

# 2nd year – ENSTA Bretagne Brest France





# Welcome to



# ENSTA Bretagne



# ENSTA Bretagne

- **State University**
- **Founded in 1819 (1971)**
- **Master and PhD. levels**
- **700 students, 65 professors + 350 part-time or invited lecturers from industry or universities**
- **6 Specialisations**

## 6 options

for specialization with majors in mechanics, electronics, information technology, marine engineering or energetic materials engineering :

- Recognition and data processing systems
- Embedded systems design and engineering
- Hydrography - Cartography
- **Vehicle design and Modeling**
- Naval architecture and offshore engineering
- Energetic materials engineering

- **2 profiles offered:**
  - ▶ Vehicles design
  - ▶ Modeling (Structures computations and advanced materials)





▪ **2 profiles :**



▶ Vehicles Design

Strong skills in

« **Ground vehicles** »



CDI Porsche (M. Porhansl)



CDI Daimler (C. Lambur)



DGA (K. Perrigouard)



CDI Mission motor  
(G . Van Laar)

**Global analysis: from the vehicle ...**

**... to the components**

Road holding

Braking

Powertrain

Crash behaviour

Car acoustic

...



▪ **2 profils :**



► **Modeling**

Strong skills in structures  
 advanced design



CDI EDF  
 (R. Munier)



CDI CNES  
 (F. Lavelle, O. Devaux)



CDI SAFRAN  
 (M. Besnard, F. Tanty)

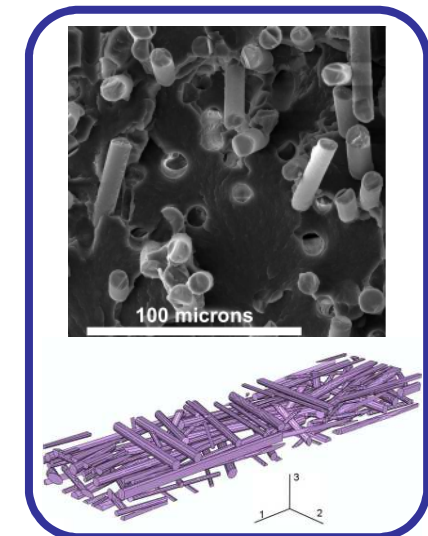
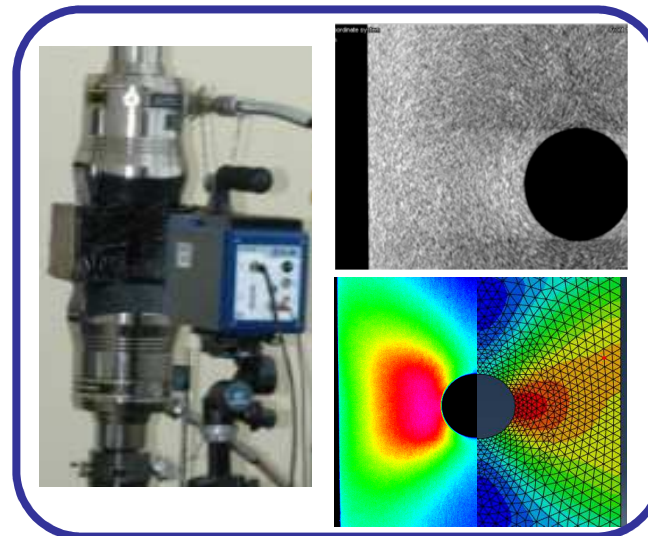
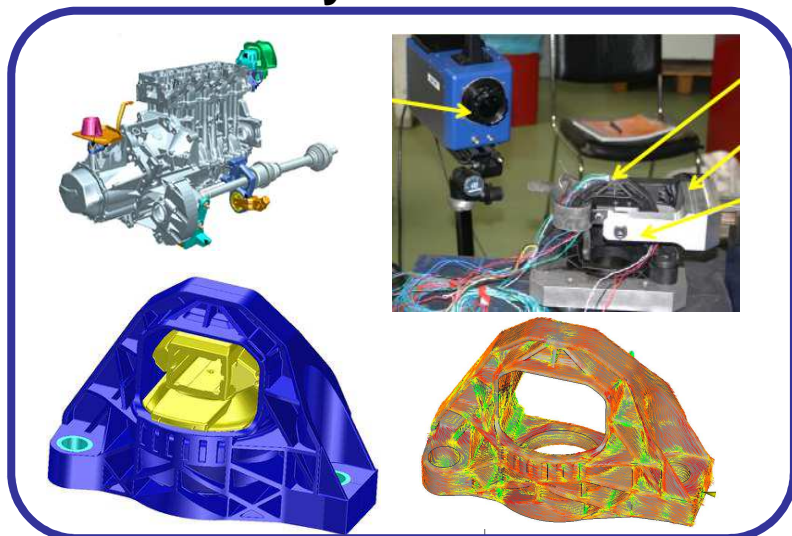


CDI TECHNIP  
 (J. Maurice)



CDI Michelin  
 (R. Mouton)

Detailed analysis: From structure ... .. to material ... .. and microstructure





S2



CVUT (Prague)



Ensta Bretagne (Brest)

TUC (Chemnitz)



Powertrains

Internal combustion engines



Applied Maths  
Mechanical Design  
Structures et thermal laws

S3  
Materials

Powertrains



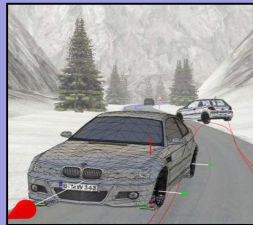
Automobile Production

Fuel cell

Hybrid motors



VD



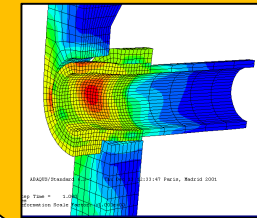
S4

Optimization for structural design  
Beams, Plates, Shells, composites

Structures Dynamics

Industrial Project

MOD



VD

Vehicle design  
Hybrid and ICE motors

Complex systems

S5

Powertrains  
Materials  
Constitutive laws

Non Linear Finite Elements Methods

MOD

Elastomers and composites  
Dynamic  
Advanced materials




**Czech or German diploma**

**Master Européen en ingénierie automobile (MSc)**

**Research Master in materials and structures (MSc)**




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Powertrains

Internal combustion engines





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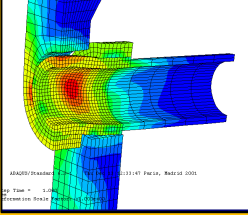
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Specific training (IFP EN, for ex.)

PhD thesis



# Where are our former students ?

## A few EMAE cursus



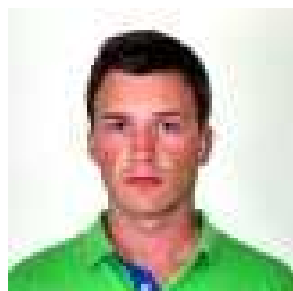
CVUT (Prague)	Ensta Bretagne (Brest)	TUC (Chemnitz)
<p>Transmission de puissance Combustion avancée</p>	<p>Outils mathématiques Conception Structures et thermique</p> <p>S3 Matériaux</p> <p>Transmission de puissance</p>	<p>Fabrication Automobile Piles à combustibles Motorisations alternatives</p>
<p>3 diplômes</p>	<p>AV</p> <p>S4</p> <p>Optimisation en calcul des structures Poutres, plaques, coques, composites Dynamique de structures Projet industriel</p> <p>MOD</p>	<p>3 diplômes</p>
<p>1 à 3 diplômes</p>	<p>AV</p> <p>Architecture véhicule Motorisation hybridation Ingénierie systèmes Projet (AS)</p> <p>S5</p> <p>Transmission de puissance Lois de comportement EF non linéaires</p> <p>MOD</p> <p>Elastomères et composites Dynamique Matériaux avancés Projet (AS)</p>	<p>2 à 4 diplômes</p>
<p>Formation spécifique (IFP EN, par ex.)</p>		<p>Doctorat : cursus d'ingénieur-docteur</p>



**Gerard Van Laar (2010)**



In charge for building and testing  
Electric Motorcycle  
San Francisco (since 2010)



**Michal Porhansl (2013)**

Developpement of hybrid motor  
Prague (depuis 2013)



**Charly Trouvé (2010)**



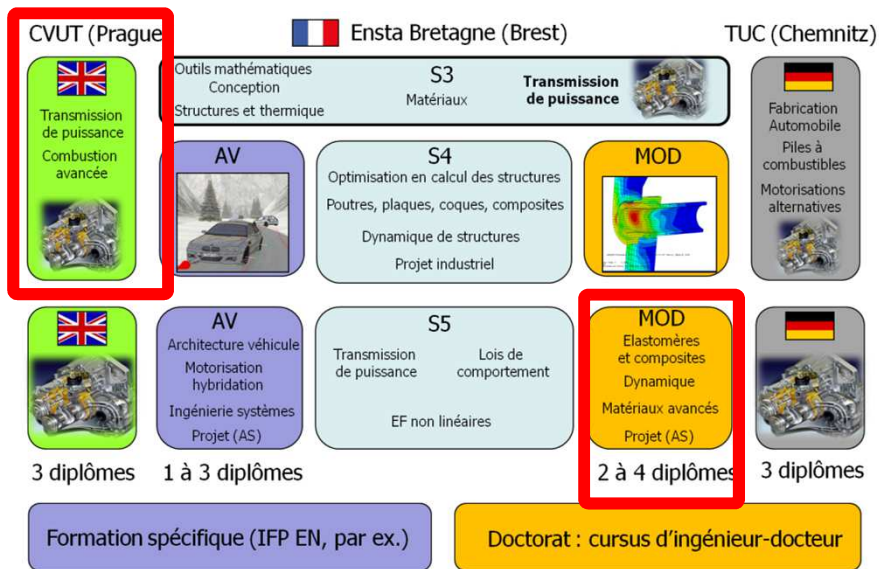
Hybrid-diesel HYbrid4  
(2010-2012)  
Hybrid-petrol HYbridAir  
Computations of consumption/pollution  
(since 2012)





# Where are our former students ?

## A few EMAE cursus



### Jiri Herian (2009)



Numerical simulations  
engineer  
Dynamic computations  
  
Euro NCAP Centre  
**Prague** (depuis 2009)



### Florian Mayot (2012)



France puis  
Allemagne



Engineer air conditioning research center  
(2012-2013)

Thermal concepts developments  
Stuttgart (since 2013)

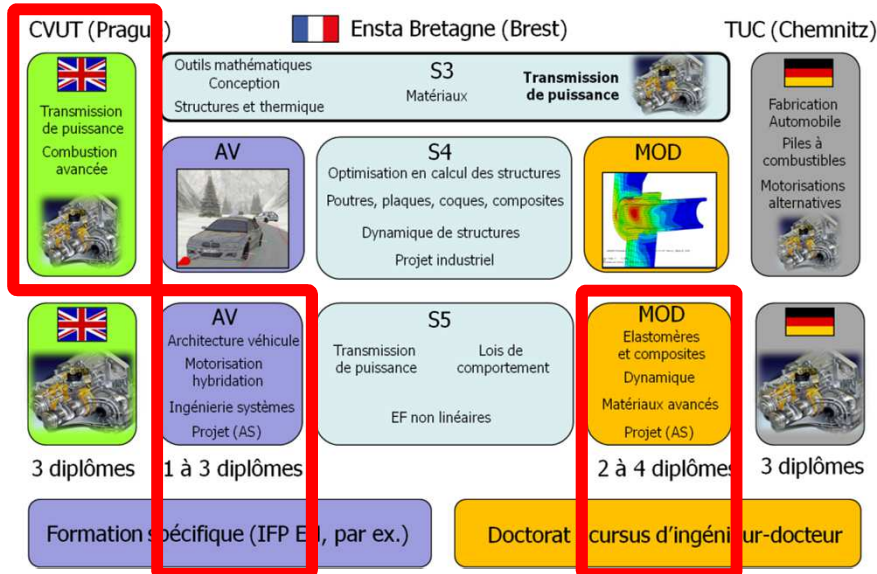
6 patents (since 2012)

Award of the best french  
VIE contract ( 2014)



# Where are our former students ?

## A few EMAE cursus



**Julie Dillenschneider (2013)**

**Thomas Philippot (2013)**

2013: Thesis at PSA (Contrôle commande Combustion)

Since 2013: IFP industrial funding ( Elec. Scooter)



**Miloslav Medricky (2009)**



PhD then puis Eng. Doctor position at the research center in **Wolfsburg** (since 2009)

Dynamic simulations  
(hot stamping and car crash)

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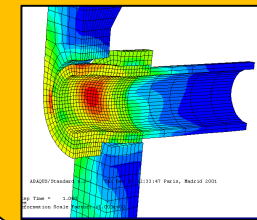
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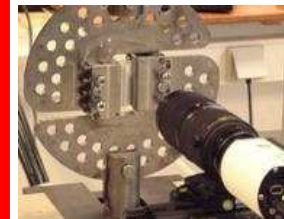
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Materials  
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Non Linear Finite Elements Methods

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Elastomers  
and composites  
Dynamic

Advanced materials



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# Training Program

**5.1 Vehicle Design**

**5.1 Composites and elastomers**

**5.2 Powertrains**

**5.3 Management and professional project**

**5.4 Industrial projects**

**5.5 Hybrid and ICE motors**

**5.5 Dynamic testing and computing**

**5.6 Non Linear Finite Elements Methods**

**5.7 Behaviour and failure of materials and structures**

**5.8 Management of complex systems**

**5.8 Multi-scale approach for advanced materials**

8\*60 hours =  
480 hours  
+ Language

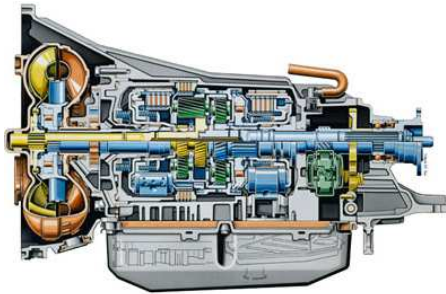
ECTS amount  
5 per UV  
7 for 5.4 (Project)

Thesis  
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5.1 Composites and elastomers



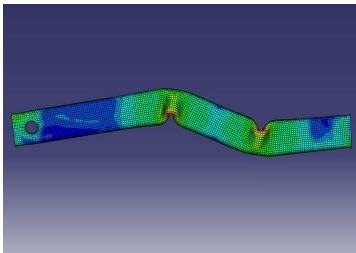
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5.3 Management and professional project

5.4 Industrial projects

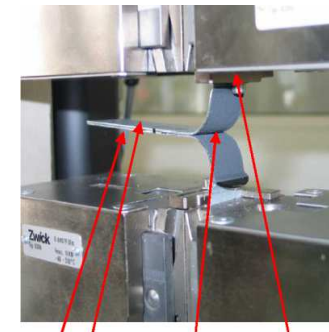
5.5 Hybrid and ICE motors

5.5 Dynamic testing and computing



5.6 Non Linear Finite Elements Methods

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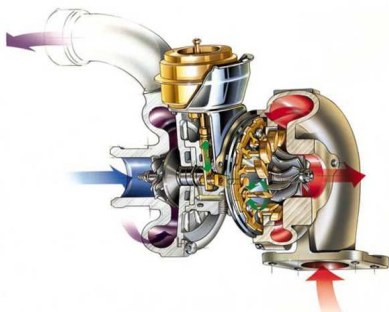
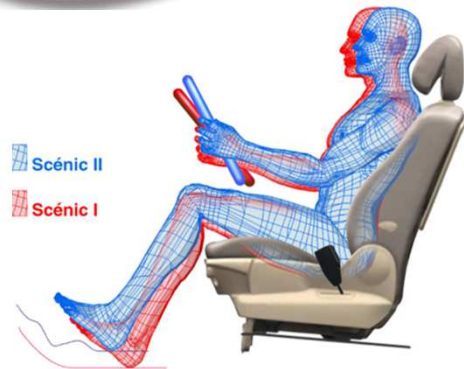


5.8 Management of complex systems

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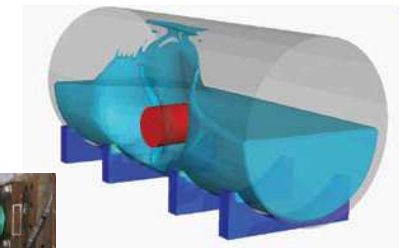
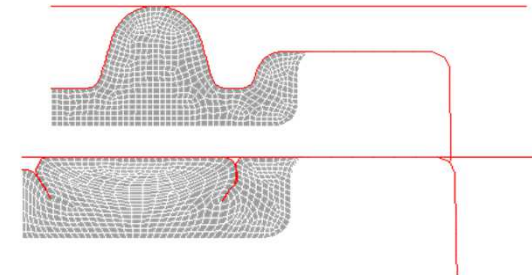
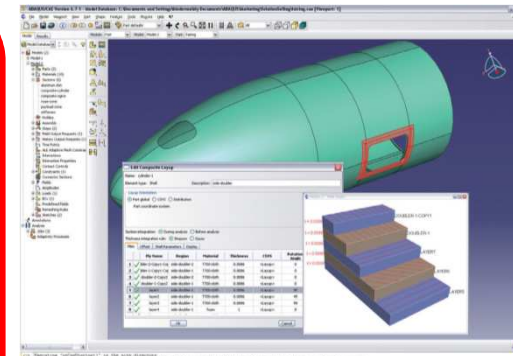
**5.4 Industrial projects**

**5.5 Dynamic testing and computing**

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# Programme de la formation AVM

5.1 Vehicle Design

5.1 Composites and elastomers

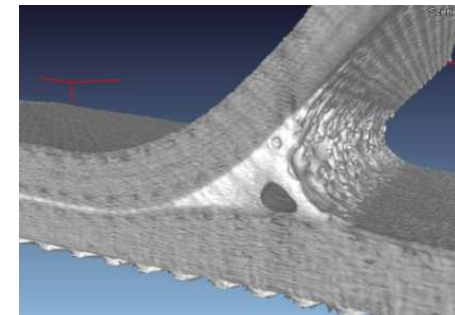
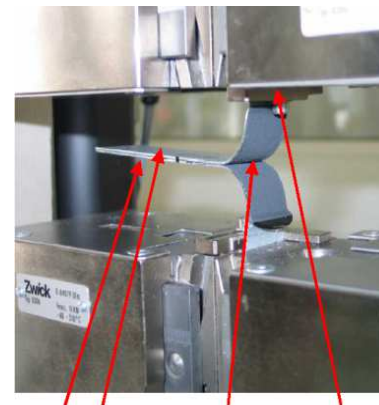
5.2 Powertrains

5.3 Management and professional project

5.4 Industrial projects



Vehicles projects



Industrial projects

## Vehicle project

The project is an application  
of the courses :

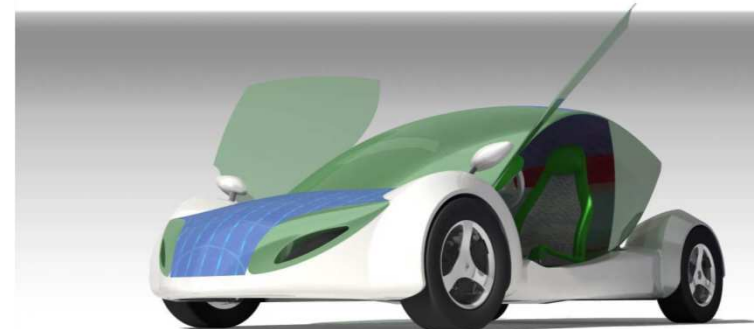
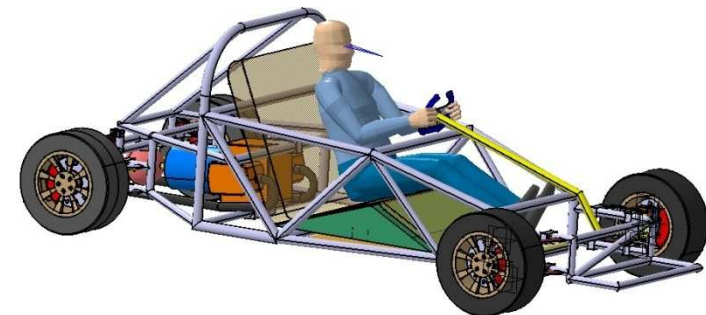
### Study a concept :

- ❖ Rules, marketing,...

### Create an architecture :

- ❖ vehicle mechanical design, performance, masses distribution, vehicle dynamics, components positioning, dynamics calculations, power unit, brakes,...

### Create a design





## Vehicle projects

### Dream4CAR

**Joint work** with  
Ecole Européenne Supérieure d'Arts  
de Bretagne (design),  
ESC Brest (marketing)  
ENSTA Bretagne (technique).

«**Green Mobility for All**»



### SIA Contest

**Jury** including Renault, PSA Peugeot  
Citroën, Michelin, Faurecia...

#### **Technical report**

Requirements: Low Carbon Dioxide  
emission, security, power efficiency.

**Race**

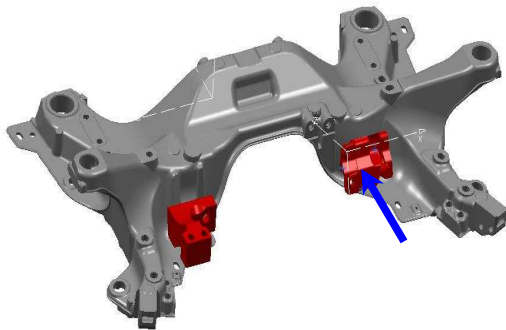


*Tiger avon (Lotus Seven)*

# Advanced industrial study

Brought by an industrial partner  
studied with a teacher

## Both experiments and simulations



Structure  
calculation, engine  
support

**PSA Peugeot  
Citroën**



Torque Rod fatigue  
design and  
certification

**Trelleborg**



Modeling of a satellite  
suspension

**EADS**

# Training Program



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7 for 5.4 (Project)

Thesis  
(mid-march  
to end of august)







# ENSTA Bretagne

## Practical informations



- **Accommodation**

**Student accommodation :  
270 Euro/month (breakfast included)**



- **Meals**

**1 meal in student canteen : 3 Euro (approx.)**

- **Brest transportation**

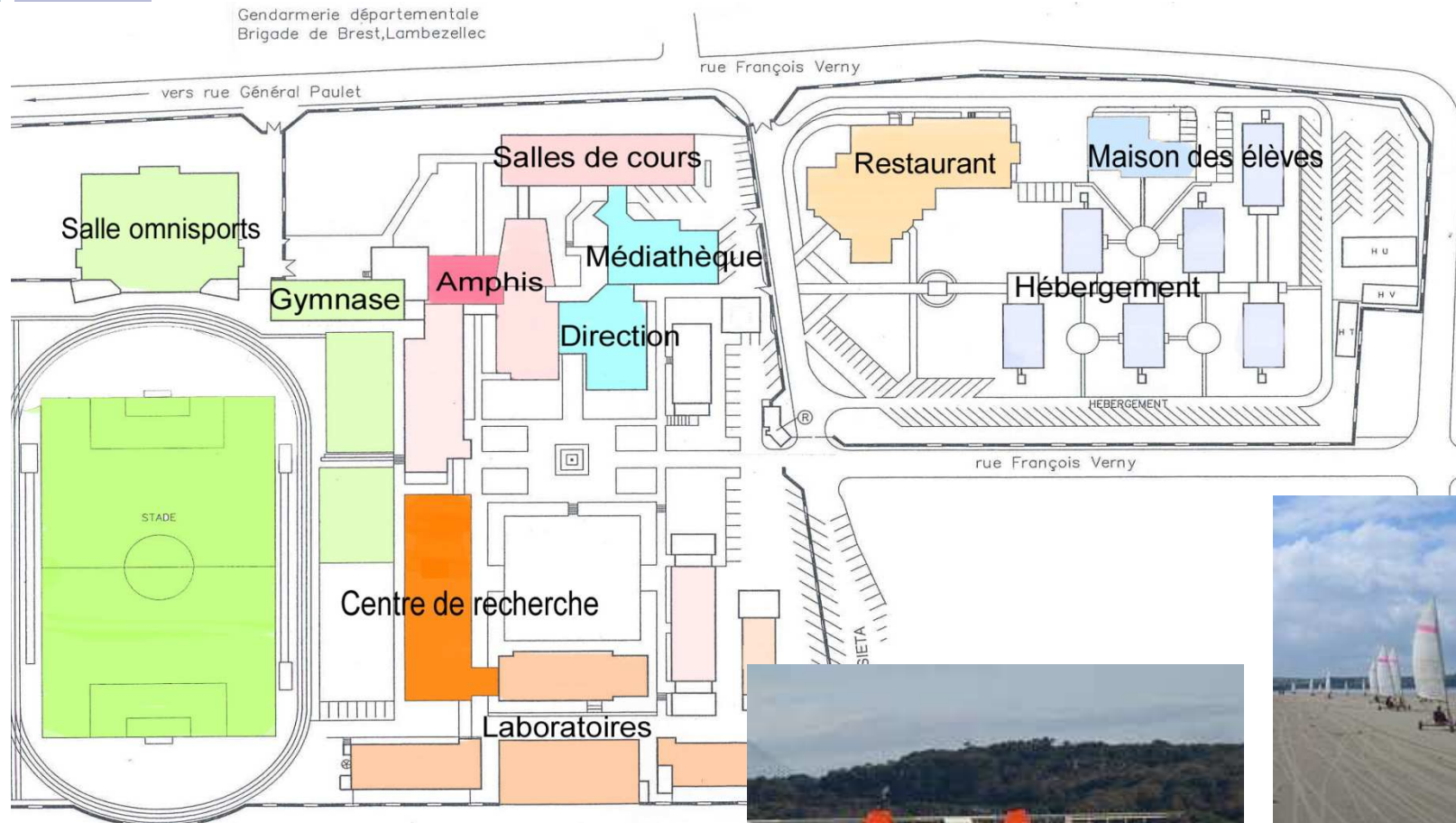
**Bus or Tram ticket for downtown : less than 1 Euro**



## Facilities

- ▶ **17-acre integrated campus**
- ▶ **25,900 m<sup>2</sup> built floor space**
- ▶ **4 lecture halls, classrooms, computer rooms**
- ▶ **Multi-media library**
- ▶ **High-speed network with access from all points, 450 on-line, individual IT stations (PC and workstations)**
- ▶ **Sports facilities : sports grounds (football, handball, volleyball, basketball, tennis) and athletics track, gymnasium, multi-sports hall, fleet of sailing boats**
- ▶ **Student residence hall: 200 rooms, students clubs, social activities**
- ▶ **Restaurant**

# Facilities





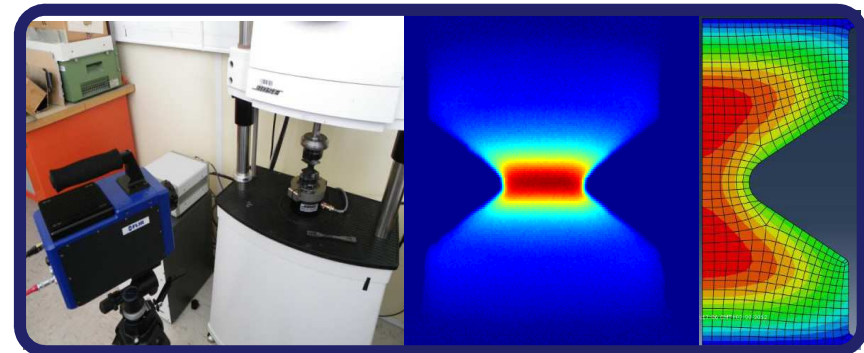
**2nd year – ENSTA Bretagne  
Brest France**



### Vehicle and components design



### Structure and Materials modeling



# Thank you for your attention

yann.marco@ensta-bretagne.fr

## For what kind of job ??

Year	Company	Country	Fonction
2007	Visteon-Autopal Services	Czech Republic	Team leader for lightning applications (french customers)
	TUV-Sud	Czech Republic	Project leader for Euro NCAP tests
2008	DEMAG (germany) (heavy weight machines)	Czech Republic	Sales Engineer
	Volkswagen AG Research department	Germany (Wolfsburg)	PhD Thesis
	Noen, a.s. (pit mining machines)	Czech Republic	Design Engineer
2009	Ricardo	United Kingdom	Design Engineer
	Automotive Lighting	Czech Republic	Design Engineer
	MBtech Bohemia	Czech Republic	Design Engineer
	MECAPLAST Group (Monaco)	Czech Republic	Products quality engineer for two czech plants
2010	Ricardo	United Kingdom	Mechanical Engineer
	Mission Motor Company (electrical motorcycles)	USA (San Francisco)	Design Engineer
	IAV (Automotive Engineerin)	France	Mechanical Engineer
	Toyota	Nederlands	Powertrain engineer



- **2 profils :**

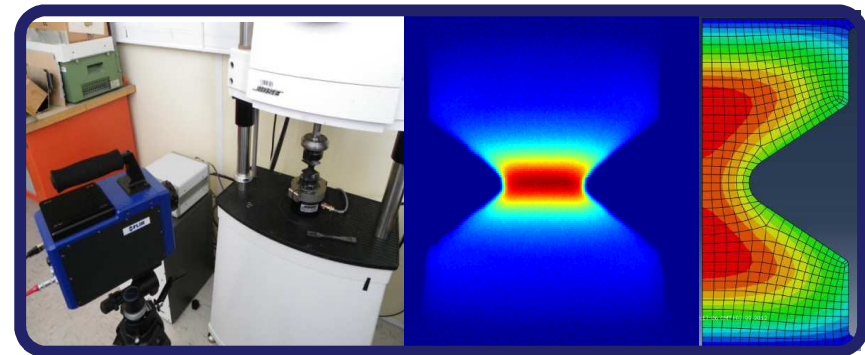
- ▶ Architecture des véhicules
- ▶ Modélisation mécanique (Calculs de structures et matériaux avancés)

**Corrélation essais – calculs**

**Véhicule et composants**



**Structure, Matériau et Matière**



- **... s'appuyant sur 2 Masters :**

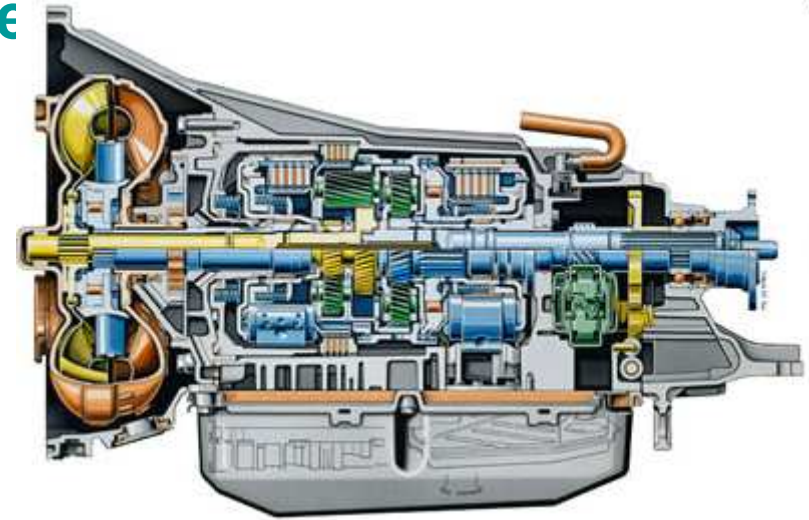
- ▶ Master européen en ingénierie automobile
- ▶ Master recherche « Matériaux et structures »



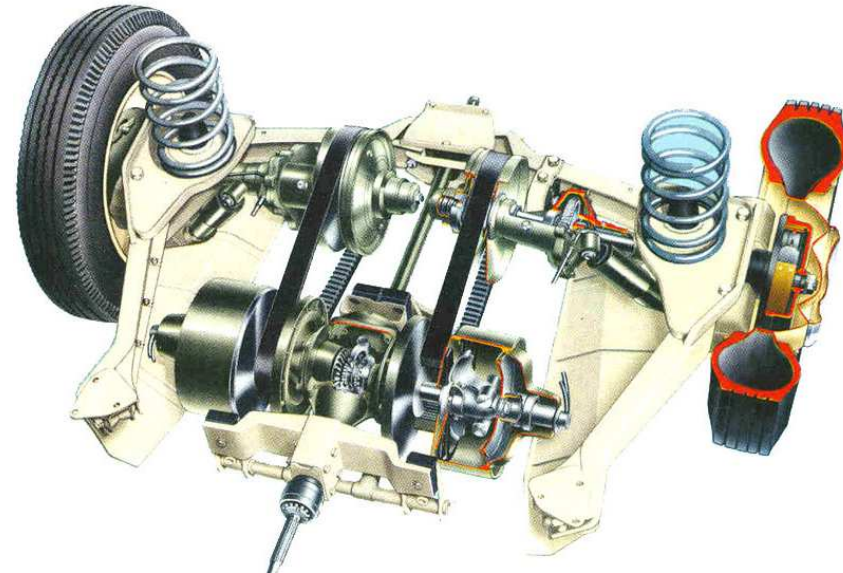
## UV 5.2 transmission de puissance

Quel est le lien entre le moteur et la roue du véhicule ?

Boite de vitesses manuelle, automatique, CVT  
Coupleur/coupleur convertisseur  
Transmission hydrostatique  
Modélisation multidomaine (Amesim, matlab)



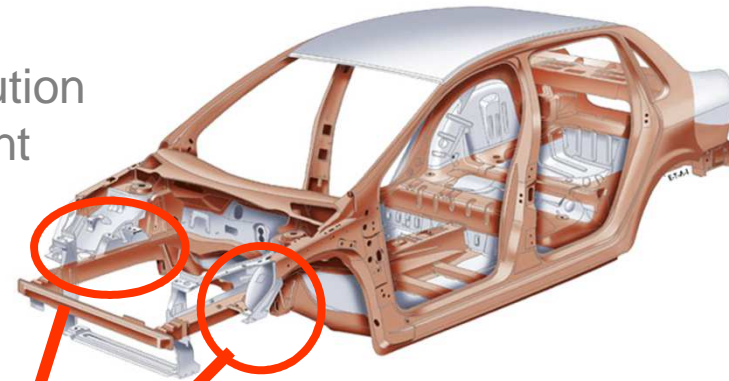
**Audi A4 quattro**  
Fahrwerk und Antriebsstrang  
Chassis and Drivetrain  
09/04



## UV 5.6 Méthodes des éléments finis non-linéaires

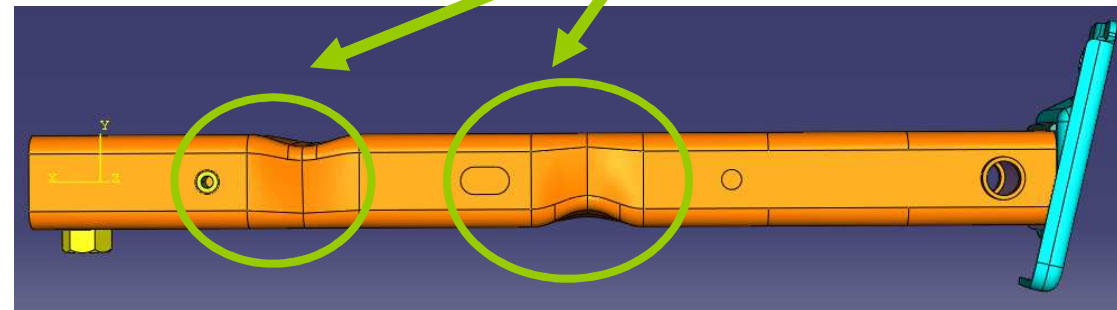
Approche variationnelle  
Résolution des problèmes non-linéaires d'évolution  
Modélisation du contact avec ou sans frottement

Simulation sous *Abaqus*

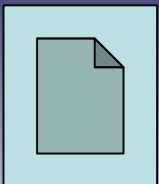
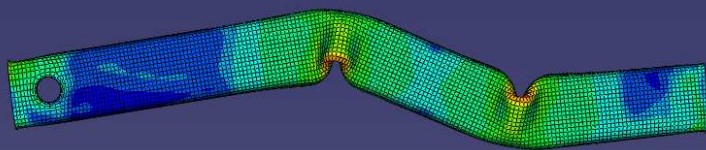


Deux pré-déformations pour guider

la déformation



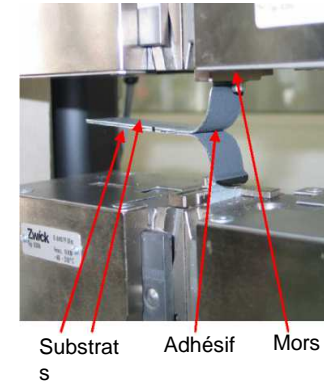
Prédire les contraintes, les déformation  
et le champ de déplacement



## UV 5.7 Comportement et ruine des matériaux et des structures

Formulation d'une loi de comportement complexe  
Simulation sous Abaqus  
Dimensionnement à la fatigue

Formulation  
d'une loi de  
comportement 3D



... le 15 février 2001 au Canada

De fatigue



Le 30 novembre 2000 ...

De rupture

Rupture d'une pale d'hélice  
du Charles De Gaulle





## UV 5.1 Architecture véhicule

Architecture des véhicules

Méthode de créativité

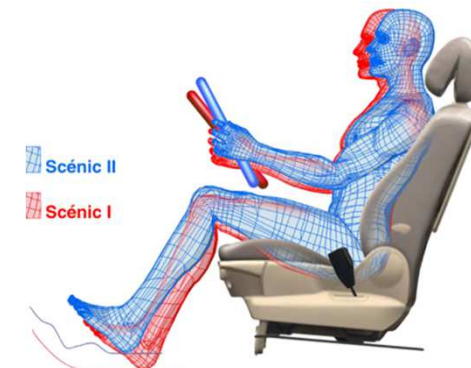
Décomposition en sous-ensembles et spécification de chaque sous-ensembles +

Définition des interfaces

Technologie avancée (analyse de certains composants, règle de dimensionnement, ...)

Maquette numérique

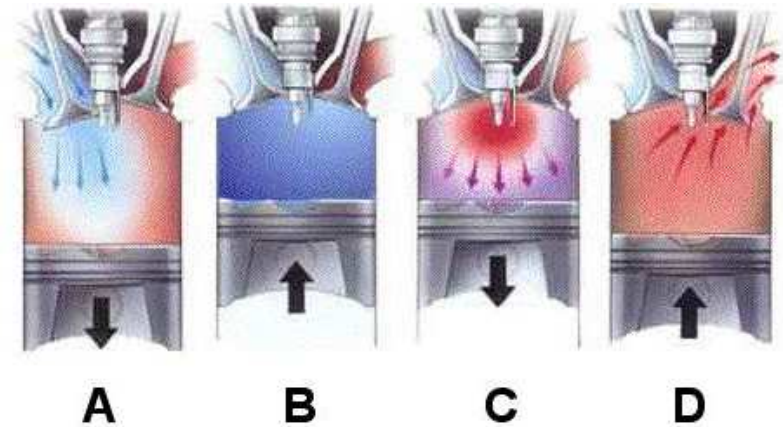
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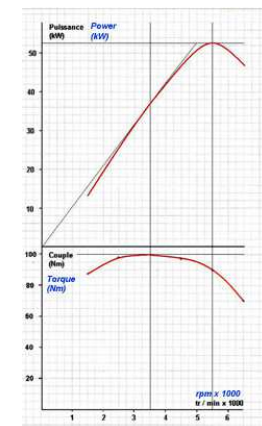
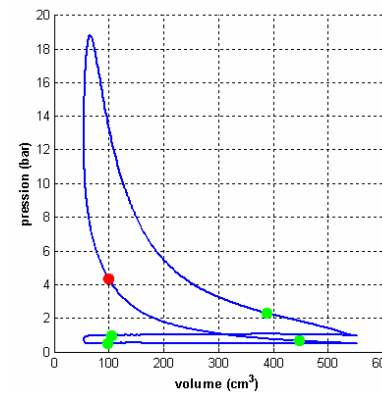
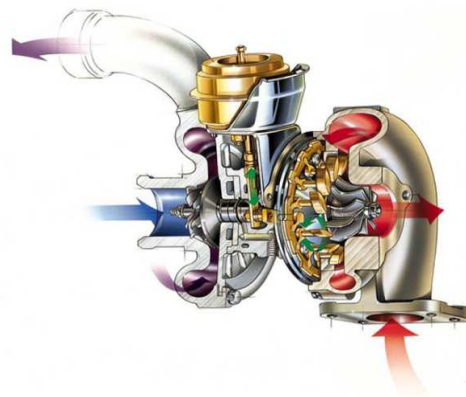
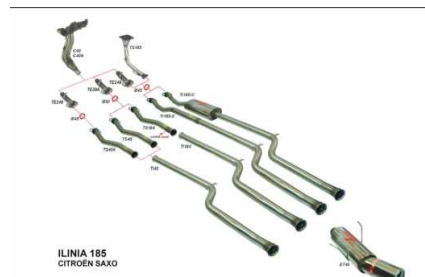
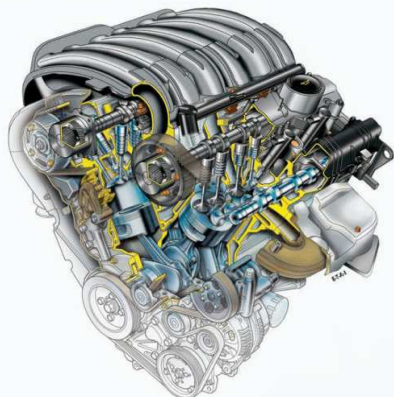
## UV 5.5 Groupes motopropulseurs conventionnels et hybrides

Comment transformer un énergie calorifique en énergie mécanique ? (essence – diesel)  
 Bases de dimensionnement d'un moteur thermique  
 TP de démontage moteur  
 Echappement et anti-pollution  
 Hybridation



CITROËN C5

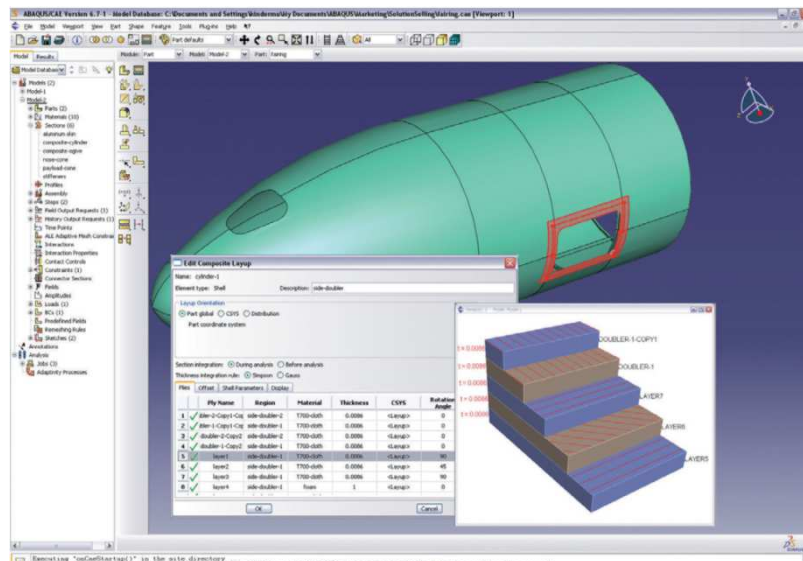
Moteur 3.0i V6  
 3.0i V6 engine



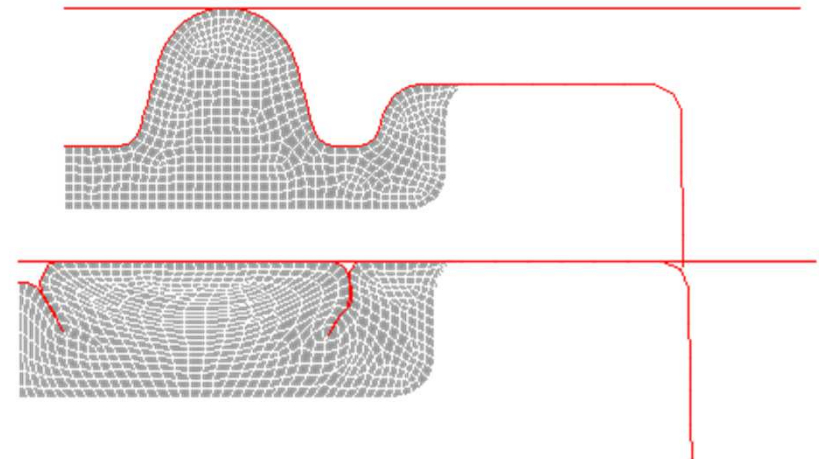
# UV 5.1 Gdef, composites et élastomères

- Cadre des grandes déformations
- Modélisation des élastomères
- Modélisation des composites

## Composites

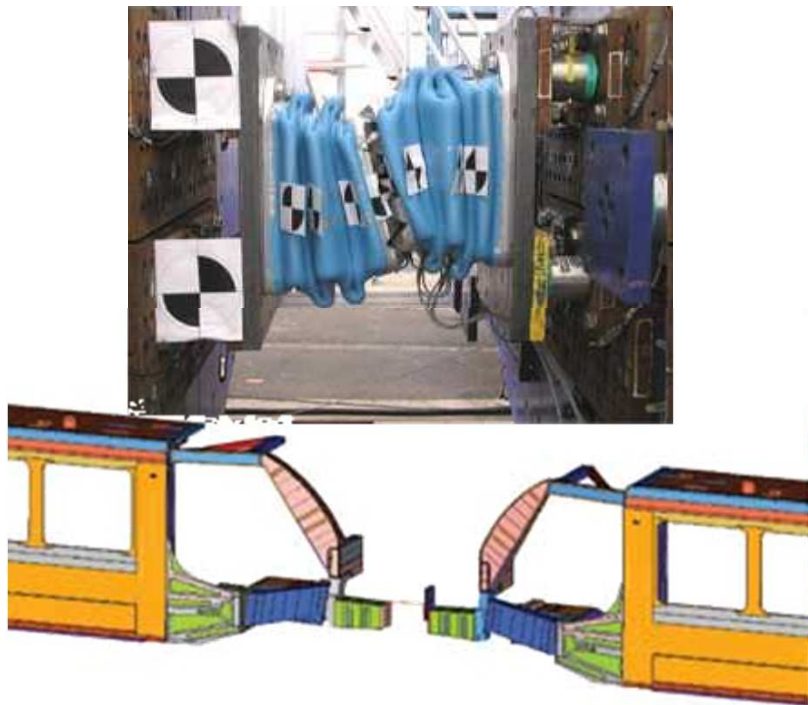


## Elastomères et grandes déformations



## UV 5.5 Dynamique explicite (45 heures communes avec les IME)

Prendre en compte la vitesse de sollicitation ...



Crash

Impact

