Potential mobilities
from NSU to Ecole des Ponts ParisTech

for students
presently following their M1 (or M2)
in the "Mechanics and Mathematics" and in
the "Physics" department

M. Vandamme

Types of mobilities

- **Type "M1 Spring": Spring semester of M1 in France, to work full time on a project. Would replace the Spring semester of M1 in Russia. In the Applied Maths & Computer Science department. Ideally, the student should arrive at the beginning of the semester, i.e., at the beginning of February 2016.**

- Type "M2 Fall": Fall semester of M2 in France, to follow the semester of classes of a French M2. Would replace the Fall semester of M2 in Russia.

- Type "Full M2": Full year of M2 in France, to follow the semester of classes + a research internship in France. Would come in-between the M1 in Russia and the M2 in Russia.

A high-level scientific background since 1747: some famous alumni

Navier

$$\rho \left(\frac{\partial \mathbf{v}}{\partial t} + \mathbf{v} \cdot \nabla \mathbf{v} \right) = -\nabla p + \nabla \cdot \mathbf{T} + \mathbf{f}$$
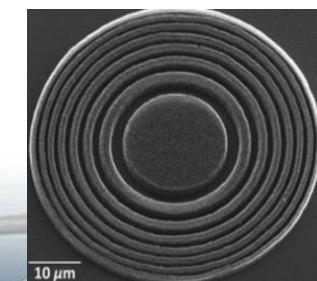
Cauchy

Coriolis

Vicat

Fresnel

Becquerel

10 µm

École des Ponts ParisTech
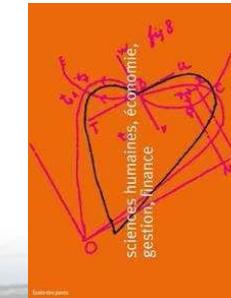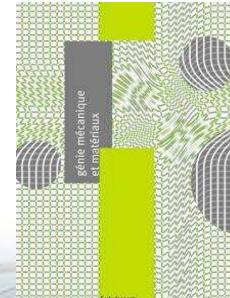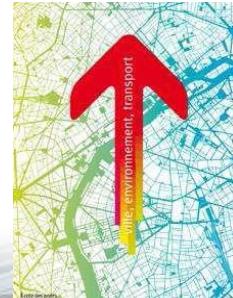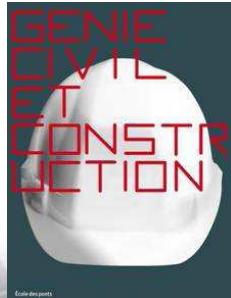
A strong technical and scientific content

- Civil Engineering and Construction
- Urban Planning, Environment and Transport
- Mechanical Engineering and Materials Sciences
- Industrial Engineering
- Economic Sciences, Management and Finance
- Applied Mathematics and Informatics

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## A participative education

Gridshells

Image recognition for mobile applications

A close relationship with industry
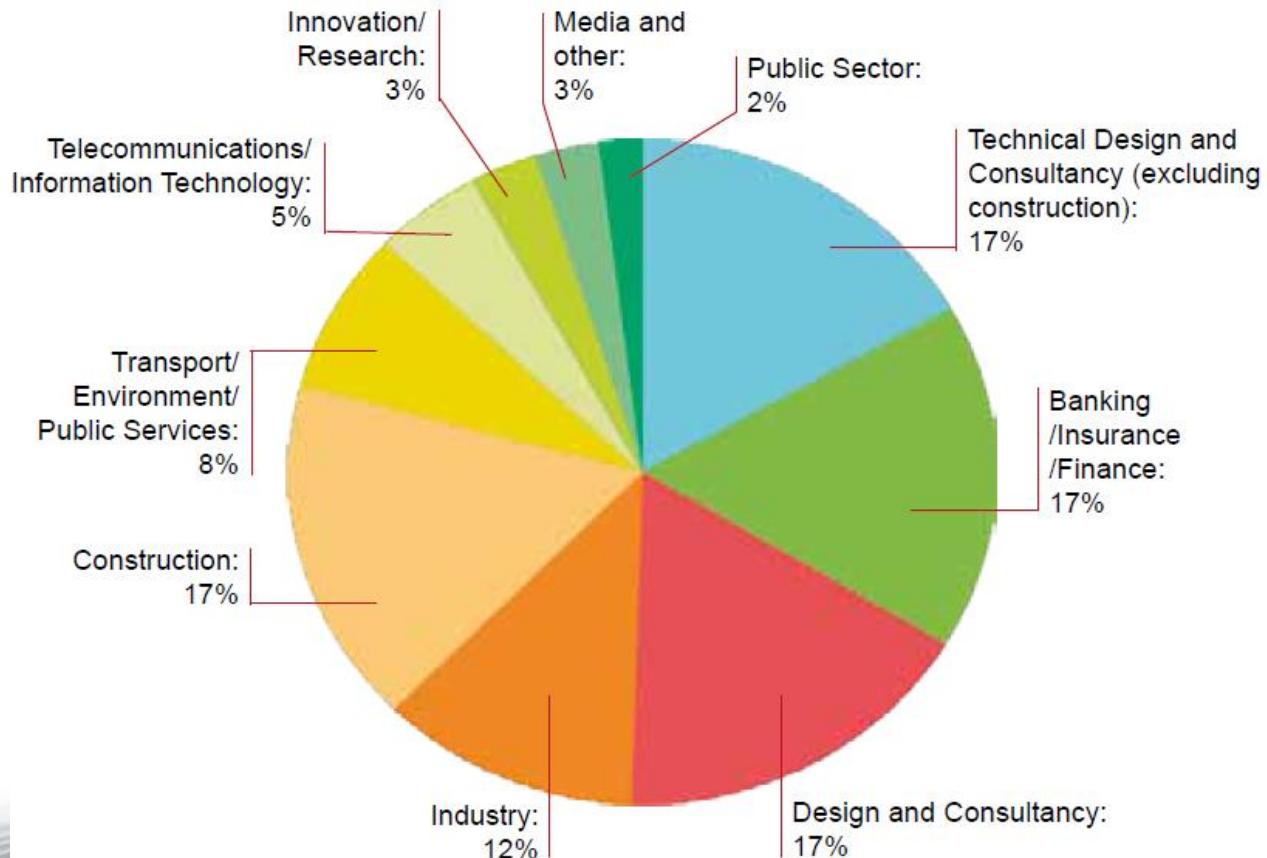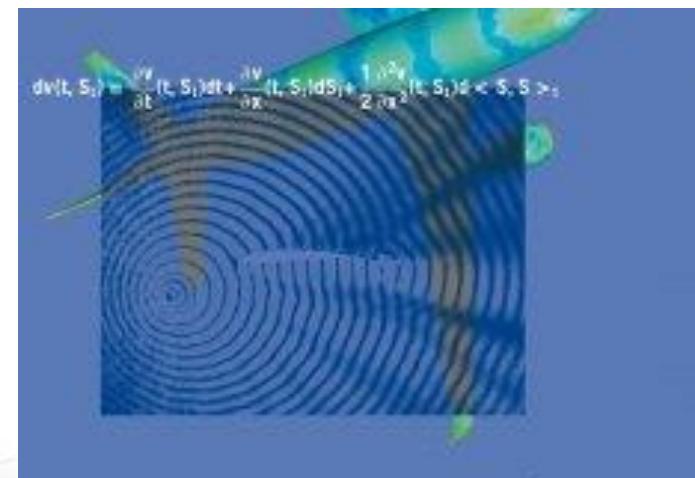
Recognition by industry and alumni

Innovation/Research: 3%
Media and other: 3%
Public Sector: 2%
Telecommunications/Information Technology: 5%
Technical Design and Consultancy (excluding construction): 17%
Transport/Environment/Public Services: 8%
Banking/Insurance/Finance: 17%
Construction: 17%
Industry: 12%
Design and Consultancy: 17%

École des Ponts ParisTech

Applied Mathematics and Informatics department (IMI department)

• Dedicated to numerical modeling and the use of efficient numerical methods

• 4 specialties:
- Numerical analysis
- Maths applied to finance
- Vision and learning
- Optimization

www.enpc.fr

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Erasmus+ stipends

- Transportation reimbursed up to 820€

- Stipend of 850€/month while in France

"M1 Spring"

"M1 Spring" semester in France
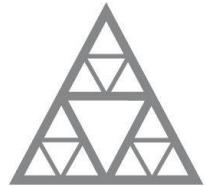
- To work full-time on a student project in the Applied Maths & Computer Science department. The list of the projects is given afterwards.

- From beginning of February 2016 (ideally) to beginning of June 2016.

- The student would be included into a group of students from Ecole des Ponts.

- Brings no additional diploma.

- The student could interact in English with the rest of the group.

- Eligible to Erasmus +

- Cost: Social security (215€) + scolarity fees (418€)

List of projects
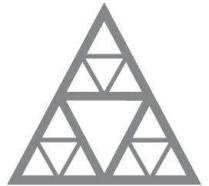
- Project "The automated road". Industrial partner: Inria.
- Project "Neural networks for molecular dynamics". Industrial partner: CEA.
- Project "Simulation of exchanges between trains and platform". Industrial partner: startup Spirops
- Project "Robot on Mars". Industrial partner: MathWorks - Matlab
- Project "One application of big data: Simulation of a bank agency". Indutrial partner: Wincor-Nixdorf - Siemens
- Project "Risk covering of value of portfolio in an insurance company". Industrial partner: AXA.
- Project "Modeling of dependency in an intensity model". Industrial partner: Société Générale.

The automated road

- [RITS team at Inria](#) : Computer science, Mathematics, and Automation. For the automated road. **(see also [here](#))**

- Vehicle lateral dynamics present one of the major challenges when trying to control an automated vehicle. The objective of this project will be to further investigate the design and implementation of a lateral controller for an automated vehicle. For doing so, the next task will be accomplished:

    1. Design a state-space vehicle dynamic model

    2. Definition of an estimator for the measurement of not available state variables

    3. Design of a feedback controller, identifying the limits of the system in terms of stability

    4. Testing the designed controller in the Pro-Sivic environment for its validation in simulation

    5. Implementation of the designed controller in the INRIA experimental platform, validating the proposed algorithm.

- Requirements: Matlab/Simulink, C or C++ programing language
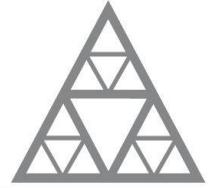
Neural networks for molecular dynamics
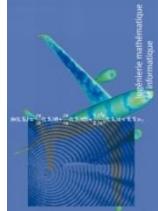
Project in partnership with **CEA and CERMICS (the Applied Maths lab at Ecole des Ponts ParisTech)**

- Aim : use of machine learning techniques for

- determining an interatomic interaction potential

- Actual output : potential energy

- "neural networks" = nonlinear function between input and output parameters

- Wanted output: forces = gradient of energy

- In practice: problem of nonlinear optimization in large dimensions

- Practical conditions:

    - C++ code provided (simple, about 100 lines)

    - Database of forces/energy of atoms
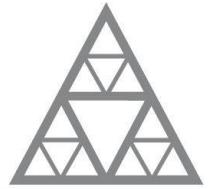
# Simulations of movements of persons between trains and platform

• Spir Ops : Artifical Intelligence, crowds simulation

• Main topics tackled :

  • Simulation of movements of persons between train and station during the stop at the BNF train station in Paris

  • Modeling of the behaviors:

    • Train driver

    • Placement of the persons on the platforms

  • Redesigning of the platform to favor more homogeneous placements on the platforms

Robot on Mars

• Project in partnership with MathWorks (Editor of Matlab) :

- **Objective:** Explore the environment and recognize objects thanks to the robot *Rover* - « Innorobo - Mission on Mars Challenge » organized by MathWorks (voir ici aussi),
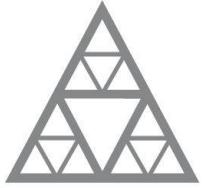
Discover the robot *Rover* on video

- **Provided material:** Robot *Rover* (manufactured with a 3D printer and equipped with a webcam and cards Raspberry Pi and Arduino)

- **Content of project:**
  - –Research and comparison of algorithms for vision and of machine learning for objects recognition
  - –Study of the compromises between performance/ease of implementation
 - –Implementation on *Rover*
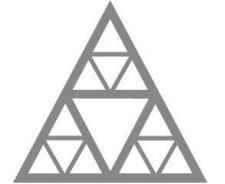
One application of big data: Simulation of a bank agency

• Project in partnership with the society Wincor-Nixdorf (now part of Siemens)

Hedging strategies of interest rate risk in an assurance company portfolio

• AXA France - Direction of Investments

• Topics tackled :

  • Intererest risk of a portfolio in an insurance company

  • Rate products of type Swaptions

  • Stochastic models: Libor Market Model (LMM+) to describe the rates of the market

  • Programming

• Objective :

  • Implementation of a model LMM+ to evaluate the rate products of type Swaptions.

"M2 Fall" or "Full M2"

"M2 Fall" and "Full M2" in France

- Masters from the "Applied Maths & Computer Science" or the "Mechanical Engineering & Materials Science" department. The list is given afterwards.
- All masters start around September 2017.

- "M2 Fall":
  - Would replace the M2 Fall semester in Russia.
  - If the research topic in Russia is OK for the head of the French M2, research in Russia could validate the research internship of the French M2 and make it possible to obtain the French M2 diploma.
  - Eligible to Erasmus +
- "Full M2":
  - Would come in-between the M1 in Russia and the M2 in Russia (i.e., 1 additional year)
  - The student would obtain the French M2.
  - Eligible to Erasmus + if NSU can register the students and recognize some of the credits
- Cost: Social security (215€) + scolarity fees (817€) + master registration if aim is to obtain M2 diploma (cost not defined for 2016-2017)

List of masters "Applied Maths"
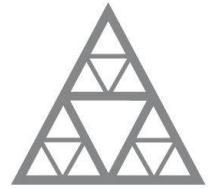
- Applied maths & computer science department:
  - "MVA" (Mathematics, Vision, Learning):
    - Classes finish End of March 2017
    - In French
    - http://www.enpc.fr/master-mathematiques-vision-apprentissage-mva

  - "MAF" (Mathematics Applied to Finance):
    - Classes finish End of March 2017
    - In French
    - http://www.enpc.fr/master-mathematiques-appliquees-la-finance-maf

  - ANEDP (Numerical Analysis and PDEs):
    - Classes could finish End of March 2017, depending on the classes chosen
    - In French
    - http://www.enpc.fr/master-analyse-numerique-equations-aux-derivees-partielles-anedp

  - MPRO (Parisian Master of Operational Research):
    - Classes run on the full 2016-2017 school year, with the research internship intertwined.
    - In French
    - http://uma.ensta-paristech.fr/mpro/

List of masters "Mech. & Mat. Sc."

- Mechanical Engineering and Materials Science department:
  - "AMMS" (Micromechanical Approaches for Sustainable Construction):
    - Classes finish mid-February 2017
    - In French
    - http://www.enpc.fr/master-mecanique-des-materiaux-et-des-structures-mms

  - "SMCD" (Materials Science for Sustainable Construction):
    - Classes finish mid-February 2017
    - In English
    - http://www.enpc.fr/en/master-material-science-sustainaible-construction-smcd

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