagne
YEAR	2012
MARK	Under Supervision

THESIS REVIEWED

Master Thesis

STUDENT	**Yenny Teresa Leal Moncada**
TITLE	Desarrollo de Algoritmos para Estimar la Concentración de Glucosa en Sangre en Pacientes con Diabetes Mellitus Tipo 1 Utilizando la Información de un Monitor Continuo de Glucosa.
UNIVERSITY	Universitat de Girona
YEAR	2008
SUPERVISOR	Dr Winston García Gabín and Dr Josep Vehí Casellas

PhD Thesis

STUDENT	**Maira Alejandra García Jaramillo**
TITLE	Prediction of postprandial blood glucose under intra-patient variability and uncertainty and its use in the design of insulin dosing strategies for type 1 diabetic patients.
UNIVERSITY	Universitat de Girona
YEAR	2011
SUPERVISOR	Dr Josep Veí and Dr Remei Calm

STUDENT	**Julio César Dehesa Valencia**
TITLE	Robust Interval Control For Nonlinear Flat Systems
UNIVERSITY	Universitat Politècnica de València
YEAR	2011
SUPERVISOR	Dr Jesus Picó i Marco

STUDENT	**Fátima Barceló Rico**
TITLE	Multimodel Approaches for Plasma Glucose Estimation in Continuous Glucose Monitoring Development of New Calibration Algorithms
UNIVERSITY	Universitat Politècnica de València
YEAR	2012
SUPERVISOR	Dr José Luis Díez Ruano and Dr Jorge Bondia Company

PATENTS

- The bio-inspired glucose controller presented in reference 9 has been patented.

PUBLICATIONS IN JOURNALS

1. J. Armengol, J. Vehí, M. A. Sainz and **P. Herrero**. Detección de fallos en procesos reales basada en modelos intervalares y múltiples ventanas temporales deslizantes. Computación y Systemas. 6(2) 094--102. 2002.
   Impact Factor: NA

2. **P. Herrero**, M. A. Sainz, J. Vehí and L. Jaulin. Quantified Set Inversion Algorithm With Application To Control. Reliable Computing. 11(5)369 - 382. 2005
   Impact Factor: 0.68

3. M. A. Sainz, **P. Herrero**, J. Vehí, J. Armengol. Continuous Minimax Optimization Using Modal Intervals. Journal of Computational and Applied Mathematics. 339(1)18--30. 2007.

Impact Factor: 1.3561

4. J. Armengol, J. Vehí, M.A. Sainz, **P. Herrero**, E.R. Celso. SQualTrack: A Tool for Robust Fault Detection. IEEE Transactions On Systems, Man, And Cybernetics—Part B: Cybernetics. 39(2)475-488. 2008.
   Impact Factor: 2.03

5. J. Wan, J. Vehí, N. Luo, and **P. Herrero**. Control of constrained nonlinear uncertain discrete-time systems via robust controllable sets: a modal interval analysis approach. ESAIM: Control, Optimisation and Calculus of Variations. 2009. 15:189-204.
   Impact Factor: 1.221

6. **P. Herrero**, L. Jaulin, J. Vehí, and M.A. Sainz. Guaranteed Set-point Computation with Application to the Control of a Sailboat. International Journal of Control, Automation and Systems. 8(1). 2010.
   Impact Factor: 0.77

7. J. Bondia, J. Vehí , C.C. Palerm , **P. Herrero**. El páncreas Artificial: Control Automático de Infusión de Insulina en Diabetes Mellitus Tipo 1. RIAI: Revista Iberoamericana de Automática e Informática Industrial. 7(2). 2010.
   Impact Factor: 0.25

8. **P. Herrero**, J. Bondia , C.C. Palerm, J. Vehí, P. Georgiou, N. Oliver, C. Toumazou. A simple robust method for estimating the glucose rate of appearance from mixed meals. Journal of Diabetes Science and Technology. (2011) Volume 1; Issue 6(1):153-62.
   Impact Factor: To appear

9. **P. Herrero**, P. Georgiou, N. Oliver, D. G. Johnston and C. Toumazou. A Bio-Inspired Glucose Controller Based on Pancreatic ß-Cell Physiology. Journal of Diabetes Science and Technology. Volume 6, Issue 3 (2012)
   Impact Factor: To appear

10. **P. Herrero**, R. Calm, J. Vehí, J. Armengol, P. Georgiou, N. Oliver, C. Tomazou
    Robust Fault Detection System For Insulin Pump Therapy using Continuous Glucose Monitoring. Journal of Diabetes Science and Technology. 2012. 1;6(5):1131-41.
    Impact Factor: To appear

11. **Herrero P,** Delaunay B, Jaulin L, et al., 2012, An Efficient Implementation of the SIVIA Algorithm in a High-Level Numerical Programming Language, Reliable Computing, Pages:239-251

12. **Herrero P,** Calm R, Vehi J, et al., 2012, Robust Fault Detection System For Insulin Pump Therapy using Continuous Glucose Monitoring, Journal of Diabetes Science and Technology, Vol:6, Pages:1131-1141

PRESENTATIONS IN CONGRESSES

12. J. Armengol, J. Vehí, M. A. Sainz and **P. Herrero**. Fault detection in a pilot plant

using interval models and multiple sliding time windows. 5th IFAC Symposium on Fault Detection, Supervision and Safety for Technical Processes (SAFEPROCESS). 2003. Washington, D.C., U.S.A.

13. **P. Herrero**, M. A. Sainz, J. Vehí and L. Jaulin. Quantified set inversion with applications to control. IEEE Conference on Control Applications International Symposium on Intelligent Control Computer Aided Control Systems Design (CCA/ISIC/CACSD). 2004. Taipei, Taiwan.

14. M. A. Sainz, **P. Herrero** and J. Vehí. Solving problems on minmax optimization. Workshop on State-of-the-Art in Scientific Computing (PARA'04). 2004. Lyngby, Copenhagen, Denmark.

15. **P. Herrero**, M. A. Sainz, J. Vehí and L. Jaulin. Quantified Set Inversion Algorithm. International workshop on Interval Mathematics and Constraint Propagation methods (IMCP'04). 2004. Novosibirsk, Russia

16. **P. Herrero**, L. Jaulin, J. Vehí, M.A. Sainz. Inner and outer approximation of the polar diagram of a sailboat. Interval analysis, constraint propagation and applications (IntCP05). 2005 Sitges, Spain.

17. J. Flórez, **P. Herrero**, M. A. Sainz and J. Vehí. Visualization of Implicit Surfaces using Quantified Set Inversion. Interval Analysis and Constraint Propagation, Applications (IntCP05). 2005. Sitges, Catalonia, Spain.

18. G. Calderon-Espinoza; J. Armengol; M. A. Sainz; **P. Herrero**. Combining interval and qualitative reasoning for fault diagnosis. 16th IFAC World Congress, 2005 , Volume 16 | Part 1, Czech Republic.

19. R. Calm, Miguel A. Sainz, **P. Herrero**, J. Vehí and J. Armengol. Parameter Identification with Quantifiers. Robust Control Design (ROCOND06). 2006. Toulouse, France

20. **P. Herrero**, E. Dassau, C.C. Palerm, H. Zisser, L. Jovanovic, C. Dalla Man, C. Cobelli, Vehí J and F.J. Doyle III. Gucose Absorption Model Library for Mixed Meals. 27th Workshop, AIDPIT Study Group, 2nd European Diabetes Technology and Transplantation meeting. 2008. Igls, Austria.

21. E. Dassau, **P. Herrero**, H. Zisser, BA. Buckingham, L. Jovanovic, C. Dalla Man, C. Cobelli, J. Vehí and F.J. Doyle III. Implications of a Meal Library & Meal Detection to Glycemic Control of Type 1 Diabetes Mellitus through MPC Control. IFAC World Congress 2008. Seoul, Korea.

22. **P. Herrero**, J. Vehí, R. Corcoy, A. Chico, B. Pons and A. de Leiva. Model Based Fault Detection in the Artificial Beta-Cell Framework. Eight Annual Meeting, Diabetes Technology Society. 2008. Bethesda, USA.

23. **P. Herrero**, M.E. Hernando, L. Roa, E. Gómez and A. de Leiva. PREDIRCAM: Technological Platform for the prevention of Diabetes Mellitus and cardioMetabolic Risk. 2nd Conference on Advanced Technologies & Treatments for Diabetes. 2009. Athens, Greece.

24. **P. Herrero**, E. Hernando, R. Garrigos, G. Garcia-Saez, J-M Cubero, I. Martinez-

Sarriegui, R. Corcoy, E. Rubinat, E. Gomez, A. de Leiva. Feasibility Study of a Technological Platform for the Prevention of Diabetes Mellitus and Cardio Metabolic Risk. Ninth Annual Meeting, Diabetes Technology Society. 2009. San Francisco, USA.

25. **P. Herrero**, P. Georgiou, N. Oliver, M. El Sharkawy, P. Pesl; D. Johnston, C. Toumazou. A Novel Bio-Inspired Glucose Controller. Tenth Annual Meeting, Diabetes Technology Society. 2010. Bethesda, USA.

26. **P. Herrero**, J. Bondia, C. C. Palerm, J. Vehí, P. Georgiou, N. Oliver, C. Toumazou. A Simple Method for Estimating the Rate of Glucose Appearance from Mixed Meals. Tenth Annual Meeting, Diabetes Technology Society. 2010. Bethesda, USA.

27. **P. Herrero**, P. Georgiou, N. Oliver, M. El Sharkawy, Peter Pesl; D. Johnston, C. Toumazou. A Glucagon-Extended Minimal Model for In-Silico Testing of Glucose Controllers. 4th Conference on Advanced Technologies & Treatments for Diabetes. 2011. London, UK.

28. **P. Herrero**, P. Georgiou, N. Oliver, M. El Sharkawy, Peter Pesl; D. Johnston, C. Toumazou. *In-Silico* Validation of a Bio-Inspired Glucose Controller. 10th Annual Meeting, Diabetes Technology Society. 2011. San Francisco, USA.

29. **P. Herrero**, P. Georgiou, N. Oliver, M. El Sharkawy, Peter Pesl; A. Chico, C. Toumazou. An Insulin Bolus Calculator based on Case-Based Reasoning. 10th Annual Meeting, Diabetes Technology Society. 2011. San Francisco, USA.

30. I. Pagkalos, **P. Herrero**; M. El-Sharkawy; P.Pesl, N.Oliver and P. Georgiou. VHDL implementation of the Biostator II glucose control algorithm for critical care. Biomedical Circuits and Systems Conference (BioCAS), 2011 IEEE. San Diego, CA, USA.

31. **P. Herrero**, P. Georgiou, N. Oliver, M. El Sharkawy, Peter Pesl; D. Johnston, C. Toumazou. Simulation Environment For Bihormonal Glucose ControllerTesting, Incorporating Intra-Day Variability And A Meal Library. 5th Conference on Advanced Technologies & Treatments for Diabetes. 2012. Barcelona, Catalonia, Spain.

INVITED SEMINARS

- I was invited by the Associació Catalana de Diabètics de Catalunya (Comarques Gironines) to give a seminar about artificial pancreas entitled 'El Pàncrees Artificial: Realitat o Ficció Molt Llunyana?' (October 2008).

- I was invited to give a talk at the 'Workshop on Insulinopenia and Optimizing Insulin Availability' (Hospital de Sant Pau, Barcelona, Spain) on 'Decision Support Tools for Optimal Insulin Dosing' (May 2008).

- I was teacher at the European Nurses Diabetes Collaborative University Project course (ENDCUP 2009) held in Hospital de Sant Pau (Barcelona, Spain).