



# MASTER'S PROGRAM

## AERONAUTICS & SPACE MAJOR TURBULENCE

This two years master's program aims at training engineers, physicists and mathematicians to be able to deal with any industrial or research environment thanks to their skills in computational, experimental and theoretical turbulence.



Three of the top French Technical Universities (**Centrale Lille, ISAE-ENSMA and ENSIP**) have teamed up to offer a unique programme. You will deal with both the science and the engineering of turbulent flow : the fundamental concepts of turbulence theory together with advanced, state-of-the-art computational and experimental methodologies.

Length of studies:  
**2 years**

Language of instruction:  
**English**

Course Directors:  
**Pr. JM. FOUCAUT**  
Centrale Lille  
**F. MARGNAT, PhD**  
ENSI Poitiers

Lecturers:  
**JC. VASSILICOS, JP. LAVAL,**  
**M. BOURGOIN, P. JORDAN,**  
**R. MANCEAU**



### Semester 1

#### Centrale Lille

30 credits | Core courses - 300 h

Mathematics for advanced fluid dynamics - Fluid Dynamics, flows stability and boundary layers - Turbulence theory - Theory of Experimental techniques: point and optical field measurement - Numerical Methods - Computer-aided numerical practice and software learning - French language and culture

### Semester 3

#### ISAE-ENSMA & ENSIP

30 credits | Core courses - 290 h

RANS/u-RANS/Hybrid modelling - Compressible turbulence - Stability & chaos - Signal processing - Aero-acoustics - Turbulent heat transfer French culture - Individual research project

### Semester 2

#### Centrale Lille

30 credits | Core courses - 140 h  
+ 2,5 months research project

Advanced turbulence theory & phenomena - Turbulent transport - Numerical simulation (CFD codes, parallel algorithms, HPC, LES & DNS) - Turbomachinery - Aerodynamics - Research project

### Semester 4

**Master Thesis** | 5 or 6 months

**The thesis takes place in a company or a laboratory, in France or abroad, cosupervised by one of the three universities involved (possibility to get a paid internship).**

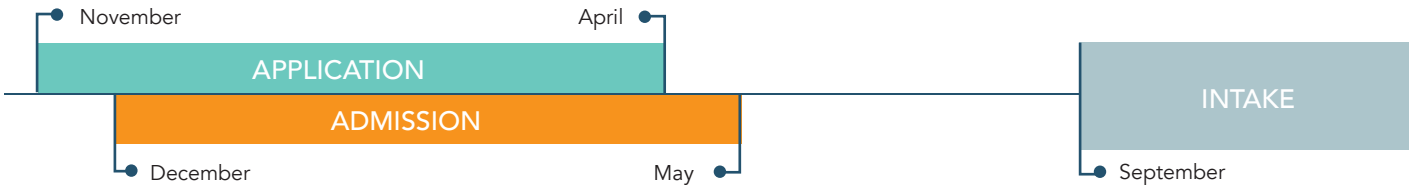
The program is tightly linked to ongoing research on turbulence and related topics in the two research laboratories: Institut P' and Laboratory of Fluid Mechanics of Lille - Kampé de Fériet (LMFL). These two laboratories have strong connections with CNRS, the French National Centre for Scientific Research.

# Admission

## Minimum requirements :

Bachelor's degree, or equivalent, in Science or Engineering disciplines which lends itself to the study of Turbulence, e.g. Mechanical, Aerospace, Engineering Physics, Physics or Applied Mathematics. Applicants must be fluent in English - written and spoken.

Tuition fees : 14 000€ for the two-years program



Apply online : <http://imp-turbulence.ec-lille.fr>



## Job prospects and further PhD studies

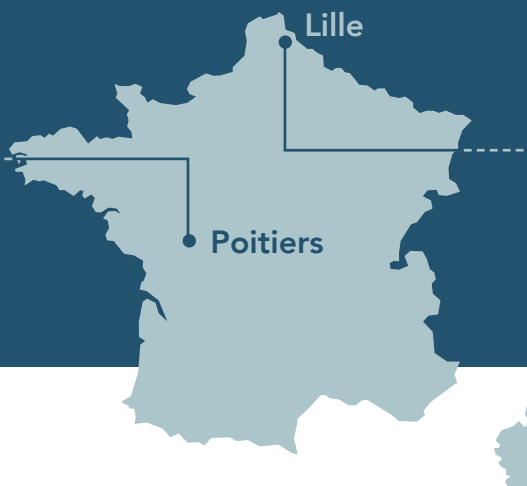
### Sector :

Aerospace, aeronautics, automotive, chemicals, electricity, oil & gas, renewable energy, transports.

### Carreer :

About 50% of graduated students choose to carry out a PhD in prestigious research laboratories. The other 50% go to the corporate world in Europe and outside Europe.

More than 100 graduates are now well established and successful professionals in both industry and reasearch structures. The TIMP-ALUMNI association (Turbulence International Master Programme Alumni) is a registered nonprofit organization in France founded in 2013. You will be able to benefit from this rich professional network and keep links with former, contemporary and future students.



## Contact :

[masters@centralelille.fr](mailto:masters@centralelille.fr)  
[international@ensma.fr](mailto:international@ensma.fr)