LU Liu-Di

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Research interests

numerical analysis, scientific computing, domain decomposition, PDE–constrained optimization, optimal control, mathematics modelling, mathematical biology, model order reduction.

Research experience

Post-doctorat contract October 2021 – present
Section of Mathematics, University of Geneva, Geneva

Project: Domain decomposition methods for PDE-constrained optimization problems
Keywords: elliptic optimal control, parabolic optimal control, convergence analysis, time parallelization, Dirichlet–Neumann method, Neumann–Neumann method, Optimized Schwarz method
Collaborators: Bastien Chaudet-Dumas (HEIG-VD), Pierre–Henri Cocquet (Université de Pau), Martin J. Gander (University of Geneva), Si-Wei Liao (Lanzhou University), Tommaso Vanzan (Politecnico di Torino), Tingting Wu (Nanjing University of Aeronautics and Astronautics)

Instructor contract October 2018 – September 2021
Sorbonne Université, Paris
192 hours of teaching task

Doctoral contract October 2018 – September 2021
Laboratoire Jacques-Louis Lions, Sorbonne Université, Paris

Project: Modelling and optimization problems in microalgae production
Keywords: microalgae, photobioreactor, raceway pond, Saint–Venant model, Han model, optimal control, nonlinear adaptive control, resource allocation, permutation, topography, photoinhibition, sensitivity analysis, parameter calibration
Collaborators: Olivier Bernard (INRIA Sophia Antipolis), Joel Ignacio Fierro Ulloa (INRIA Sophia Antipolis), Nan Pan (École Polytechnique), Jacques Sainte-Marie (INRIA Paris), Julien Salomon (INRIA Paris)

Research Internship March 2018 – September 2018
INRIA Paris, team ANGE, Paris

Project: Model order reduction for Burgers' equation
Keyword: reduced basis, Burgers' equation, characteristic equation, Proper Orthogonal Decomposition (POD), Empirical Interpolation Method (EIM), Greedy algorithm, *a posteriori* estimation
Supervisors: Julien Salomon (INRIA Paris), Jacques Sainte-Marie (INRIA Paris)

Education

Sorbonne Université (Université Pierre et Marie Curie), Paris, France 2018 – 2021
Ph.D. degree in Applied mathematics
Defended September 29th 2021 at Laboratory Jacques-Louis Lions, UMR 7598, Paris

Title: Lagrangian approaches for modelling and optimization of hydrodynamic-photosynthesis coupling

Supervisors:

Julien Salomon Senior Researcher at INRIA Paris

Jury:

Referees	Benoît Chachuat	Professor at Imperial College London
	Yannick Privat	Professor at University of Strasbourg
President of Jury	Florence Hubert	Professor at Aix-Marseille University
Examiners	Céline Grandmont	Senior Researcher at INRIA Paris
	Camille Pouchol	Associate Professor at University of Paris
	Magali Ribot	Professor at University of Orléans
Invited	Martin J. Gander	Professor at University of Geneva
	Olivier Bernard	Senior Researcher at INRIA Sophia Antipolis

Sorbonne Université (Université Pierre et Marie Curie), Paris, France 2016 – 2018
Master degree in Mathematics and applications

Université Claude Bernard Lyon 1, Lyon, France 2015 – 2016
Bachelor degree in Mathematics and applications

Université Savoie Mont Blanc, Chambéry, France 2013 – 2015
First and second year of Bachelor in Mathematics

Publication

Preprints

Optimized Schwarz methods for heterogeneous heat transfer problems, with Martin J. Gander and Tingting Wu, Submitted (2025)

Representing inhibition in growth kinetics: the Haldane KIS, with Olivier Bernard and Nan Pan, Submitted (2024)

Non-overlapping Schwarz methods in time for parabolic optimal control problems, with Martin J. Gander, Submitted (2024)

International peer-reviewed journal papers

Should hydrodynamics be accounted for to compute the growth rate of microalgae in a photobioreactor? with Olivier Bernard and Joel Ignacio Fierro Ulloa, To appear in *SIAM Journal on Applied Mathematics* (2025)

Topography optimization for enhancing microalgal growth in raceway ponds, with Olivier Bernard, Jacques Sainte–Marie and Julien Salomon, To appear in *SIAM Journal on Control and Optimization* (2025)

New time domain decomposition methods for parabolic optimal control problems II: Neumann–Neumann algorithms, with Martin J. Gander, *SIAM Journal on Numerical Analysis*, 62(6):2588–2610 (2024)

New time domain decomposition methods for parabolic optimal control problems I: Dirichlet–Neumann and Neumann–Dirichlet algorithms, with Martin J. Gander, *SIAM Journal on Numerical Analysis*, 62(4):2048–2070 (2024)

Theoretical growth rate of microalgae under high/low-flashing light, with Olivier Bernard and Joel Ignacio Fierro Ulloa, *Journal of Mathematical Biology*, 86(48):1–32 (2023)

Optimization of mixing strategy in microalgal raceway ponds, with Olivier Bernard and Julien Salomon, *International Journal of Robust and Nonlinear Control*, 33(9):4989–5010 (2023)

Optimal optical conditions for microalgal production in photobioreactors, with Olivier Bernard, *Journal of Process Control*, 112:69–77 (2022)

Internationales peer-reviewed conferences proceedings

Dirichlet–Neumann and Neumann–Neumann methods for elliptic control problems, with Martin J. Gander, In *Domain Decomposition Methods in Science and Engineering XXVII. DD 2022.* Lecture Notes in Computational Science and Engineering, vol 149. Springer, Cham. 207–214 (2024)

- *Mixing strategies combined with shape design to enhance productivity of a raceway pond*, with Olivier Bernard and Julien Salomon, In *11th IFAC SYMPOSIUM on Advanced Control of Chemical Processes*, 54(3):281–286 (2021)
- *Optimizing microalgal productivity in raceway ponds through a controlled mixing device*, with Olivier Bernard and Julien Salomon, In *2021 American Control Conference*, 640–645 (2021)
- *Controlling the bottom topography of a microalgal pond to optimize productivity*, with Olivier Bernard, Jacques Sainte–Marie and Julien Salomon, In *2021 American Control Conference*, 634–639 (2021)

Grant & Scholarship

Parrainage of INRIA PARIS grant of 1000 euros with Bastien Chaudet-Dumas and Lucas Perrin, 04/2023–06/2023.

Project BOUM grant of 1000 euros from the SMAI (French Society of Industrial and Applied Mathematics) with Bastien Chaudet-Dumas and Lucas Perrin, 11/2022–06/2023.

PhD scholarship at École doctorale de Sciences Mathématiques de Paris Centre (ED386), 10/2018–09/2021. (I also competed for and was awarded a PhD scholarship at Université Côte d'Azur/EDSTIC, but I declined this offer.)

Organization

Mini-symposium at *29th International Domain Decomposition Conference (DD XXIX)* under the title **Iterative and direct solvers for optimization and inverse problems,** with Marcella Bonazzoli and Tommaso Vanzan, Milan, 2025

Mini-symposium at *28th International Domain Decomposition Conference (DD XXVIII)* under the title **Transmission conditions in domain decomposition methods and optimal control problems,** Thuwal, 2024

Research school on **Iterative Methods for Partial Differential Equations 2023 (IMPDE2023)** with Bastien Chaudet-Dumas and Lucas Perrin, Paris, 2023.
Website: `https://impde2023.sciencesconf.org`

Mini-symposium at *27th International Domain Decomposition Conference (DD XXVII)* under the title **Convergence analysis of non overlapping domain decomposition methods,** with Bastien Chaudet-Dumas, Pragues, 2022

Mini-symposium at *45ème Congrès National d'Analyse Numérique (CANUM2022)* under the title **Méthodes parallèles pour les équations aux dérivées partielles,** with Bastien Chaudet-Dumas and Martin J. Gander, Evian-les-Bains, 2022

Research stay

10.02.2025 – 14.02.2025, laboratory for applied sciences in mechanics and electrical engineering (SIAME) at UPPA, collaboration with Pierre–Henri Cocquet and Yves Le Guer.

16.07.2021 – 15.08.2021, team Biocore at INRIA Sophia Antipolis, collaboration with Olivier Bernard and Joel Ignacio Fierro Ulloa.

02.2020 – 04.2021, team Biocore at INRIA Sophia Antipolis, collaboration with Olivier Bernard.

Talk

Milano, June 23-27, 2025, *Some recent results on time domain decomposition methods for PDE-constrained optimization*, 29th International Domain Decomposition Conference (DD29)

Fort Worth, March 5, 2025, *Non-overlapping domain decomposition methods for time parallel solution of PDE-constrained optimization problems*, SIAM Conference on Computational Science and Engineering 2025

Pau, February 13, 2025, *Time domain decomposition and application to PDE-constrained optimization problems*, Seminar in Laboratory of Mathematics and its Applications of PAU

Geneva, September 10, 2024, *Time domain decomposition and application to PDE-constrained optimization problems*, University of Geneva, Swiss Numerical Analysis Day 2024

Podbanské, March 16, 2024, *Time domain decomposition methods for parabolic optimal control problems*, Grand Hotel Permon, ALGORITMY 2024

Thuwal, January 31, 2024, *Dirichlet-Neumann and Neumann-Neumann Methods for Parabolic Optimal Control Problems II*, 28th International Domain Decomposition Conference (DD28)

Roscoff, April 13, 2023, *Modélisation et optimisation de la production d'algues: défis et enjeux*, Station Biologique de Roscoff, Workshop Interdisciplinary

Marseille, March 14, 2023, *Méthodes de décomposition de domaines et quelques applications pour les problèmes du contrôle optimal*, Institut de mathématiques de Marseille, Seminar of Applied Analysis

Amiens, March 6, 2023, *Méthodes de décomposition de domaines et quelques applications pour les problèmes du contrôle optimal*, Laboratoire Amiénois de Mathématique Fondamentale et Appliquée, Seminar of Applied Analysis of Amiens

Lugano, August 25, 2022, *Multigrid method for optimal control problem*, International Multigrid Conference 2022 (IMG2022)

Pragues, July 25, 2022, *Dirichlet–Neumann and Neumann–Neumann Methods for Parabolic Control Problems*, 27th International Domain Decomposition Conference (DD27)

Pragues, July 25, 2022, *Dirichlet–Neumann and Neumann–Neumann Methods for Elliptic Control Problems*, 27th International Domain Decomposition Conference (DD27)

Marseille, July 11, 2022 , *Non-overlapping domain decomposition methods for parabolic control problems*, 11th Conference on Parallel-in-Time Integration (PinT2022)

Evian-les-Bains, June 14, 2022, *Non-overlapping Domain Decomposition Methods for Elliptic Control Problems*, 45th French National Congress of Numerical Analysis (CANUM2020)

Paris, April 13, 20222, *Domain Decomposition Methods and Applications for Optimal Control Problems*, Laboratory Jacques-Louis Lions, Seminar of team ANGE

Jouy-en-Josas, January 24, 2022, *Some modelling and optimization problems for microalgal raceway pond*, INRAE Jouy-en-Josas, Seminar of MaIAGE

Geneva, November 2, 2021, *Microalgal raceway ponds modelling and optimization problems*, Section of Mathematics, Numerical Analysis Seminar

Venice, June 13, 2021, *Mixing Strategies Combined with Shape Design to Enhance Productivity of a Raceway Pond*, 11th IFAC SYMPOSIUM on Advanced Control of Chemical Processes 2021 (ADCHEM21)

Sophia Antipolis, June 3, 2021, *Some optimization problems in an algal raceway pond*, INRIA Sophia Antipolis, Seminar of team BIOCORE

Online, May 28, 2021 , *Shape design combining with a mixing device in an algal raceway pond*, 8th EGRIN school

New Orleans, May 25, 2021, *Optimizing microalgal productivity in raceway ponds through a controlled mixing device*, 2021 American Control Conference (ACC2021)

New Orleans, May 25, 2021, *Controlling the bottom topography of a microalgal pond to optimize productivity*, 2021 American Control Conference (ACC2021)

Toulouse, May 18, 2021, *Microalgal raceway ponds modelling and optimization problems*, Institut de Mathématiques de Toulouse, Seminar of Modelling, Analysis and Calcul

Online, December 3, 2020, *Microalgal raceway ponds modelling and optimization problems*, Congress of Numerical Analysis for young researchers 2020 (CAN-J 2020)

Online, November 4, 2020, *Optimization problems of a microalgal raceway to enhance productivity*, Seminar of team ANGE

Paris, May 28, 2019, *Réduction de modèle pour l'équation de Burgers*, Laboratory Jacques-Louis Lions, Ph.D. seminar

Paris, December 12, 2018, *Model Reduction for hyperbolic Equations*, Laboratory Jacques-Louis Lions, Seminar of team ANGE

Supervison

Ph.D

Si-Wei Liao, 12.2023 – , co-supervision with Martin J. Gander (CSC scholarship, joint with Lanzhou University).

Tingting Wu, 12.2023–03.2025, co-supervision with Martin J. Gander (CSC scholarship, joint with Nanjing University of Aeronautics and Astronautics). Defended 07/03/2025, now assistant professor in Wuxi Taihu University.

Joel Ignacio Fierro ulloa, 10.2021–10.2024, co-supervision with Olivier Bernard. Defended 29/10/2024, now postdoc in INRIA Grenoble team DANCE.

Master

Melina Andorra, 02/2025 - 06/2025, co-supervision with Martin J. Gander for numerical analysis seminar Master reports.

Guillaume Louis, 02/2025 - 06/2025, co-supervision with Martin J. Gander for numerical analysis seminar Master reports.

Yano Rasolofo, 02/2025 - 06/2025, co-supervision with Martin J. Gander for numerical analysis seminar Master reports.

Joel Ignacio Fierro ulloa, 06.2021–09.2021, co-supervision with Olivier Bernard.

Bachelor

Dylan Machado, 05.2022–08.2022, co-supervision with Julien Salomon. Now Ph.D in INRIA Saclay team POEMS.

Teaching

University of Geneva (290h)

2024-2025	Mathematics for computer scientists	Bachelor first year	28h
	Numerical Analysis for PDEs	Master	30h
	Numerical Analysis Seminar	Master	26h
2023-2024	Analysis II - Real Analysis	Bachelor second year	28h
	Mathematics for computer scientists	Bachelor first year	30h
	Scientific computation for electromagnetism	Master	8h
	Animator of Mathscope	School groups	
2022-2023	Analysis II - Real Analysis	Bachelor second year	28h
	Numerical Analysis	Bachelor second year	28h
	Animator of Mathscope	School groups	
2021-2022	Analysis II - Real Analysis	Bachelor second year	56h
	Numerical Analysis	Bachelor second year	28h

Sorbonne University (196h)

2019-2020	Mathematics for scientific study I	Bachelor first year	108h
	University certificate of return to higher education for exiled persons	Bachelor preparation	10h
2018-2019	Analysis and Algebra for science	Bachelor first year	36h
	Numerical methods for differential equations	Bachelor third year	28h
	University certificate of return to higher education for exiled persons	Bachelor preparation	14h

Review activity

IFAC, ADCHEM conference proceedings

IEEE, CDC conference proceedings

Springer, Computational and Applied Mathematics

Elsevier, Computers & Mathematics with Applications

Global Science Press, International Journal of Numerical Analysis and Modeling

Service

Since 2023, jury member of Maturité (high-school final test in Switzerland) in the Canton of Geneva for several high-schools: Collège Sismondi, Collège Rousseau, Collège de Candolle, École Moser, Collège Saussure.

Skill

Languages:	Chinese (Native), English (Fluent), French (Fluent)
Computer skills:	Matlab, Python, Tex, Git, Maple, C++, HTML, CSS
Operation systems:	MacOS, Linux, Windows