Liu-Di Lu

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Research Interests

I specialize in the fields of numerical analysis, optimization and control, high performance computing and partial differential equations (PDEs). My research interests are diverse including domain decomposition methods, multigrid methods, PDE-constrained optimization problems, mathematics modelling, mathematical biology, model order reduction, space-time methods.

Work Experience

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

Topic: Domain Decomposition methods for PDE-constrained optimal control problems
Keywords: elliptic optimal control, parabolic optimal control, convergence analysis, time parallelization, Dirichlet-Neumann method, Neumann-Neumann method, Optimized Schwarz method
Collaborators: Martin Jakob Gander, Section of Mathematics, University of Geneva, Bastien Chaudet-Dumas, Section of Mathematics, University of Geneva

Instructor contract October 2018 - September 2021
Sorbonne University, Paris
192 hours of teaching task

Doctoral contract October 2018 - September 2021
Laboratory Jacques-Louis Lions, Sorbonne University, Paris

Topic: Lagrangian approaches for modelling and optimization of hydrodynamic-photosynthesis coupling
Keywords: microalgae, photobioreactor, raceway pond, Saint-Venant model, Han model, nonlinear adaptive control, resource allocation, permutation, topography, photoinhibition
Collaborators: Jacques Sainte-Marie, INRIA Paris, team ANGE, Joel Ignacio Fierro ulloa, INRIA Sophia Antipolis, team BIOCORE

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

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

Education

Sorbonne University, 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, team ANGE
Olivier Bernard	Senior researcher at INRIA Sophia Antipolis, team BIOCORE

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 Jakob Gander	professor at University of Geneva

Sorbonne University, Paris, France 2016 - 2018
Master degree in Mathematics and applications

University Claude Bernard Lyon 1, Lyon, France 2015 - 2016
Bachelor degree in Mathematics and applications

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

Publications

International peer-reviewed journal papers

How to estimate the growth rate of microalgae considering the hydrodynamics of the photobioreactor? with Olivier Bernard and J. Ignacio Fierro U., In preparation (2024)

From the calibration viewpoint, what do we know about the Haldane model?, with Olivier Bernard and Nan Pan, In preparation (2024)

New time domain decomposition methods for parabolic optimal control problems II: Neumann-Neumann algorithms, with Martin Jakob Gander, Submitted (2024)

New time domain decomposition methods for parabolic optimal control problems I: Dirichlet-Neumann and Neumann-Dirichlet algorithms, with Martin Jakob Gander, Accepted in SIAM Journal on Numerical Analysis (2023)

Topography optimization for enhancing Microalgal growth in raceway ponds, with Olivier Bernard, Jacques Sainte-Marie and Julien Salomon, Submitted (2023)

Theoretical growth rate of microalgae under high/low-flashing light, with Olivier Bernard and J. Ignacio Fierro U., 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, 1-22 (2022)

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 Jakob Gander, accepted In the 27th International Domain Decomposition Conference (2023)

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)

Talks

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 Interdisiplinary

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

Organization

Mini-symposium at *28th International Domain Decomposition Conference (DD XXVIII)* under the title **Transmission conditions in domain decomposition methods and optimal control problems,** with Martin Jakob Gander, 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 Jakob Gander, Evian-les-Bains, 2022

Scholarship & Grant

Ph.D scholarship from École doctorale de Sciences Mathématiques de Paris Centre (ED386), 2018.

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

Parrainage of INRIA PARIS grant of 1000 euros with Bastien Chaudet-Dumas and Lucas Perrin, 2023

Teaching

University of Geneva			
2023-2024	Analysis II - Real Analysis	Bachelor second year	28h
	Mathematics for computer science	Bachelor first year	28h
	Animator of Mathscope		
2022-2023	Analysis II - Real Analysis	Bachelor second year	28h
	Numerical Analysis	Bachelor second year	28h
	Animator of Mathscope		
2021-2022	Analysis II - Real Analysis	Bachelor second year	56h
	Numerical Analysis	Bachelor second year	28h
Sorbonne University			
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

Supervison

Ting-Ting Wu (CSC six months), co-supervised with Martin Jakob Gander, since 21.12.2023, Ph.D thesis

Si-Wei Liao (CSC two years), co-supervised with Martin Jakob Gander, since 11.12.2023, Ph.D thesis

Dylan Machado, co-supervised with Julien Salomon, 05.2022-08.2022, Bachelor thesis

Joel Ignacio Fierro ulloa, co-supervised with Olivier Bernard, since 10.2021, Ph.D thesis

Joel Ignacio Fierro ulloa, co-supervised with Olivier Bernard, 06.2021-09.2021, Master thesis

Skills

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