Partial Differential Equations and Scientific Computing in Orsay

A Master Program of Université Paris-Sud (director : Filippo Santambrogio),
an international program in collaboration with UPMC, École Polytechnique, Paris-Dauphine

Intensive training period (two weeks : September 9 to 20)

In French
At Orsay,
– Functional Analysis (1st week)
– Scientific Computing (2nd week, in Computer Labs)
Other intensive courses from the Master Program in Analysis, Arithmetics and Geometry (AAG) are available.

In English
At IHP (Downtown Paris),
– Functional Analysis (1st week)
– Basic Notions of Linear PDEs (1^{st}week)
– Numerical Methods for PDEs (2nd week)
– Scientific Computing (2nd week)

First term classes (September 23 to January)

Courses in English from the Master Program at Paris-Sud

- K. Pankrashkin : Introduction to spectral theory$^{\#}$
- P. Gérard : Hamiltonian system in finite and infinite dimension$^{\#}$
- U. Boscain, Y. Chitour, F. Jean : Geometric Control$^{\diamond}$
- F. Coquel, F. Lagoutière : Theoretical and numerical analysis of hyperbolic systems of conservation laws$^{\diamond}$

Courses in French from the Master Program at Paris-Sud

- F. Santambrogio : Elliptic equations and calculus of variations$^{\#}$
- F. Rousset : Dispersive equations and solitary waves
- B. Maury : Finite element method, constraints and duality
- P. Lafitte : Long time approximation of ODEs and application to kinetic equations$^{\otimes}$

Courses in English from our partner universities

- Monday, Université Pierre et Marie Curie
  - F. Hecht : From PDEs to their numerical solution by finite element methods (with C++ implementation)
  - Y. Maday : Variational approximations of PDEs
- Wednesday, Université Paris-Dauphine
  - Eric Séré : Nonlinear elliptic PDEs
  - S. Mischler : Introduction to evolution equations
- Thursday, École Polytechnique
  - F. Golse : Kinetic models
  - G. Allaire, F. Alouges : Homogenization

All the first term courses are between 24 and 36h. Students are asked to attend at least five courses and validate at least four, the list of exams they choose being validated by the Director of the Master Program. International students are free to choose from the list of courses in Orsay and the list of courses in English in the partner universities.

$^{\#}$ in common with the AAG Master program ; $^{\diamond}$ in common with École Polytechnique and UPMC ;
$^{\otimes}$ in common with École Centrale Paris ; * in common with the MathSV Master program.

Courses in common with Polytechnique may be held in Polytechnique or Orsay, according to the weekday.

Second term classes (February to May)

Courses from the Master Program at Paris-Sud

These are more advanced courses. The language will be chosen by agreement between teachers and students and at least half of the courses will be guaranteed to be in English. Other courses will be offered by our partner universities.

- D. Hilhorst : Finite volume methods for nonlinear parabolic equations
- B. Maury : Modelisation of the respiratory system$^{☆}$
- A. Chambolle : Calculus of variations and variational convergence$^{◈}$
- A. De Bouard : Nonlinear dispersive PDE's and applications in optics$^{◈}$
- C. Gérard : Introduction to Quantum Field Theory on curved space-times$^{\#}$
- Y. Brenier : Optimal transport methods in analysis and geometry$^{\#◈}$

All the courses are between 20 and 24h. Students are asked to attend and validate two courses.

Personal research project (between February and August)

Each student will develop a personal research project, taking either the form of a research internship in a company or in a public laboratory, or of a research-level dissertation (*mémoire*, i.e. Master Thesis) under the guidance of a professor from Paris-Sud or other universities in France or abroad. It will typically last at least three months and often lead to a PhD thesis. The project ends with a public defense, in July or September, and is graded by a Jury committee.

F.A.Q.

- **What and where are Orsay and Paris-Sud ?** Orsay is a small town 30' away from Downtown Paris by suburban rail (RER). It hosts one of the biggest campus for scientific studies in Europe : Université Paris-Sud, constantly ranked among the 10 best institutions worldwide for mathematics.
- **Who can apply ?** If you have finished (or will have by September) four years of studies after high school you can apply. The standard profile is a student having 4 or 5 years of studies in Maths or Applied Maths.
- **Do you admit everybody ?** Admission is selective, but we do not have a maximal number of students. We accept any good student interested in PDEs and numerical analysis, with a solid mathematical background.
- **What's the deadline for enrolling ?** you can submit your application till September.
- **Do I need special formal procedures to come to France and enroll for Master ?** It depends on your nationality. If you are European there is nothing special to do !
- **How much does it cost to enroll to Paris-Sud for this Master ?** Tuition fees are approximately 250 euros per year (+ Social Security if you need, Europeans don't really need). Besides that, you should obviously consider living expenses : Paris is an expensive city, but southern suburbs are much less.
- **Should I know French to follow your courses ?** No need ! our agreement with other universities in the Parisian region allows you to compose your list of courses choosing from all the four institutions.
- **Where are these universities located and is it easy to commute ?** Orsay and Polytechnique are in Southern Paris, Dauphine and UPMC in Downtown Paris. The main commuting tool is the RER B and it takes from 40' to 1h to connect the two poles. Each university concentrates its courses in English on a different day, so that you don't have to cross Paris several times a day.
- **Will I get a joint diploma by these four universities at the end of this program ?** No, you choose where to enroll, and then you get the diploma of the University you chose. You are just allowed to select courses from the other ones.
- **Do you have many foreign students ?** A lot ! in the last two years, 40% of the students came from abroad. By the way, one third of our teachers this year were also foreigners.
- **Is there a tutoring and/or a training program ?** Yes ! the year starts with two weeks of intensive training courses to freshen up the main notions. Tutoring by PhD students and PostDocs starts this year, and will be organized for selected courses and extended to all the basic courses in the next years.
- **Will you keep me for PhD ?** If you are brilliant student, we will fight to convince you to stay ! We have several different sources of PhD scholarships : it's competitive, but more than feasible.
- **What if I have further questions ?** Just write an email : `filippo.santambrogio@math.u-psud.fr` if you have pedagogical questions, `valerie.lavigne@math.u-psud.fr` for administrative ones.