ESI Group @ Academy





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Mission & Vision



ESI's Mission

Deliver Virtual Prototyping solutions that improve industrial product development

ESI's Vision

Be the leader in Virtual Prototyping thanks to a unique knowledge in material physics



The Story of ESI



ISO 9001-2000 CERTIFICATION

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The Story of ESI



- NVH
- Durability
- Vibro-Acoustics
- Comfort



ENTRY INTO VIRTUAL REALITYv

ESI acquires IC.IDO

2011



Image courtesy of Mitsubishi Hitachi Power Systems Europe

EMBRACING OPEN SOURCE

2012

ESI acquires OpenCFD, the makers of OpenFOAM

MAKE IT SMART

2016

ESI makes prototypes smart by integrating acquisitions in Systems Engineering, Cloud Computing, Data Analytics and Machine Learning



Sectorial diversification – To Whom do we Sell Industries



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Virtual Prototyping Delivers Exponential Benefits Moving from inert to intelligent and autonomous





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What is VPS





Introduction A bit of history

1973: Company creation: ESI France

Jacques Dubois,

1984 - Volkswagen Polo study

(5000 elements)





Alain de Rouvray, **PhD UC Berkeley**

Eberhard Haug, **PhD UC Berkeley** PhD UC Berkeley





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1990 - Audi (25.000 elements)

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Introduction

Model Size and CPU Time history



Single Core Model of VPS VPS description

- Multiple Modelling technics
 - Linear and Non Linear Static with contact
 - Creep analysis
 - Implicit Transient Dynamic
 - Explicit Transient Dynamic
 - Modal Responses
 - Eigenmodes
 - Harmonic and Transient Response
 - Thermo-Mechanical Loading
- Modern Architecture
 - Effective High Performance Computation (HPC)
 - Workstations and HPC Clusters
 - Full native Distributed Memory Processing for all physics
 - Multi Stage Capacity for chaining
 - Bolt Preloading
 - Spring back
 - Full Manufacturing to performance chaining
 - Casting, stamping and welding effects can be considered.
 - Manufacturing of composite materials effects can be considered.
 - Python Interface



VIRTUAL PERFORMANCE

SOLUTION





Single Core Model of VPS Type of solutions

- Explicit-based solutions
 - PAM-CRASH

PAM-SAFE

PAM-SHOCK

PAM-MEDYSA

- Linear and non-linear materials, large displacements
 - Safety systems + human models
 - Non-linear Dynamics
 - High velocity impact
- Implicit-based solutions
 - PAM-STATICS
 Linear and no large displace
 - PAM-NVH
 - PAM-ACOUSTICS
- Linear and non-linear materials, large displacements
 - Eigen-mode Extraction, Harmonic and Transient Analyses
 - STICS Interior acoustics, Porous Elastic Materials





Single Core Model of VPS

Efficient solution, breaking silos between engineering teams



Single Core Model of VPS Reliable results with manufacturing effects **Full Performances** assessment Crash & Comfort Safetv **Composite Forming Fibers orientation Available Manufacturing** NVH & Acoustics Durability Process Data Stamping Process scattering **Process Database** Castin **Process Database Composite Forming Decision Making** Assembly type Database Assembly process Choice **Including Manufacturing** Database constraints T D. Borzacchiello, J.V. Aguado, F. Chinesta "Sparse Subspace Learning: Crash simuli Institut de Calcui Intensi: Ecole Centrale de Nantes (2017) Casting **Process defects**



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HEV/EV Design, Developement & Validation



Electrified Powertrain

Concept of the hybrid framework



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Electrified Powertrains

Structure of models

Example of a parallel hybrid vehicle:

- The electric machine acts as a motor or a generator.
- The ICE accelerates the vehicle and charges the battery through the generator.



- Signals: driving cycle...

 Controller: driver, operating strategy, transmission control ...

- Powertrain: ICE, clutch, transmission, driveline, brake ...
- Power Net: battery, electric machine, converter, el. load ...

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Electrified Powertrains Control Level



Electrified Powertrains Physical Level



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Power Balance

Sankey diagram

- Diagram to show the flow variables with arrows
- Currently limited to 3 variables (arrows) in 1 diagram
- Ratio of the 3 values affect the thickness of the arrows in the diagram
- Suitable for power/energy or other flow variable visualizations



IC.IDO





