

# Higher Institute of Simulation and Engineering

- SUP 'SIMU -



*Xeon Phi cards for  
Parallels computing*



The **Personnals Computers** and the **CLOUD** give acces to smalls, midles and greats enterprises to powers computing that allow to optimize the costs of achieving their engineering projects using simulations and manufacturing them by CFAO or 3D printing.

*The simulation covers all areas and fields of knowledge : mechanical, hydrodynamic , electrical, biology, buildings, aerodynamics, thermal , nuclear, video games, defense ..*



**Training of engineers mastering simulation**

# Training : 3 years

Direct access  
3<sup>rd</sup> year

Access 1<sup>st</sup> Year

EUROMASTERE in SIMULATIONS &  
EXTREMES ENVIRONMENTS

School of Simulations and  
Engineering

Video games

phenomenology

- Neutronic
- Détonics
- Radar
- Sonar
- Structural Mechanics
- Fluid Mechanics
- Thermal – Fire
- Internal-External Ballistics
- Etc ...

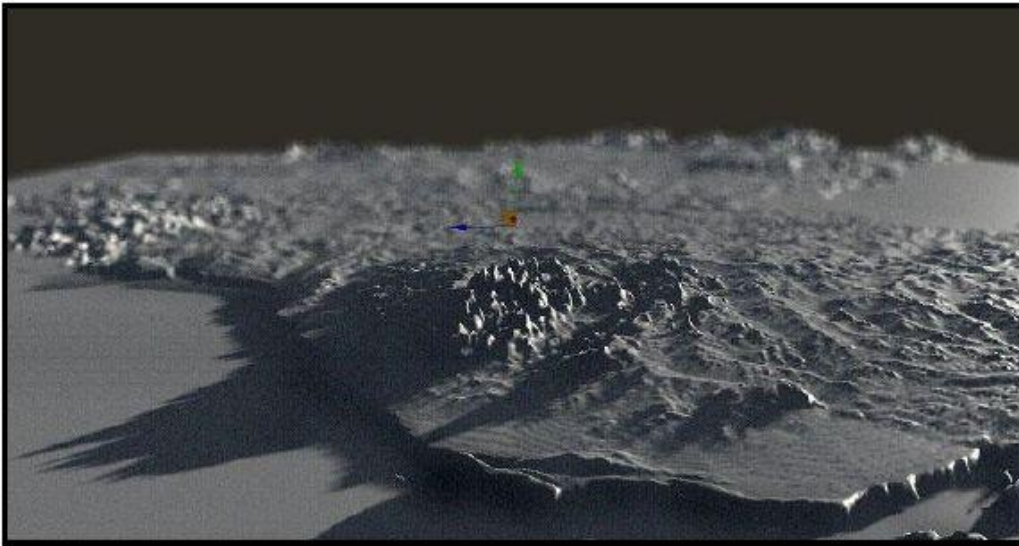
Nice  
environment



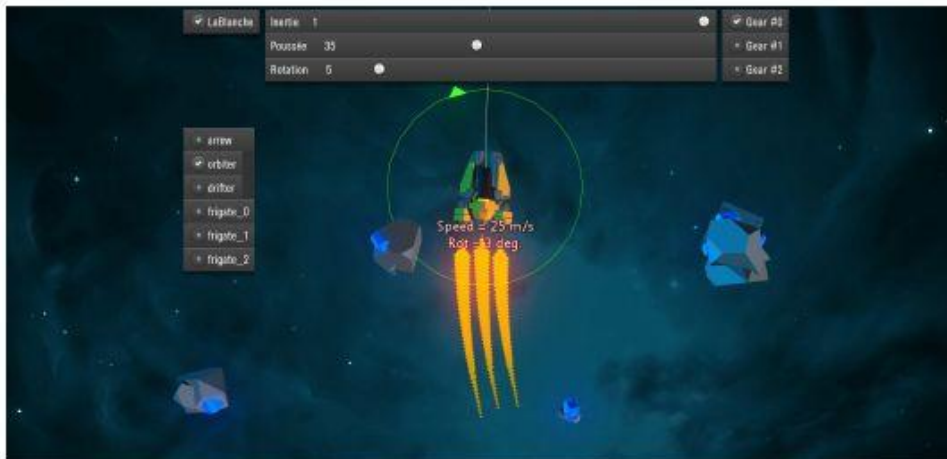
MOOC Classroom



# Extract of video games Courses



*Visualisation temps-réel de données d'élévation*



*Boucle de jeu, contrôles, affichage*

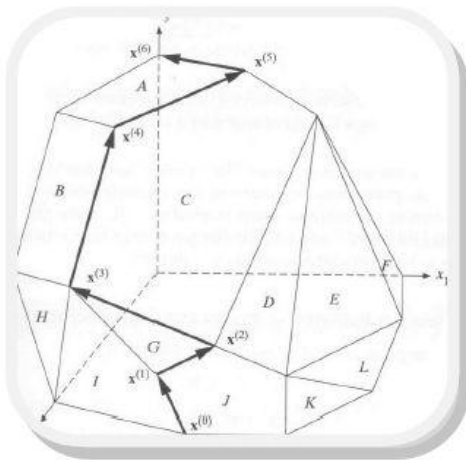


*Traitement d'image*



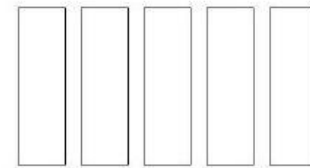
# Extract of Operational research Courses

## Introduction à la recherche opérationnelle

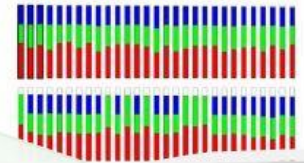
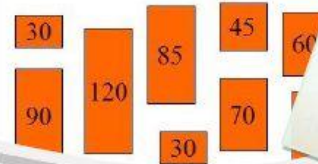


Algorithmique Logistique  
*Complexité* Simplex  
Organisations Recuit Simulé  
*Aéronautique* Médecine  
Théorie des graphes Industrie  
...

### The Bin Packing Problem



- Pack all the pieces into as few bins as possible



Modéliser

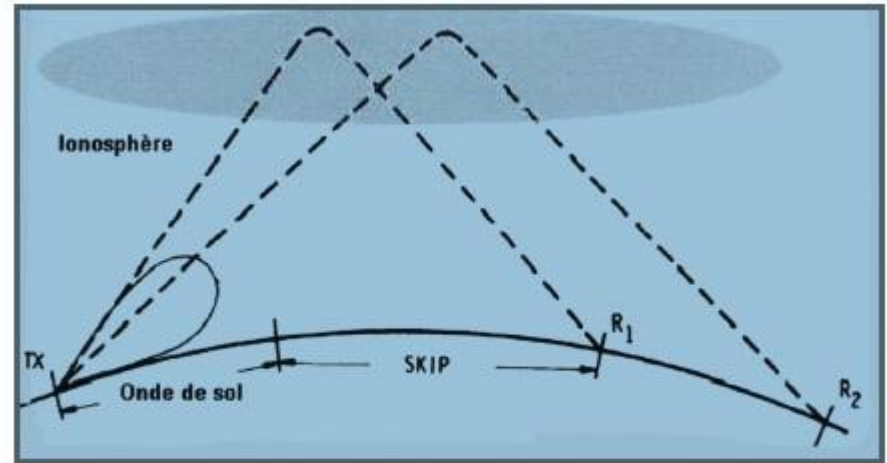
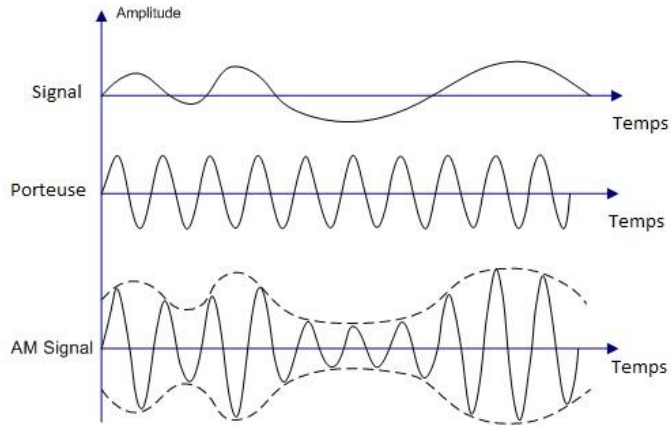
Objectif du cours : Acquérir les notions, méthodes et principes généraux utiles à l'analyse de problématiques posées par des domaines variés (de la médecine à la logistique) en vue de les rationaliser



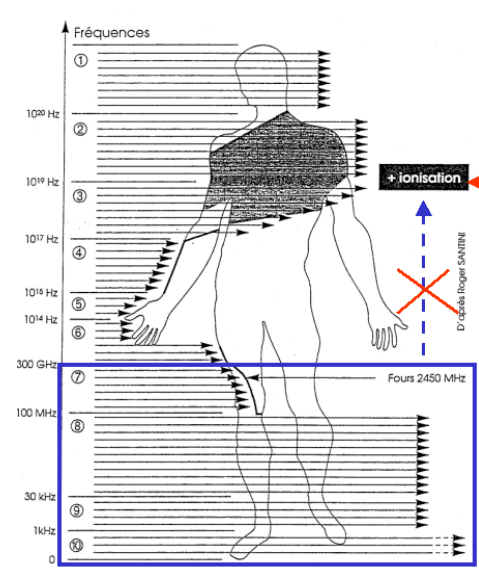
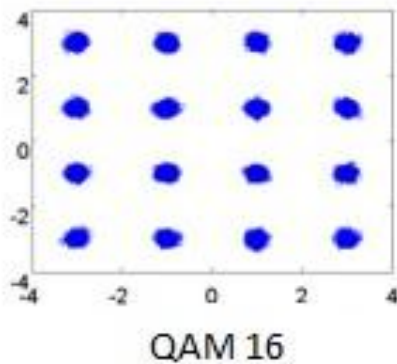
Optimiser



# Extract of Telecom Courses



*Avec un angle de tir très faible, l'onde de sol s'atténue rapidement et une zone de silence existe (skip)*



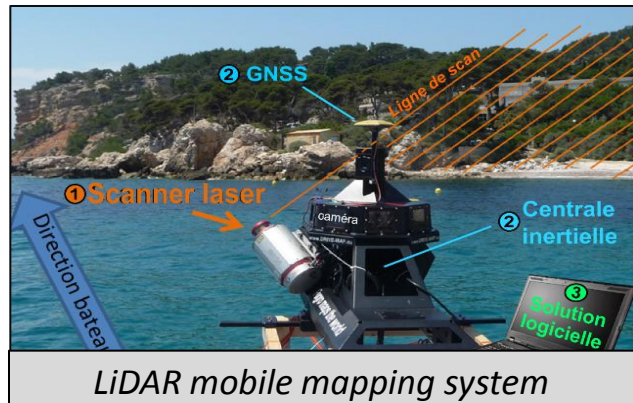


# Extract of Building techniques - Soil & 3D Big Data Courses

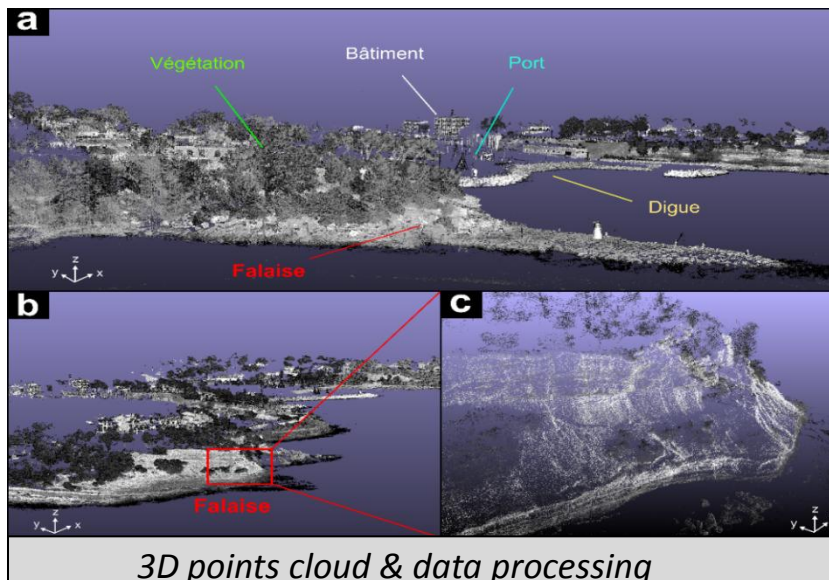
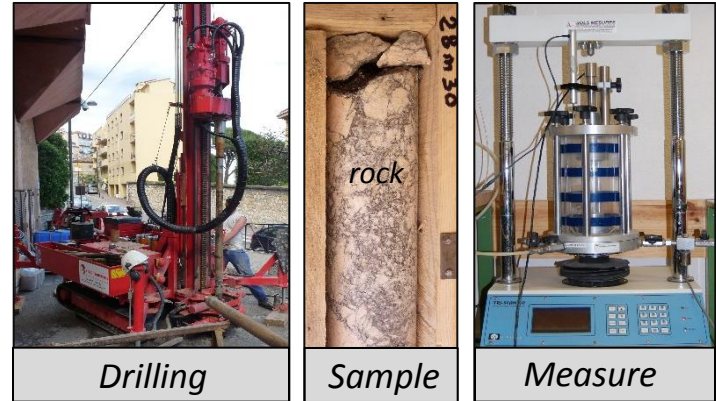
Acquisition & LiDAR data :

Building & Soil :

## Remote sensing - Numerical simulation



## Geotechnics – Physical simulation



# Extract of Nuclear – Neutronics Courses

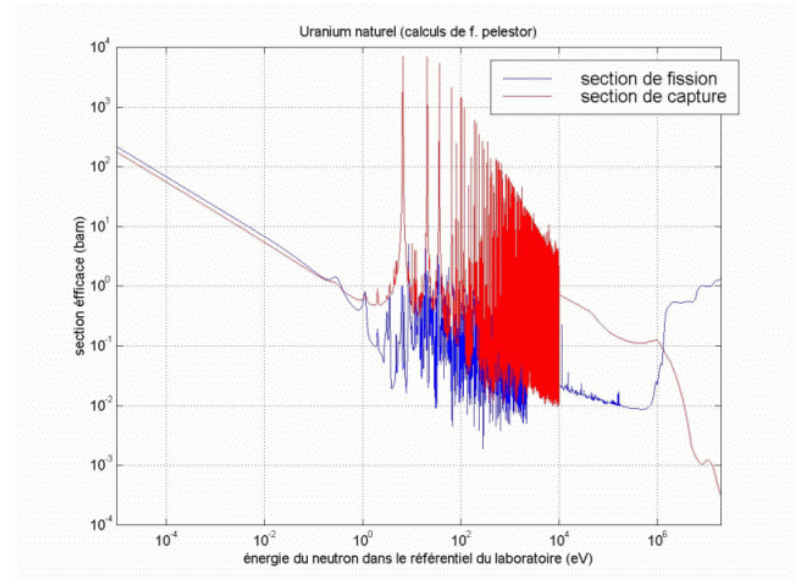


Hydrodynamic – neutronic coupling necessary for the study of nuclear accident (here compute with  $K_{static}$  which overestimates the supercritical duration  $\rightarrow \Delta t_{supercritique}$  too long)

## Equation du Transport avec neutrons retardés :

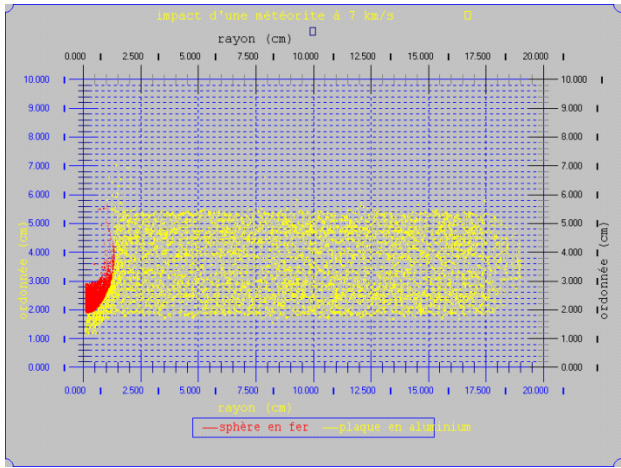
$$\begin{aligned} \partial F(\mathbf{v}, \mathbf{r}, t) / \partial t + \mathbf{v} \cdot (\nabla F(\mathbf{v}, \mathbf{r}, t)) + N \cdot \sigma(\mathbf{v}) \cdot \mathbf{v} \cdot F(\mathbf{v}, \mathbf{r}, t) &= S(\mathbf{v}, \mathbf{r}, t) + N(\mathbf{r}, t) \cdot \mathbf{v}' \cdot F(\mathbf{v}', \mathbf{r}, t) \\ \partial \{ [\sigma_f(\mathbf{v}') \cdot \mathbf{v}(\mathbf{v}') \cdot (1 - \beta) \cdot g_f(\mathbf{v}) + \sigma_{in}(\mathbf{v}') \cdot g_{in}(\mathbf{v}', \mathbf{v})] / (4 \cdot \pi) &+ \sigma_{el}(\mathbf{v}', \theta_L) \cdot \delta(\mathbf{v} - \mathbf{h}(\mathbf{v}', \theta_L)) \} \cdot d\mathbf{v}' d\Omega' + \\ \partial \lambda_i \cdot c_i(\mathbf{r}, t) \cdot g_i(\mathbf{v}) / (4 \cdot \pi) \end{aligned}$$

ignition probability in case of accident :  $p(n, t) = \frac{r^{\eta-1} e^{-r}}{\Gamma(\eta)} \frac{\eta}{\bar{n}(t)}$

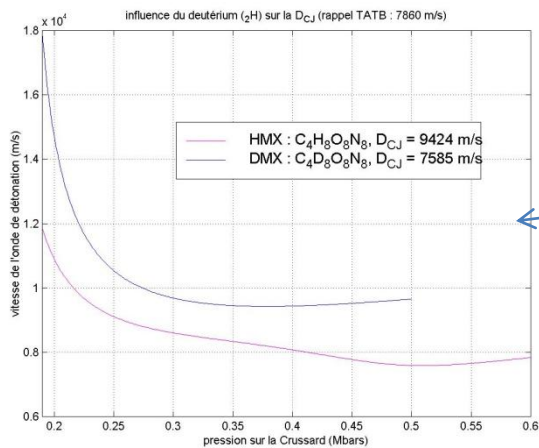


Calculation of cross sections

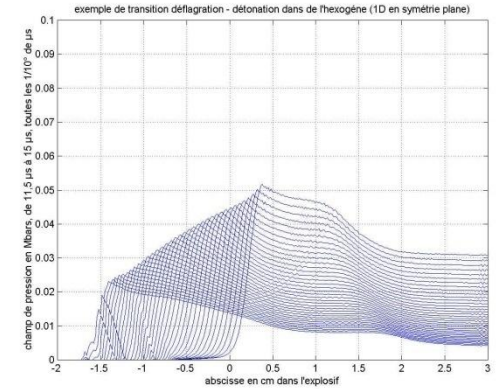
# Extract of Detonics Course



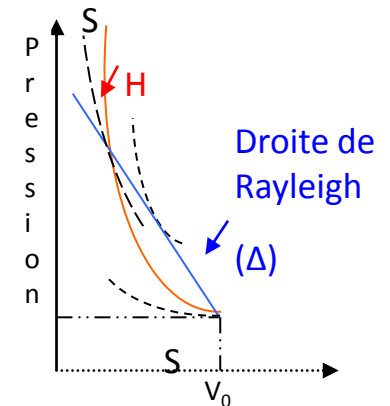
*Impact hyper vitesse (7 km/s)  
D'une bille Fe sur une cible Al*



*Explosives properties obtained with  
thermochemicals simulations*



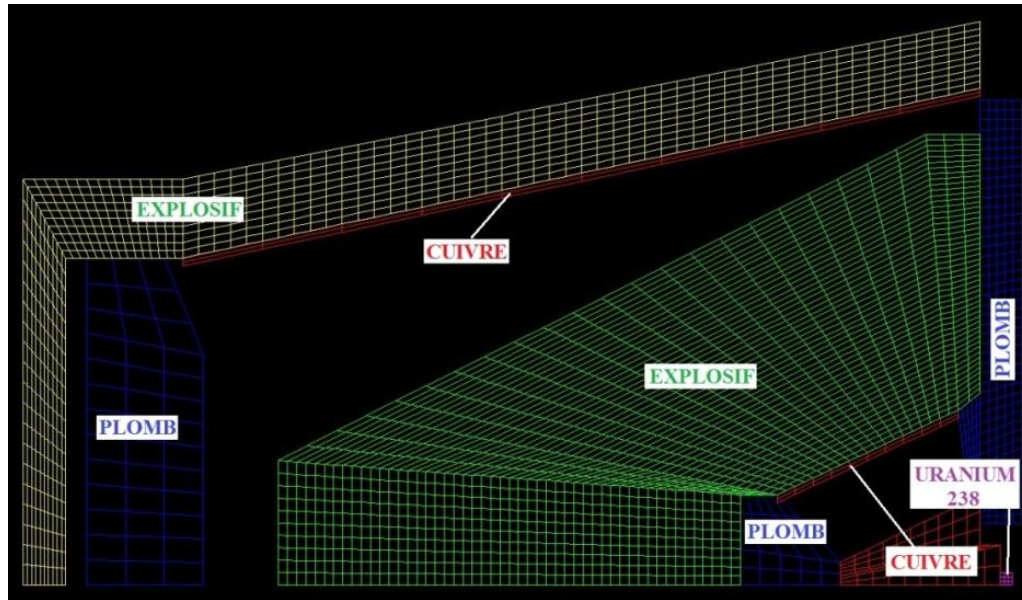
*Deflagration - detonation transition*



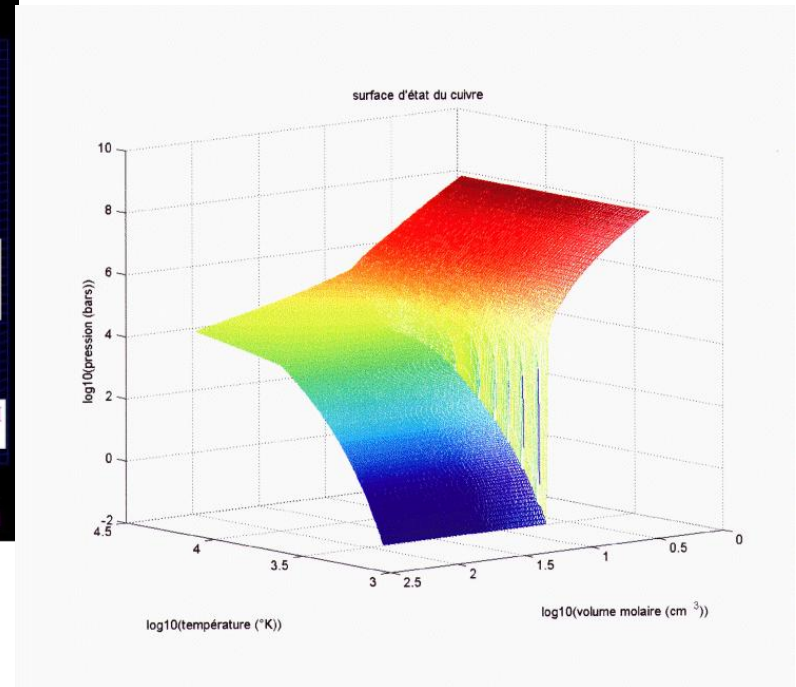
*Thermodynamics of  
explosives*



# Extract of Equations Of State Courses

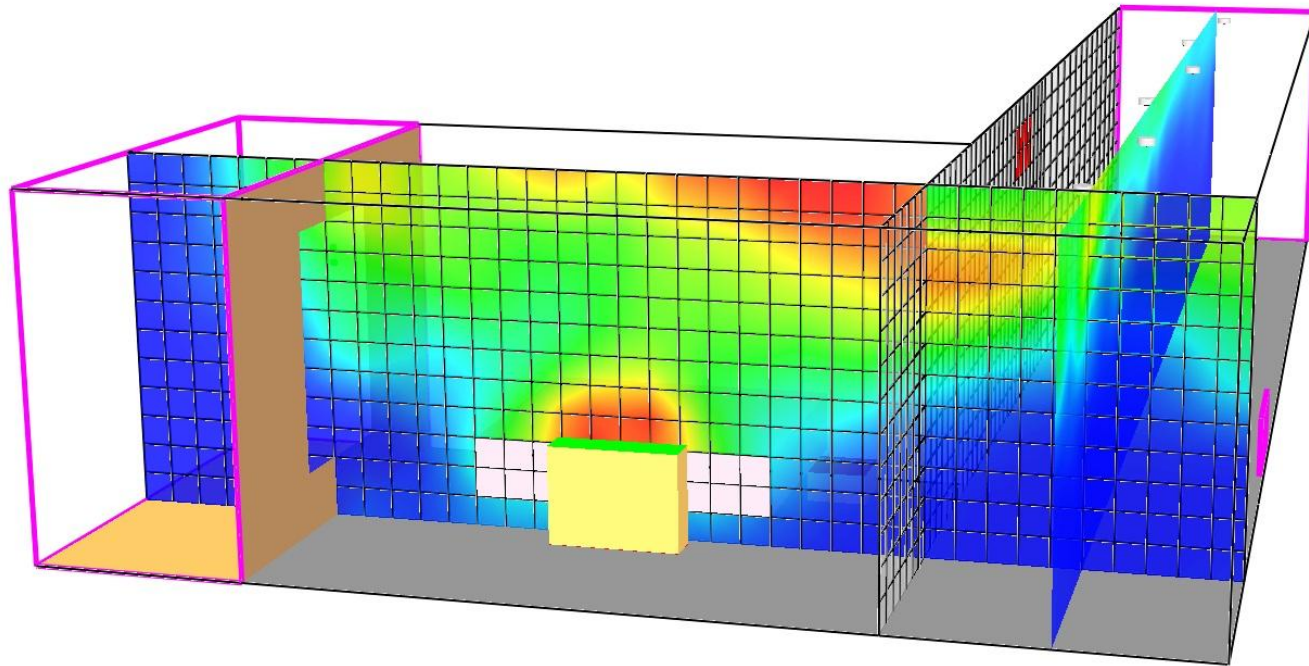


*Mesh for the simulation of the change in gas liquid solid phase at the end of comparison with the experience gained from the bibliography, See article : " vaporizing of uranium after - schock loading "*



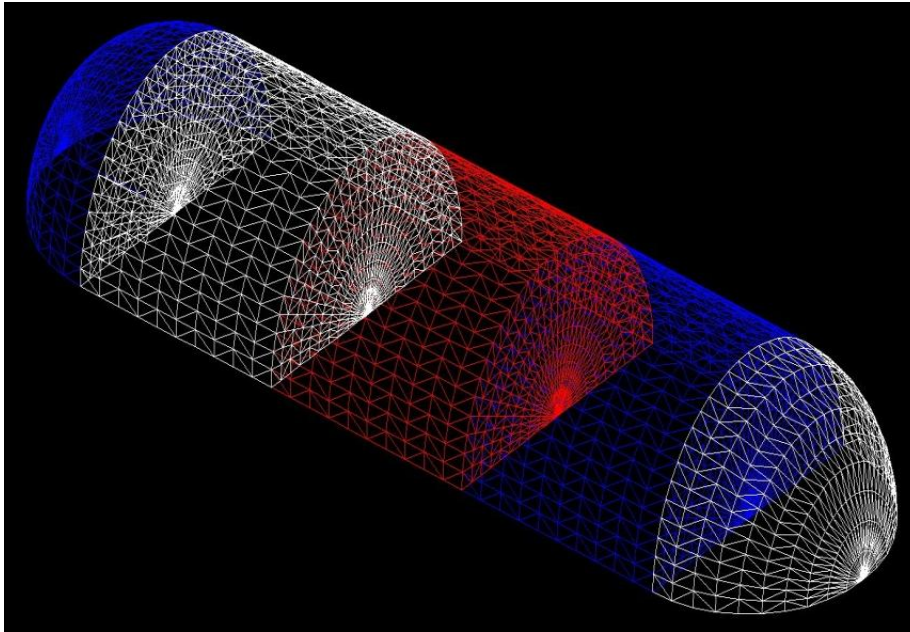
*Equations of state copper  
at very high pressure and temperature*

# Extract of Thermal Courses

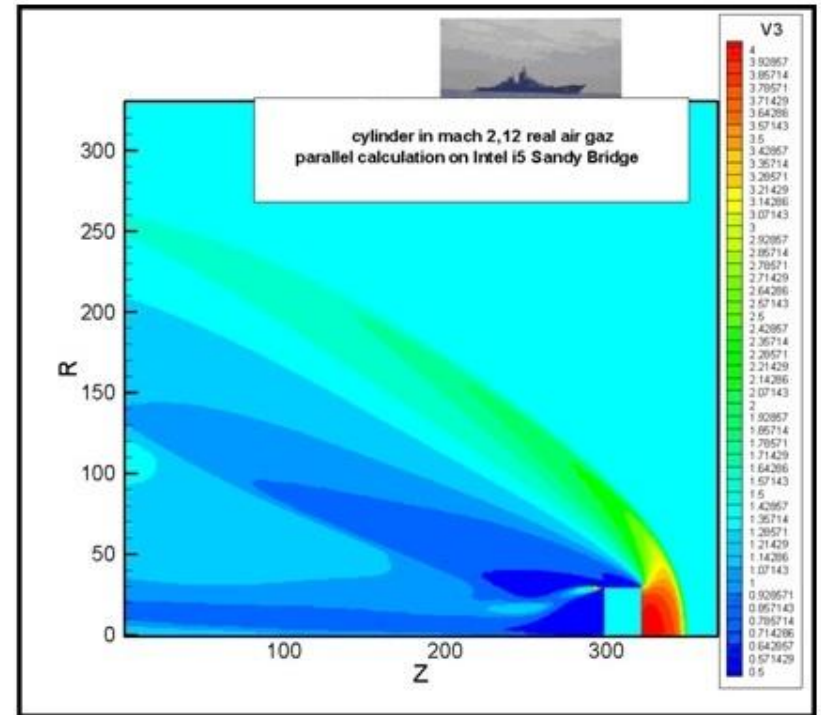


*Propagation of a Fire in a Building*

# Extract of Structural and Fluids Mechanics Courses



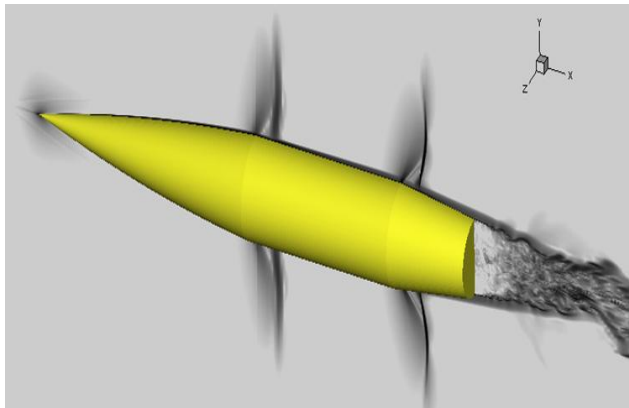
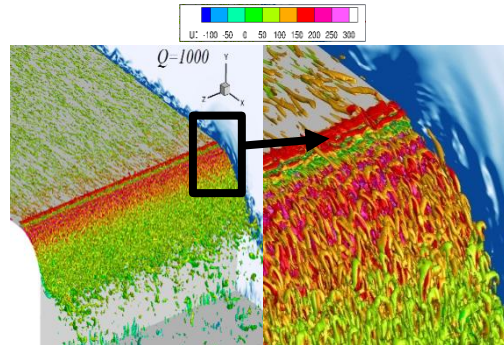
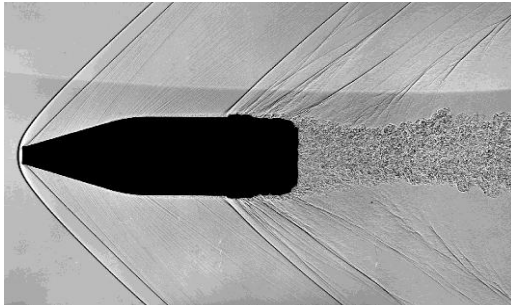
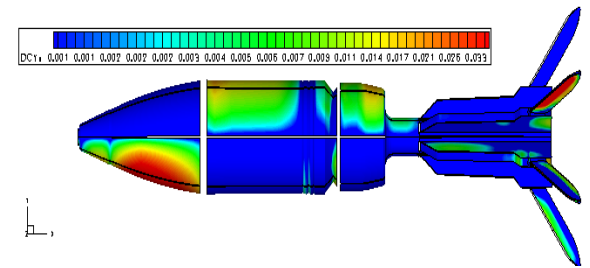
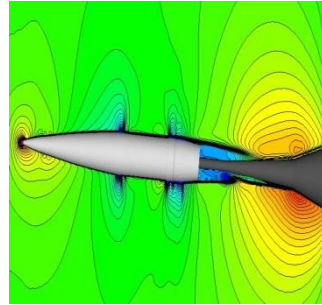
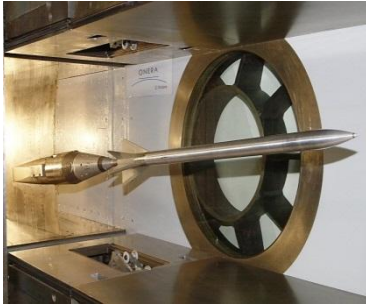
*Finite Element Mesh*



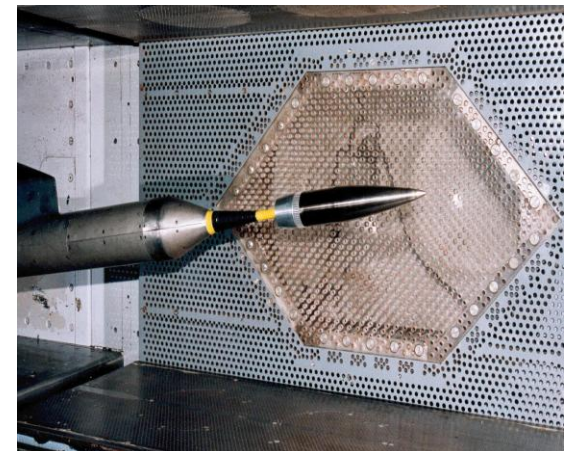
*Écoulement autour d'un cylindre se déplaçant à Mach 2 dans l'air*



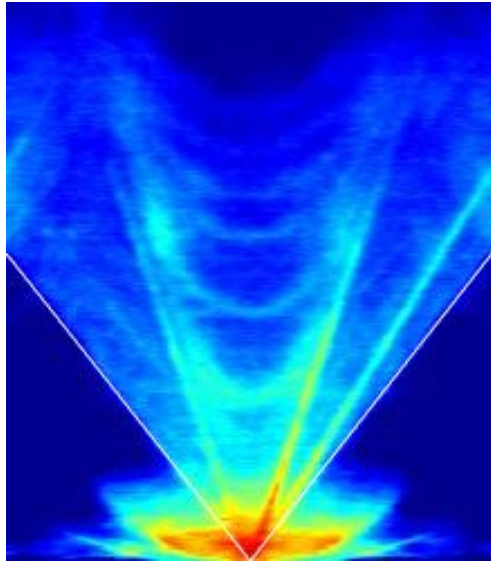
# Extract of aerodynamics and ballistics courses



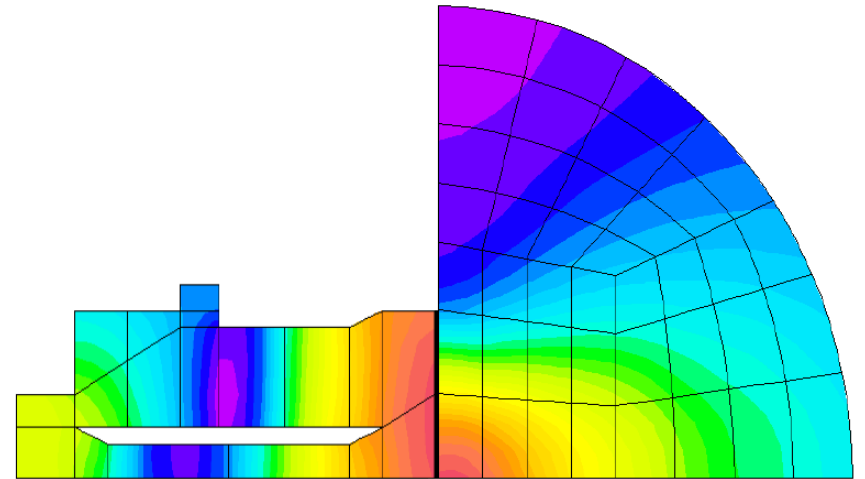
*Criterion Q colored by the longitudinal velocity and Criterion Q colored by the longitudinal velocity and digital Schlieren for three values of  $Q / (U^\infty D)^2 = 1000$  in the case of the full scale*



# Extract of Sonar and Propagation Courses

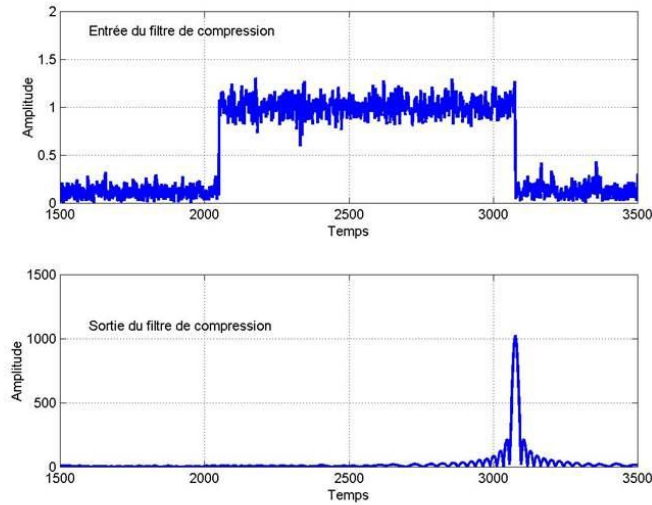


*Kw analysis of a side antenna*



*EF modeling a transducer*

# Extract of Radar Courses



*adjusted filter*



*Radar for air traffic control*

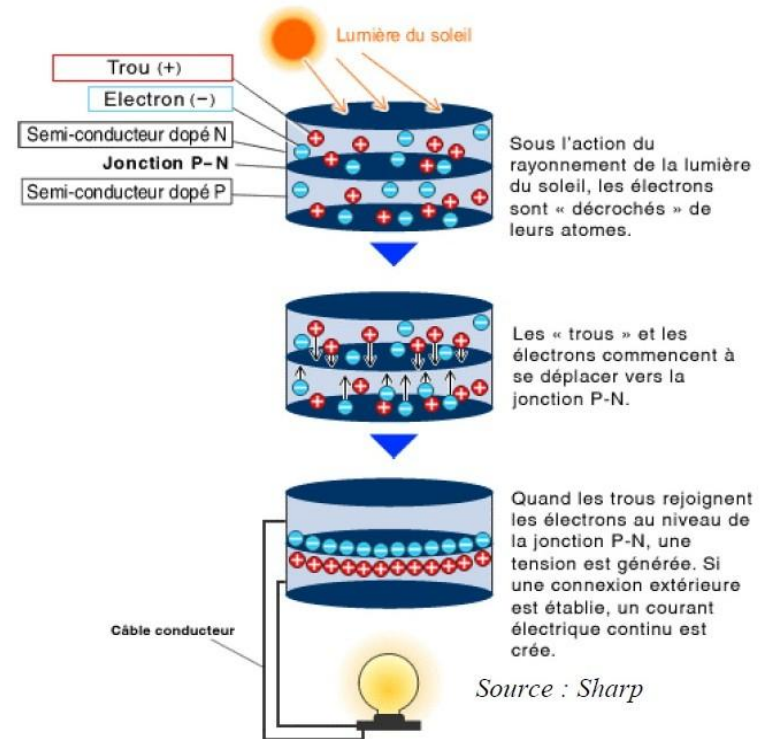
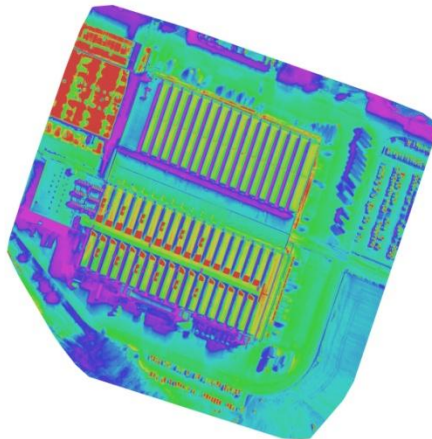
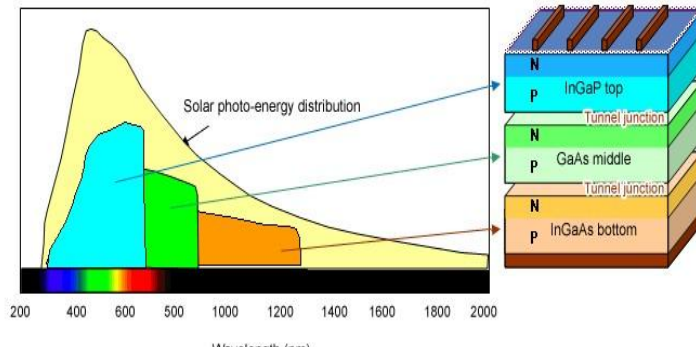


*Radar measurement*

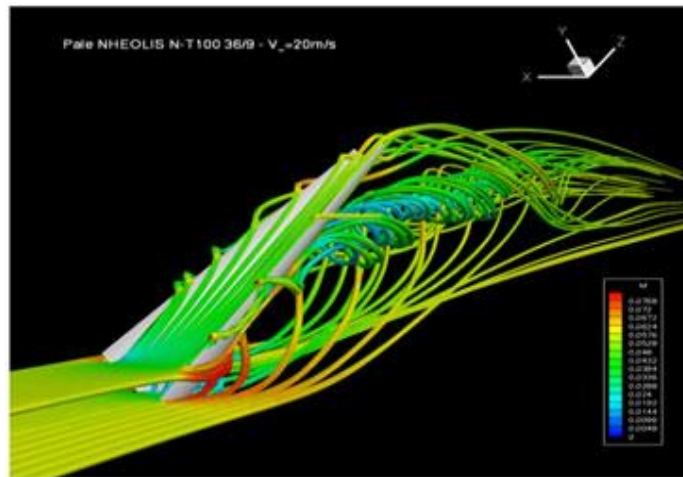
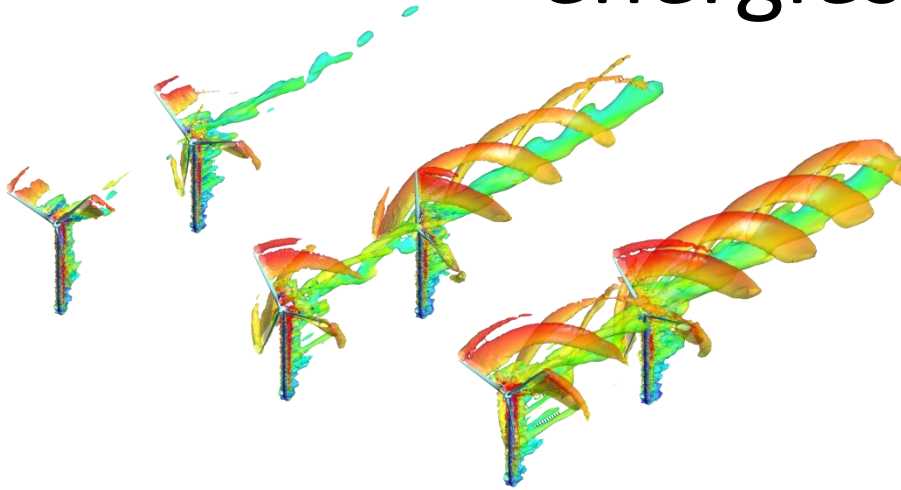


# Extracts of the course of renewable energies

Wavelength Distribution of Solar Photo-Energy and Wavelength Sensitivity of Triple-Junction Compound Solar Cell



# Extracts of the course of renewable energies



# Higher Institute of Simulation and Engineering

## 1<sup>st</sup> year

### 1<sup>st</sup> semester (30 ECTS)

Module A1 : <b>Project Management- web</b>	2 ECTS		
Module A2 : <b>Languages</b>	2 ECTS	Module B2 : <b>Informatics</b>	7 ECTS
<ul style="list-style-type: none"> <li>• English</li> <li>• Portugais</li> <li>• Spanish</li> <li>• German</li> <li>• Persan-Dari-Turque-Kurde-arabe</li> <li>• Italian</li> </ul>		<ul style="list-style-type: none"> <li>• Languages and linux - Shell &amp; makefile ,</li> <li>• - CAM and 3D PRINT , Big Data, imagerie médicale</li> <li>• - Design protected websites - PHP - APACHE</li> </ul>	
Module A3 : <b>Communication - web</b>	4 ECTS	Module B3 : <b>Fluids Mechanics</b>	5 ECTS
groupware crowdsourcing project Géopolitique et renseignements		<ul style="list-style-type: none"> <li>• Continuum mechanics , numerical schemes ,</li> <li>• - Aerodynamics , combustion</li> <li>• - Oceanography</li> </ul>	
Module B12 : <b>Financial Mathematics</b>	1 ECTS	Module B4 : <b>Electrotechnics</b>	1 ECTS
		•-Basics and fundamentals	
Module B1 : <b>Mathematics for Physics</b>	6 ECTS	Module B5 : <b>Introduction to video games</b>	1 ECTS
<ul style="list-style-type: none"> <li>• Torsors , tensors , Partial Differential Equations</li> <li>• Numerical analysis</li> <li>• Optimization - Operational Research</li> <li>• Signal processing; Distribution</li> </ul>			
Module C1 : <b>Conferences (combat systems , point sextant , ...)</b>			1 ECTS
Module C2 : <b>Visits (Tokamak, SNLE Le Redoutable at Cherbourg, ...)</b>			



# Higher Institute of Simulation and Engineering

## 1<sup>st</sup> year

### 2<sup>nd</sup> semester (30 ECTS)

#### Module B5 : **Fast dynamic - detonics**

3 ECTS

- Shocks Waves
- Detonation Waves

#### Module B6 : **Thermal**

6 ECTS

- Overview
- fires
- digital tools
- Solar energy
- Combustion

#### Module B7 : **Structural Calculations**

3 ECTS

- RDM
- Codes Finite Element

#### Module B8 : **Radars & Electromagnetics**

3 ECTS

#### Module B9 : **Sonar & Acoustic**

2 ECTS

#### Module B10 : **Building techniques and Soil**

2 ECTS

#### Module B 11 : **Nuclear reactors and Neutronics**

3 ECTS

- Classical theory and random neutronic
- Equations of state applied to safety
- Cross sections , nuclear reactors

#### Module B12 : **Quantum mechanics**

2 ECTS

#### Module P1 : **Custom Professional Project**

6 ECTS

*This module is a working simulation or modeling performed alone or in teams, in the framework of a project defined by one or professors, or to meet the needs of a company*

# Higher Institute of Simulation and Engineering

## 2<sup>nd</sup> year

### 1<sup>st</sup> semester (30 ECTS)

Module A1 : <b>Management</b>	2 ECTS	Module B1 : <b>Mathematics for Physics</b>	5 ECTS
		<ul style="list-style-type: none"><li>• Partial Differential Equations</li><li>• Numerical analysis</li><li>• Complex, Hypercomplexe Calculations</li><li>• Differentiable Manifolds – topology</li></ul>	
Module A2 : <b>Languages</b>	4 ECTS	Module B2 : <b>Informatics</b>	6 ECTS
<ul style="list-style-type: none"><li>• English</li><li>• Portuguese</li><li>• Spanish</li><li>• German</li><li>• Persian-Dari-Turque-Kurde-arabe</li></ul>		<ul style="list-style-type: none"><li>• Parallel Computations</li><li>• Networks</li><li>• , imagerie médicale - Web sites</li></ul>	
Module A3 : <b>legal knowledge</b>	3 ECTS	Module B3 : <b>Reactive Flows</b>	6 ECTS
Géopolitique et renseignements		<ul style="list-style-type: none"><li>• Interior ballistics , combustion</li><li>• Engine type – reaction</li><li>• Calculation Codes</li></ul>	
Module A4 : <b>New business start up</b>	1 ECTS	Module B4 : <b>Materials</b>	2 ECTS
Module C1 : <b>Conferences</b> (armurerie, ...)			1 ECTS
Module C2 : <b>Visits</b>			

# Higher Institute of Simulation and Engineering

## 2<sup>nd</sup> year

### 2<sup>nd</sup> semester (30 ECTS)

**Module B5 : High speed Dynamics- Detonics**

3 ECTS

- Underwater explosion – mining
- Codes and EOS

**Module B6: Structure calculation**

3 ECTS

- Finite elements theory

**Module B7 : Ship characteristics**

3 ECTS

- hydrodynamics
- Stability

**Module B8 : CAD/CAM and 3D printing**

3 ECTS

**Module B9 : Automatics and Electrotechnics**  
(electric engines)

3 ECTS

**Module B 10 : Neutonics**

2 ECTS

- codes

**Module B11 : Quantum mechanics**

2 ECTS

**Module B12 : Electronics**

3 ECTS

**Module P1 :Custom Professional Project**

8 ECTS

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# Higher Institute of Simulation and Engineering

## 3<sup>rd</sup> year

### 1<sup>st</sup> semester (30 ECTS)

Module A1 : **Management – Human ressources**

1 ECTS

Module B1 : **Computing**

3 ECTS

- Video game (overview) – augmented reality
- Cloud

Module A2 : **Language teaching**

4 ECTS

- English
- Portuguese
- Spanish
- German
- Persan-Dari-Turque-Kurde-arabe

Module B2 : **Engine**

3 ECTS

- Heat engine
- Pulse detonation engine

Module B3 : **Electrotechnics**

2 ECTS

Module A3 : **Legal knowledge**

4 ECTS

**Géopolitique et renseignements**

1 ECTS

Module A4 : **New bussiness start up**

Module P1 (sur l'année) : **Custom Professional Project**

12 ECTS

*This module is a working simulation or modeling performed alone or in teams, in the framework of a project defined by one or professors, or to meet the needs of a company*



# Higher Institute of Simulation and Engineering

## 3<sup>rd</sup> year

### 2<sup>nd</sup> semester (30 ECTS)

Module B4: **Genetics and data processing**

3 ECTS

Module B5 : **Video games**

10 ECTS

Module B6 : **Pyrotechnic systems**

2 ECTS

- Airbag
- Pyrotechnic devices

Module P1 (sur l'année) : **Custom Professional Project**

15 ECTS

*This module is a working simulation or modeling performed alone or in teams, in the framework of a project defined by one or professors, or to meet the needs of a company*

# MASTERE SPECIALISE SIMULATION & EXTREME ENVIRONMENTS

## 1<sup>st</sup> Semester (32 ECTS)

Module A1 : <b>Projet management - web</b>	2 ECTS	Module B1 : <b>Applied Mathematics</b> -Optimisation – Operational reseaech -Signal processing	6 ECTS
Module A2 : <b>Language teaching</b> -English - Portuguese - Spanish -German -Persan-Dari-Turque-Kurde-arabe	2 ECTS	Module B2 : <b>Computing</b> -Langages & linux - shell & makefile, - CAD/CAM and 3D printing - Web design - PHP - APACHE - Genetics	8 ECTS
Module A3 : <b>Communication - web - Management of collaborative projets</b> <b>Géopolitique et renseignements</b>	4 ECTS	Module B3 : <b>Flows</b> - Fluid mechanics (numerical schemes) - Ballistics, combustion - Wind turbine, Marine turbine - Ship theory, oceanography	6 ECTS
		Module B4 : <b>Electrotechnics</b> - simulations	1 ECTS
		Module B5 : <b>Pyrotechnic systems</b>	1 ECTS
Module C1 : Conferences (systèmes de combat, sextant, ...)			1 ECTS
Module C2 : Guided Visit (Tokamak, SNLE Le Redoutable in Cherbourg, Armurerie ...)			1 ECTS

# MASTERE SPECIALISE SIMULATION & EXTREME ENVIRONMENTS

## 2<sup>nd</sup> semester<sub>(32 ECTS)</sub>

### Module B5 : **Fast dynamics - Detonics**

3 ECTS

- Shock waves
- Detonation waves

### Module B6 : **Thermal**

5 ECTS

- Overview
- Fire
- numerical tools
- Solar energy
- Combustion

### Module B7 : **Structure calculation**

4 ECTS

- RDM
- Finite elements codes

### Module B8 : **Radars & Electromagnetics**

3 ECTS

### Module B9 : **Sonar & Acoustics**

2 ECTS

### Module B10 : **Telecom**

2 ECTS

### Module B10 : **Geology**

3 ECTS

- Geology
- Soil behaviour

### Module B 11 : **Neutronics**

2 ECTS

- Classical theory and random neutronic
- Equation of state (high pressure and temperature)
- Cross sections , nuclear reactors

### Module B12 : **Neutronics and Detonics codes**

2 ECTS

### Module P1 : **Custom Professional Project**

6 ECTS

*This module is a working simulation or modeling performed alone or in teams, in the framework of a project defined by one or professors, or to meet the needs of a company*