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Nationality: French
Date of birth: December 8th, 1982

Curriculum Vitae

Last update: February 2016.

Academic experiences

- 2012 - Researcher (Starting Research Position) at Inria Sophia-Antipolis (Biocore team), France.
- 2010 - 2012 Post-doctorate at AM2V (Analysis & Mathematical Modeling Valparaíso), Departamento de Matemática, Universidad Técnica Federico Santa María, Valparaíso, Chile with Pedro Gajardo.
- 2008 - 2010 Post-doctorate at INRIA (the French national institute for research in computer science and control) of Sophia-Antipolis, COMORE research group (Modelling and control of renewable resources) with Olivier Bernard.
- 2005 - 2008 Ph.D., Université de Technologie de Compiègne (UTC), France
Title: Modelling and control of hairy root culture.
Advisors: K. Shakourzadeh (UTC) and M. Boitel-Conti (UPJV)
- 2004 - 2005 Master “Industrial and Urban Environment”, INSA de Lyon, France
- 2000 - 2005 Engineering degree, INSA de Lyon, France. Specialized in energy and environmental engineering

Main Research interests

Modelling, control and optimization of biological systems. Applications to hairy root, microalgae, anaerobic digestion...

Publications

Most of my recent publications are available as preprints on: hal.inria.fr

- Journal articles in biotechnology/bioprocesses:

- J1. Giordano N, Mairet F, Gouze J-L, Geiselmann J, de Jong H. (2016) **Dynamical Allocation of Cellular Resources as an Optimal Control Problem: Novel Insights into Microbial Growth Strategies**. PLOS Computational Biology. To appear.
- J2. Jimenez J *et al.* (2015) **Instrumentation and control of anaerobic digestion processes: A review and some research challenges**. Reviews in Environmental Science and Bio/technology 14:615-648.
- J3. Muñoz-Tamayo R, Martinon P, Bougaran G, Mairet F, Bernard O. (2014) **Getting the most out of it: optimal experiments for parameter estimation of microalgae growth models**. Journal of Process Control 24:991–1001.
- J4. Mairet F, Moisan M, Bernard O. (2014) **Estimation of neutral lipid and carbohydrate quotas in microalgae using adaptive interval observers**. Bioprocess and Biosystems Engineering. 37(1):51-61.

- J5. Muñoz-Tamayo R, Mairet F, Bernard O. (2013) **Optimizing microalgal production in raceway systems**. *Biotechnology Progress* 29:543-552.
- J6. Bayen T, Mairet F. (2013) **Minimal time control of fed-batch bioreactor with product inhibition**. *Bioprocess and Biosystems Engineering* 36(10):1485-1496.
- J7. Mairet F, Bernard O, Cameron E, Ras M, Lardon L, Steyer JP, Chachuat B. (2012) **Three-reaction model for the anaerobic digestion of microalgae**. *Biotechnology & Bioengineering* 109: 415-425.
- J8. Donoso-Bravo A, Mairet F. (2012) **Determining the limiting reaction in anaerobic digestion processes. How has this been tackled?** *Journal of Chemical Technology & Biotechnology* 87:1375-1378.
- J9. Mairet F, Bernard O, Masci P, Lacour T, Sciandra A. (2011) **Modelling neutral lipid production by the microalga *Isochrysis aff galbana* under nitrogen limitation**. *Bioresource Technology* 102:142-149.
- J10. Mairet F, Bernard O, Ras M, Lardon L, Steyer J-P. (2011) **Modeling anaerobic digestion of microalgae using ADM1**. *Bioresource Technology* 102: 6823-6829.
- J11. Mairet F, Villon P, Shakourzadeh K, Boitel-Conti M. (2010) **Modeling and optimization of hairy root growth in fed-batch process**. *Biotechnology Progress* 26:847-856.
- J12. Mairet F, Sierra J, Glorian V, Villon P, Shakourzadeh K, Boitel-Conti M. (2009) **A new approach to define optimized range of medium composition for enhancement of hairy root production in fed-batch process**. *Bioprocess and Biosystems Engineering* 32: 257-265.

- **Journal articles in control theory/applied mathematics:**

- J13. Mairet F, Gouzé J.-L. (2015) **Hybrid control of a bioreactor with quantized measurements**. *IEEE Transactions on Automatic Control*. To appear.
- J14. Mairet F, Muñoz-Tamayo R, Bernard O. (2015) **Adaptive control of light extinction for optimizing microalgal production**. *Journal of Process Control* 30: 117–124.
- J15. Bayen T, Mairet F, Mazade M. (2015) **Analysis of an optimal control problem connected to bioprocesses involving a saturated singular arc**. *Discrete and Continuous Dynamical System – B* 20 39-58.
- J16. Bayen T, Mairet F, Mazade M. (2015) **Optimal feeding strategy for the minimal time problem of a fed-batch bioreactor with mortality rate**. *Optimal Control Applications and Methods* 36: 77–92.
- J17. Bayen T, Mairet F, Martinon P, Sebbah P. (2014) **Analysis of a periodic optimal control problem connected to microalgae anaerobic digestion**. *Optimal Control Applications and Methods*. To appear.
- J18. Bayen T, Mairet F. (2014) **Optimization of the separation of two species in a chemostat**. *Automatica* 50:1243–1248.
- J19. Mairet F, Moisan M, Bernard O. (2014) **Interval observer with near optimal adaptation dynamics. Application to the estimation of lipid quota in microalgae**. *International Journal of Robust and Nonlinear Control* 24:1142–1157
- J20. Bayen T, Gajardo P, Mairet F. (2013) **Optimal synthesis for the minimum time control problems of fed-batch bioprocesses for growth functions with two maxima**. *Journal of Optimization Theory and Applications* 158:521–553.
- J21. Mairet F, Moisan M, Bernard O. (2010) **Interval observer-based estimator of specific growth rate in bioreactors**. *Journal Européen des Systèmes Automatisés* 44:493-507.

- **Book chapters**

- B1. Bernard O, Mairet F, Chachuat B (2016) **Modelling of Microalgae Culture Systems with Applications to Control and Optimization**. In *Microalgae Biotechnology*, edited by Clemens Posten and Steven Fen Chen. *Advances in Biochemical Engineering/Biotechnology*, Springer.

- **Conference Proceedings (peer reviewed):**

- C1. Mairet F, Bernard O. **The photoinhibistat: operating microalgae culture under photoinhibition for strain selection**. 11th IFAC Symposium on Dynamics and Control of Process Systems, including Biosystems (DYCOPS-CAB), Trondheim (Norway), 2016.

- C2. Grimaud G, Le Guennec V, Ayata S, Mairet F, Sciandra A, Bernard, O. **Modelling the effect of temperature on phytoplankton growth across the global ocean.** 8th Vienna International Conference on Mathematical Modelling (MATHMOD), Vienna (Austria), 2015.
- C3. Mairet F, Gouzé J.-L. **Control of a bioreactor with quantized measurements.** 1st International Conference on Formal Methods in Macro-Biology, Nouméa (New Caledonia), 2014.
- C4. Mairet F, Bernard O. **Robustness of closed-loop control to biodiversity: a didactic example.** 19th IFAC World Congress, Cape Town (South Africa), 2014.
- C5. Grimaud GM, Mairet F, Bernard O. **Modelling thermal adaptation in microalgae: an adaptive dynamics point of view.** 19th IFAC World Congress, Cape Town (South Africa), 2014.
- C6. Bayen T, Mairet F, Mazade M. **Minimal time problem for a fed-batch bioreactor with a non admissible singular arc.** European Control Conference (ECC14), Strasbourg (France), 2014.
- C7. Mairet F, Muñoz-Tamayo R, Bernard O. **Adaptive control for optimizing microalgae production.** 12th Computer Applications in Biotechnology (CAB), Mumbai (India), 2013.
- C8. Muñoz-Tamayo R, Martinon P, Bougaran G, Mairet F, Bernard O. **Design of optimal experiments for parameter estimation of microalgae growth models.** 12th Computer Applications in Biotechnology (CAB), Mumbai (India), 2013.
- C9. Bayen T, Mairet F, Mazade M. **Fed-batch bioreactor with mortality rate.** 9th IFAC Symposium on Nonlinear Control Systems (NOLCOS), Toulouse (France), 2013.
- C10. Mairet F, Muñoz-Tamayo R, Bernard O. **Driving species competition in a light-limited chemostat.** 9th IFAC Symposium on Nonlinear Control Systems (NOLCOS), Toulouse (France), 2013.
- C11. Bayen T, Mairet F, Martinon P, Sebbah P. **Optimizing the anaerobic digestion of microalgae in a coupled process.** European Control Conference (ECC13), Zurich, 2013.
- C12. Muñoz-Tamayo R, Mairet F, Bernard O. **Driving microalgal production in raceway systems to near optimal productivities.** European Control Conference (ECC13), Zurich, 2013.
- C13. Bayen T, Gajardo P, Mairet F. **Minimal time control of fed-batch bioreactor with product inhibition.** 20th Mediterranean Conference on Control and Automation (MED 2012), Barcelona (Spain), 2012.
- C14. Mairet F, Moisan M, Bernard O. **Adaptive interval observer with application to the estimation of biofuel production by microalgae.** 20th Mediterranean Conference on Control and Automation (MED 2012), Barcelona (Spain), 2012.
- C15. Mairet F, Bernard O, Ras M, Lardon L, Steyer J-P. **Anaerobic digestion of microalgae: evaluation of process performances using ADM1.** Stic & Environnement, St-Etienne (France), 2011.
- C16. Mairet F, Bernard O, Ras M, Lardon L, Steyer J-P. **Testing the ability of ADM1 to represent the anaerobic digestion of microalgae.** 8th IWA Symposium on Systems Analysis and Integrated Assessment Watermatex, San Sebastian (Spain), 2011.
- C17. Mairet F, Bernard O, Masci P, Lacour T, Sciandra A. **Modelling microalgae growth in nitrogen limited photobioreactor for estimating biomass, carbohydrate and neutral lipid productivities.** 18th IFAC World Congress, Milan (Italy), 2011.
- C18. Mairet F, Bernard O, Ras M, Lardon L, Steyer J-P. **A dynamic model for anaerobic digestion of microalgae.** 18th IFAC World Congress, Milan (Italy), 2011.
- C19. Cameron ET, Mairet F, Bernard O, Ras M, Lardon L, Steyer JP, Chachuat B. **Anaerobic digestion of microalgae: identification for optimization and control.** 18th IFAC World Congress, Milan (Italy), 2011.
- C20. Mairet F, Moisan M, Bernard O. **Estimation of lipid accumulation in microalgae with dynamic interval observers.** 9th IEEE International Conference on Control & Automation (ICCA'11), Santiago (Chile), 2011.
- C21. Mairet F, Titica M, Bernard O, Pruvost J. **Coupling biological and radiative models to describe microalgal growth in a photobioreactor.** 11th Computer Applications in Biotechnology (CAB), Leuven (Belgium), 2010.
- C22. Mairet F, Bernard O, Masci P, Lacour T, Sciandra A. **Modelling neutral lipid production in microalgae.** 9th International Symposium on Dynamics and Control of Process Systems (DYCOPS), Leuven (Belgium), 2010.
- C23. Mairet F, Bernard O. **Coupling framers to get enhanced interval observers. Application to growth rate estimation in a photobioreactor.** 48th IEEE Conference on Decision and Control (CDC), Shanghai (China), 2009.
- C24. Mairet F, Moisan M, Bernard O. **Interval observer-based estimator of specific growth rate in bioreactors.** Stic & Environnement, Calais (France), 2009.

- Preprints

- P1. Mairet F, Bernard O, Sciandra A, Pruvost E, Combe C. **Bioréacteur pour microalgues**. Brevet déposé en mars 2015, n° 15 52343.
- P2. Martinez C, Mairet F (2015) **Modeling an absorption column connected to a photobioreactor for biogas upgrading**. Submitted to Applied Mathematical Modelling.
- P3. Mairet F, Bernard O. (2015) **Robustness of bioprocess feedback control to biodiversity**. Submitted to International Journal of Robust and Nonlinear Control.
- P4. Mairet F, Ramirez H, Rojas A. (2015) **Modelling and stability analysis of a microalgal pond with nitrification**. Submitted to Applied Mathematical Modelling.
- P5. Mairet F, Donoso-Bravo A, Gajardo P. (2014) **Non-ideally mixed bioreactor: Analysis of a two-zone model**. Submitted to Mathematical Biosciences and Engineering.
- P6. Bayen T, Mairet F, Martinon P, Sebbah P. (2013) **Study of a controlled Kolmogorov periodic equation connected to the optimization of periodic bioprocess**. Preprint hal-00855054.

- Workshop and Conference (without proceedings):

- W1. Mairet F, Gouze J-L, Sépulchre J.-A. **Control of bio-conversion of polymeric substrate in the chemostat**. Foundations of Systems Biology in Engineering, Boston (USA), 2015. Poster.
- W2. Grimaud G, Mairet F, Ayata S, Sciandra A, Bernard O. **A simple Adaptive Dynamics model to study the effect of global warming on marine phytoplankton**. Mathematical Models in Ecology and Evolution, Paris (France), 2015. Poster
- W3. Giordano N, Mairet F, Gouze J-L, Geiselmann J, de Jong H. **Dynamic optimisation of resource allocation in microorganisms**. 21st International Symposium on Mathematical Theory of Networks and Systems (MTNS), Groningen (Netherlands), 2014. Extended abstract.
- W4. Muñoz-Tamayo R, Mairet F, Bernard O. **A closed-loop controller for optimizing nitrogen removal in a microalgal outdoor pond**. 11th IWA Conference on Instrumentation, Control and Automation, Narbonne (France), 2013. Poster.
- W5. Mairet F, Bernard O, Masci P, Lacour T, Sciandra A. **Modelling neutral lipid productivity in photobioreactors under nitrogen deprivity**. 8th European Workshop "Biotechnology of Microalgae", Nuthetal 2010.
- W6. Cameron ET, Mairet F, Bernard O, Ras M, Steyer JP, Chachuat B. **Model-based optimization of an algal bioreactor coupled to an anaerobic digester**. AIChE Annual Meeting, Salt Lake City 2010.
- W7. Sierra J, Mairet F, Shakourzadeh K, Lebeault JM, Glorian V, Boitel-Conti M, Sangwan-Norreel B. **The influence of operating mode on the production of hairy roots in confined bioreactor**. International Symposium on Environmental Biotechnology (ISEB), Leipzig 2006.

Projects

Participation to collaborative projects:

- **ANR¹ Phycover** (2014-2017): Using phytoplankton and methanisation for both treatment of effluent and organic matter in order to optimize bioenergy production and digestate valorization.
- Programme Gaspard Monge pour L'Optimisation et la Recherche Opérationnelle (2015-2016), **OPTIBIO** : New challenges in the optimal control of bioprocesses.
- **ANR Purple Sun** (2013-2016): Development of innovative positive energy (using semi-transparent photovoltaic panels) production processes for microalgae production.
- **ANR Facteur 4** (2012-2015): propose non GMO strains of microalgae with enhanced performance. Directed selection of microalgae with interesting properties from an industrial point of view.

¹ The French National Research Agency

- **FUI Salinalgue** (2011-2015): use endemic microalgae species in areas of high salinity (previously used to produce salt) to produce both biofuel (either lipid based or methane) and co-products.
- **ANR Symbiose** (2009-2012): improve the energetic balance of biofuel microalgal productions and recycle nitrogen and phosphorus. The project proposes to study the coupling between a microalgal production system and an anaerobic digester.
- **ANR Shamash** (2006-2010): production of lipid biofuel from microalgae.

Industrial transfers:

- **Rhodia**: Simulator of anaerobic co-digestion based on ADM1 (2010).
- **Enea consulting**: Geographical assessment of microalgae productivity (2013-2014).

International collaborations:

- **Inria Chile – CIRIC**, team Bionature.
- **Associated team Greencore** with PUCV, UFRO and UTFSM (Chile).

Student supervisions

PhD:

- Carlos Martinez (2016-), Inria-UPMC, France
- Ghjuvan Grimaud (2013-2016), Inria-LOV, France

Master or engineer thesis:

- Ignacio Lopez (2015), Universidad de Chile, Chile
- Carlos Martinez (2014), Universidad de la Frontera, Chile
- Esteban Hernández (2013-2014), Universidad Técnica Federico Santa María, Chile
- Omar Risco (2012), Universidad Técnica Federico Santa María, Chile

Teaching activities

2007/2008: Process control, 86h, UTC, France

2005/2007: Physic Mechanic, 2x96h, UTC, France

2014: Lecture (3h) on modelling microalgae growth during the 3rd French-Chilean Workshop on Bioprocess Modeling, Valparaiso (Chile).

Other activities

- Reviewer for Biotechnology and Bioengineering, Fuel, IEEE Transactions on Automatic Control, International Journal of Robust and Nonlinear Control, Journal of Applied Phycology, Journal of Process Control, Water Research... and conferences.
- Organization of the 2nd French-Chilean Workshop on Bioprocess Modeling, Pucon (Chile), January 2012.
- Elected member of the Center Committee of Inria Sophia-Antipolis.

Languages

French : native language ; English : fluent ; Spanish : fluent.