# Frontiers of Mathematics Lecture

## From microscopic to macroscopic scale equations: mean field, hydrodynamic and graph limits

## Abstract

Considering finite particle systems, we elaborate on various ways to pass to the limit as the number of agents tends to infinity, either by mean field limit, deriving the Vlasov equation, or by hydrodynamic or graph limit, obtaining the Euler equation. We provide convergence estimates. We also show how to pass from Liouville to Vlasov or to Euler by taking adequate moments. Our results encompass and generalize a number of known results of the literature. As a surprising consequence of our analysis, we show that sufficiently regular solutions of any quasilinear PDE can be approximated by solutions of systems of $N$ particles, to within $1/\log(N)$. This is a work with Thierry Paul.

### Professor Emmanuel Trélat
*Sorbonne Université, France*

Date :
June 24, 2025 (Tuesday)

Time :
5:00 – 6:00 pm
(Tea Reception starts at 4:30 pm)

Venue :
Lecture Theatre C, LG1/F,
Chow Yei Ching Building,
The University of Hong Kong

## Biography

Emmanuel Trélat is full professor at Sorbonne Université and is the director of Laboratoire Jacques-Louis Lions. Formerly, he was assistant professor at Univ. Paris-Saclay and professor at Univ. Orléans. He was also the director of Fondation Sciences Mathématiques de Paris. He is the Editor in Chief of the journal ESAIM: Control Calc. Var. Optim. and is Associate Editor of several other journals, including SIAM Review.

His research interests range over control theory in finite and infinite dimension, optimal control, stabilization, geometry, numerical analysis. He also collaborates with industrials, for example he is the inventor of the software that is used for the control guidance of the Ariane launchers. He has been awarded a number of prizes, among which the Felix Klein Prize in 2012, and an invited speaker invitation to ICM in 2018. He is also a member of Academia Europaea.

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