

## Liu-Di Lu

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## Research Interests

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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

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**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

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**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

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### In preparation

*How to estimate the growth rate of microalgae considering the hydrodynamics of the photobioreactor?* with Olivier Bernard and J. Ignacio Fierro U., To be submitted to SIAM Journal on Applied Mathematics (2024)

*From the calibration viewpoint, what do we know about the Haldane model?*, with Olivier Bernard and Nan Pan, In preparation (2023)

### Preprints

*New time domain decomposition methods for parabolic optimal control problems II: Neumann-Neumann algorithms*, with Martin Jakob Gander, Submitted to SIAM Journal on Numerical Analysis (2024)

*Topography optimization for enhancing Microalgal growth in raceway ponds*, with Olivier Bernard, Jacques Sainte-Marie and Julien Salomon, Submitted to SIAM Journal on Control and Optimization (2023)

### International peer-reviewed journal papers

*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)

*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, 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)

### Talks

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**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, 2022**, *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

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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

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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

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### University of Geneva

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

## Supervision

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**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

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