UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II

DIPARTIMENTO DI INGEGNERIA INDUSTRIALE

PhD In Industrial Engineering

Coordinator: Prof. Michele Grassi

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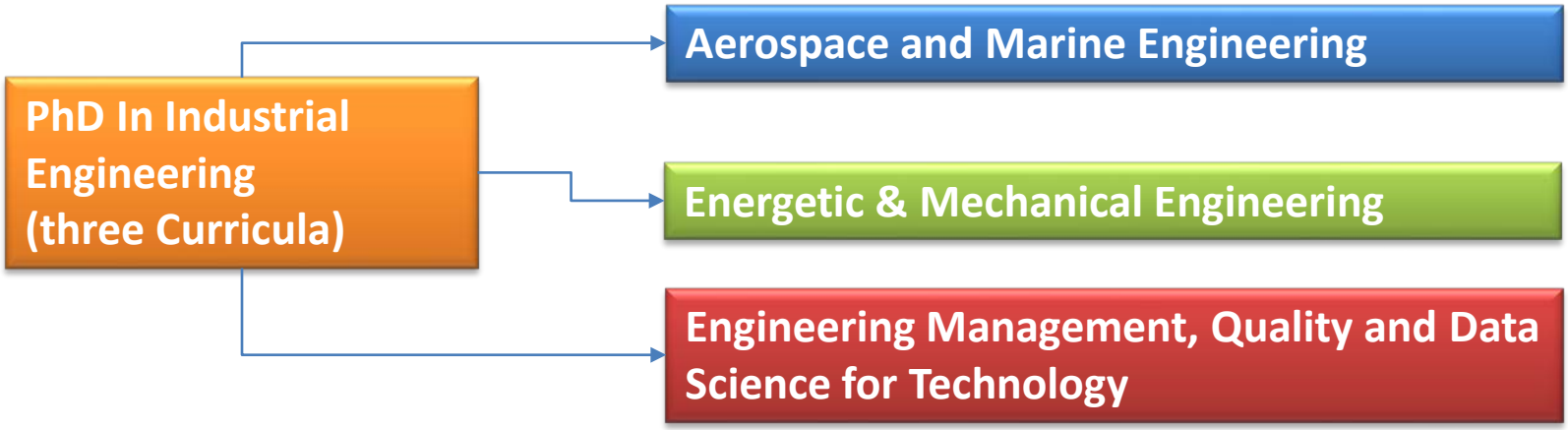
Department of Industrial Engineering

University of Naples Federico II

MUR

DIPARTIMENTO DI ECCELLENZA 2023-2027

3-Year PhD Program



The PhD program aims at training highly qualified professionals for mechanical, marine, aerospace and management industry. It is organized as follows:

Training Activity	24-36 Credits for courses (with final evaluation) 6-14 Credits for seminars (no final evaluation)
Teaching Activity	Up to 15 Credits (about 40 hours per year)
Research Activity	115-150 Credits
Stages	4-6 months (in the average) at foreign research institutions and industries

Enrolled PhD Students ~ 100

Why Sign UP

- **Opportunity to acquire high-level skills in domains as Aerospace, Naval, Management, Energy and Mechanical Engineering**
- **Opportunity to combine specialized with interdisciplinary training**
- **Involvement in important international projects, in collaboration with prestigious universities and research centers**
- **Possibility to spend part of the PhD at prestigious University and research centers abroad.**
- **Involvement in projects in close cooperation with important national and international companies, giving students the opportunity to continue your professional career in a company with important positions.**

ENTRY REQUIREMENS

To access the PhD program in Industrial Engineering, a master's degree is required

Applicants must pass a selection process based on their academic qualifications and an oral interview

Call for applications: each year in May-June

Training Objectives

Acquire knowledge of innovative design methodologies, technical-economic and energy-environmental analysis, management of industrial and manufacturing plants and related technologies

Keep up with technological developments in the relevant sector to incorporate new technologies into innovative design solutions

Create strong links with the industrial world: training paths and research objectives defined in strong synergy with national and international industrial realities, which also support scholarships

Acquire the ability to develop and manage independent research projects

JOB OPPORTUNITIES

Goal is training highly qualified professionals who:

- **Can find employment in aerospace companies, agencies and research centers, energy production and conversion entities, plant engineering companies, automation and robotics industries, manufacturing companies, universities and public research institutions.**
- **Are capable of meeting the challenges posed by the objectives of the National Recovery and Resilience Plan (PNRR), concerning digitalization, innovation, green revolution, ecological transition, sustainable mobility, and competitiveness**

Main research Areas

Naval Architecture

Marine Engineering

Flight Mechanics

Aerospace Structures

Aerospace Systems

Fluid Dynamics

Aerospace Propulsion

Fluid Mechanics and Machinery

Systems for Energy and Environment

Industrial Applied Thermodynamics

Mechanical and Thermal Measurements

Applied Mechanics

Mechanical and Machine Design

Design and Methods of Industrial Engineering

Industrial Plants Engineering

Economics and Management Engineering

Operations Research

Statistics for experimental and technological research

Environmental Applied Thermodynamics

Main laboratories

- Towing Tank
- Turbomachinery
- Automotive Motor and Gear
- Spray
- Oleodynamic
- Motorcycle
- Servo-assisted Bicycle
- Rotary Systems
- Tyre Dynamics
- Robotics
- Thermofluid dynamics Measurements
- Photometry and Lighting
- Environmental Control
- Virtual Reality
- Materials and Structures
- Aeronautical Structures and Acoustics
- Aerospace Propulsion
- Aerospace Systems & Guidance, Navigation and Control
- Material Characterization and Degradation
- Hypersonic Flow
- Microgravity
- Plasma Wind Tunnel
- Subsonic Wind Tunnel
- Drop Test and Dynamic Impact
- Smart Structures and Health Monitoring
- Particle Interferometry Velocity

a total of about 7700 square meters

135m x 9m x4m Towing Tank

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Dynamics of marine vehicles

Towing Tank
Wave maker

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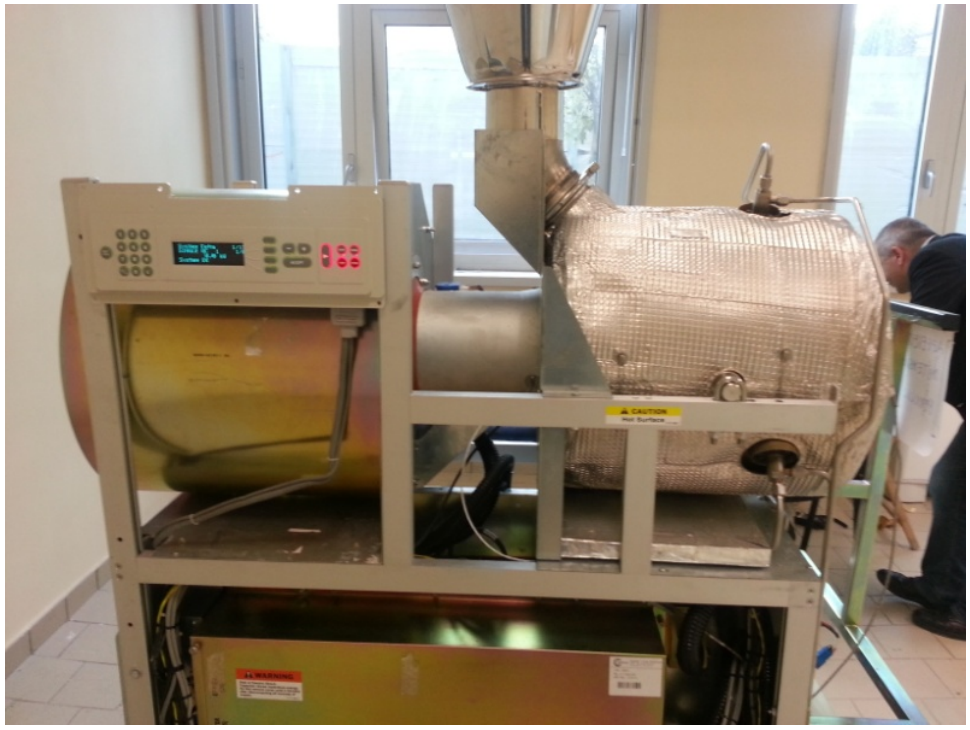
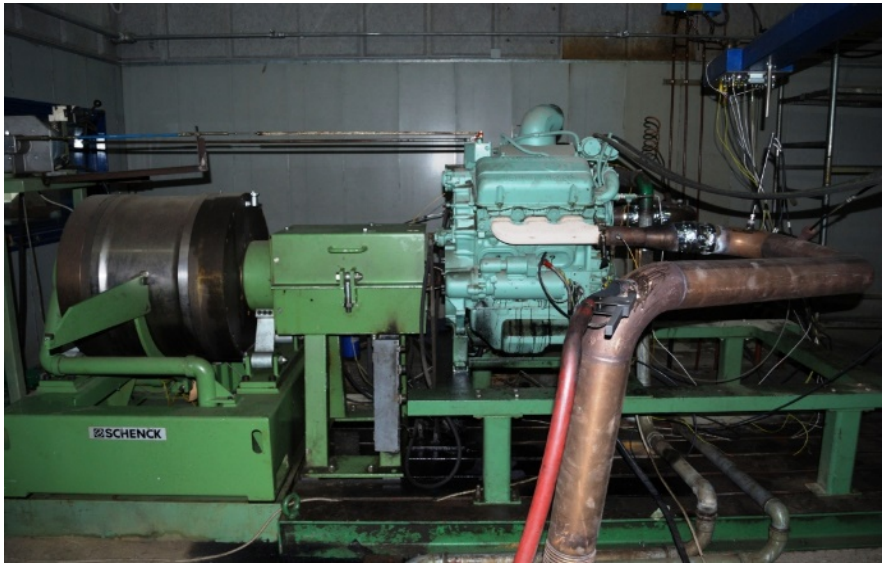
Automotive Laboratory
Inertia characterization of motor vehicles



Gas Microturbine Laboratory



Diesel Engine Test Bench

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Tyre laboratory

GT and sport tyre dynamic performance under varying loads and working conditions

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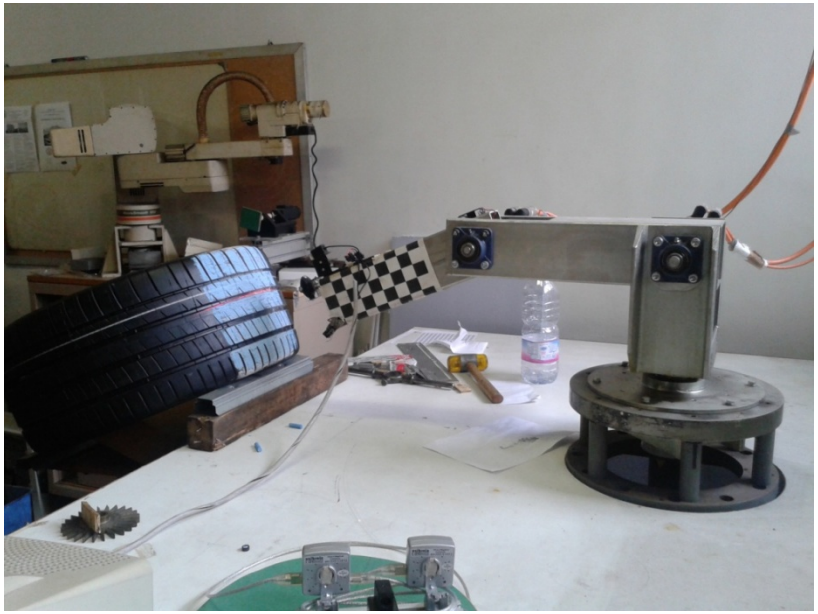

Tyre laboratory
Interaction of vehicles with road surface
Dynamics of racing cars

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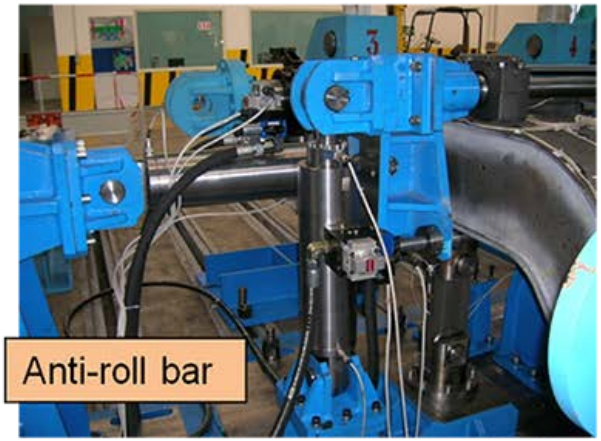
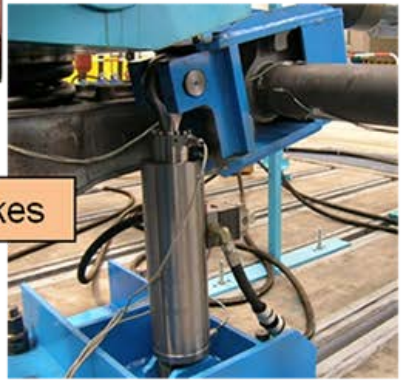
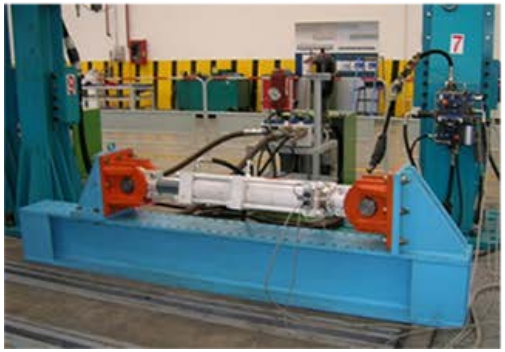
Materials and Structures Mechanics Laboratory

Full-scale tests on components and structures/certification of industrial products

TSR – Static and Fatigue test on bogie frame (10.000.000 cycles)
19 synchronous actuators







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Laboratory of Photometry and Lighting
Photometry for energy management and indoor applications

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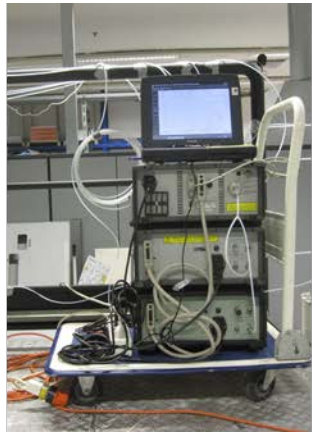


Laboratory of Indoor Environmental Quality

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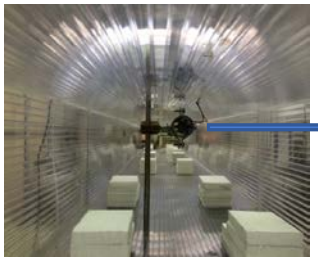

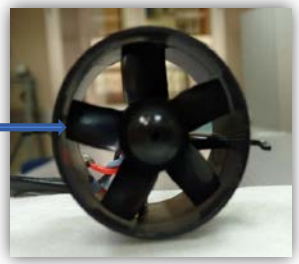

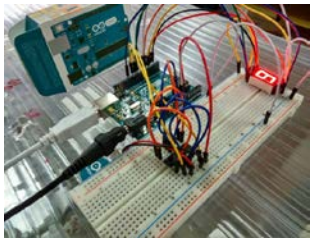

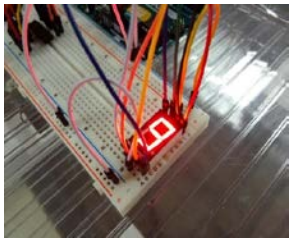

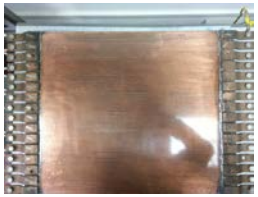

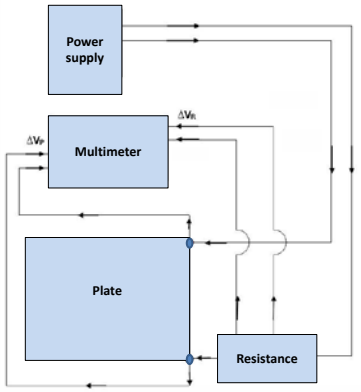

Laboratory of Thermal-Fluid Dynamic Measurements

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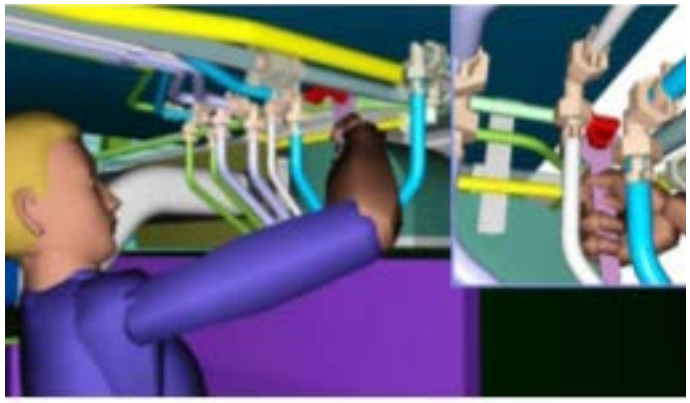

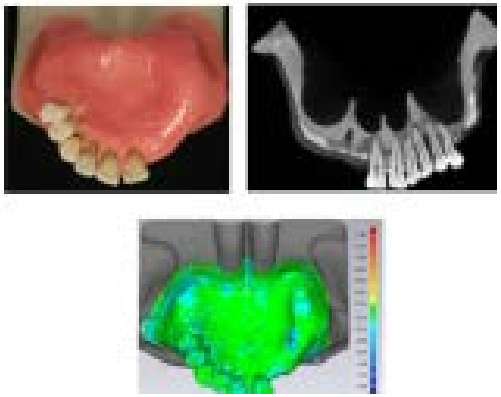

Interactive Design and Simulation (IDEAS)
DII-UNINA-Fraunhofer Joint Lab
CAD Modeling and Virtual Prototyping – Medical Engineering- CAE

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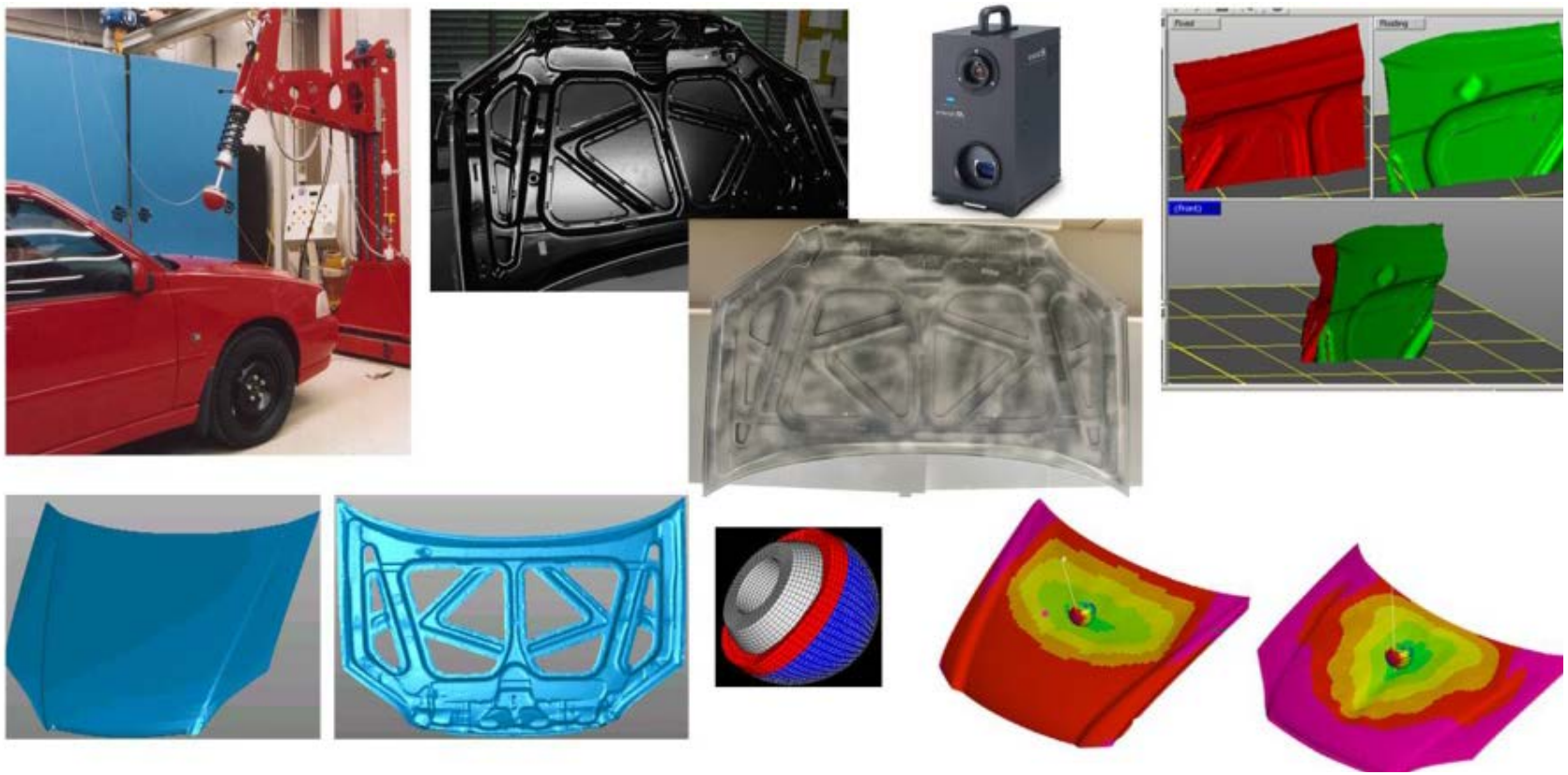

Interactive Design and Simulation (IDEAS)

DII-UNINA-Fraunhofer Joint Lab

Safety performance analysis in child head pedestrian impact through non-contact Reverse Engineering Techniques

Subsonic wind tunnel

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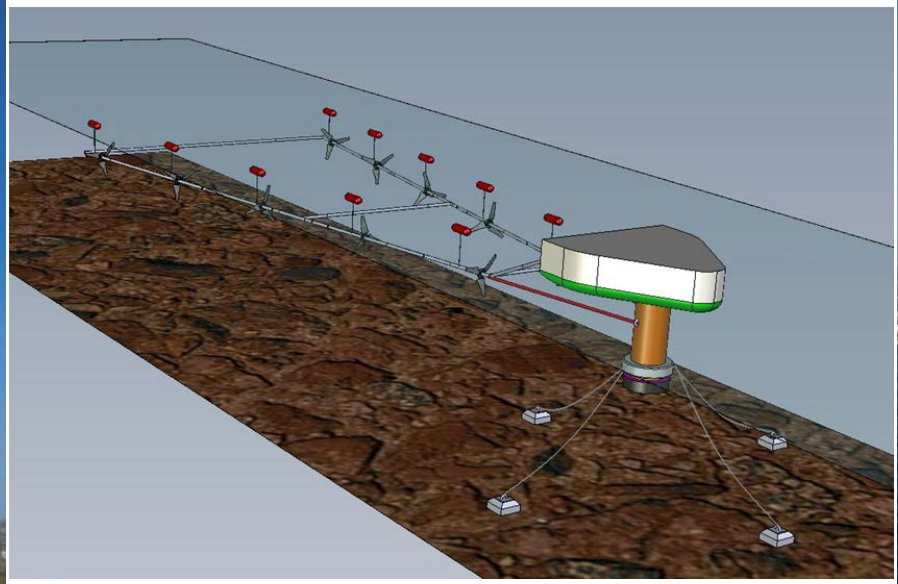

Renewable energy
Test of wind and marine turbines with horizontal and vertical axis

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Laboratory for promoting experiences in aeronautical structures and acoustics

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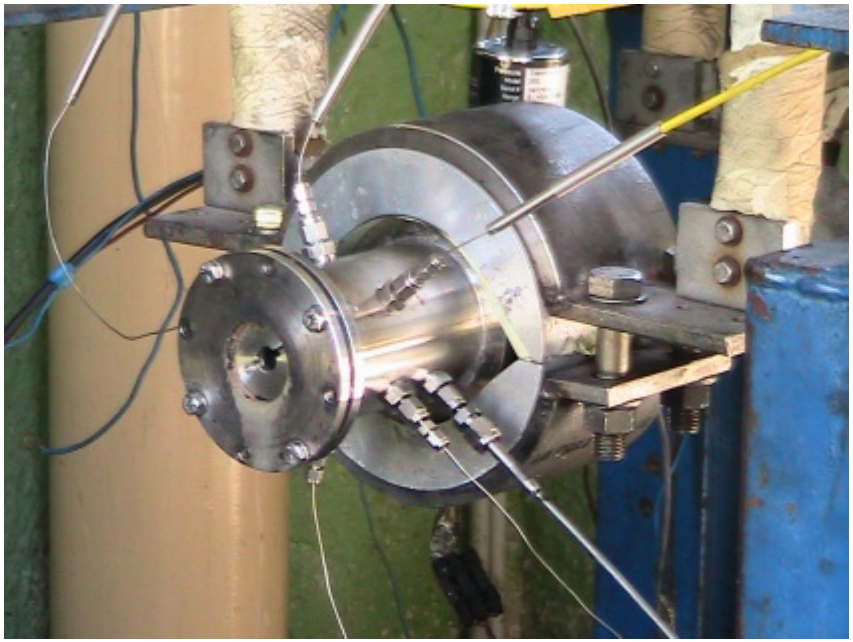

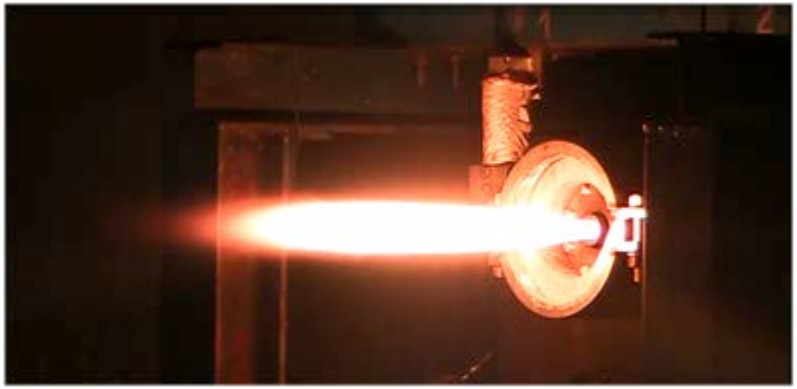

Aerospace Propulsion Laboratory
Test of rocket engines operated with hybrids propellants

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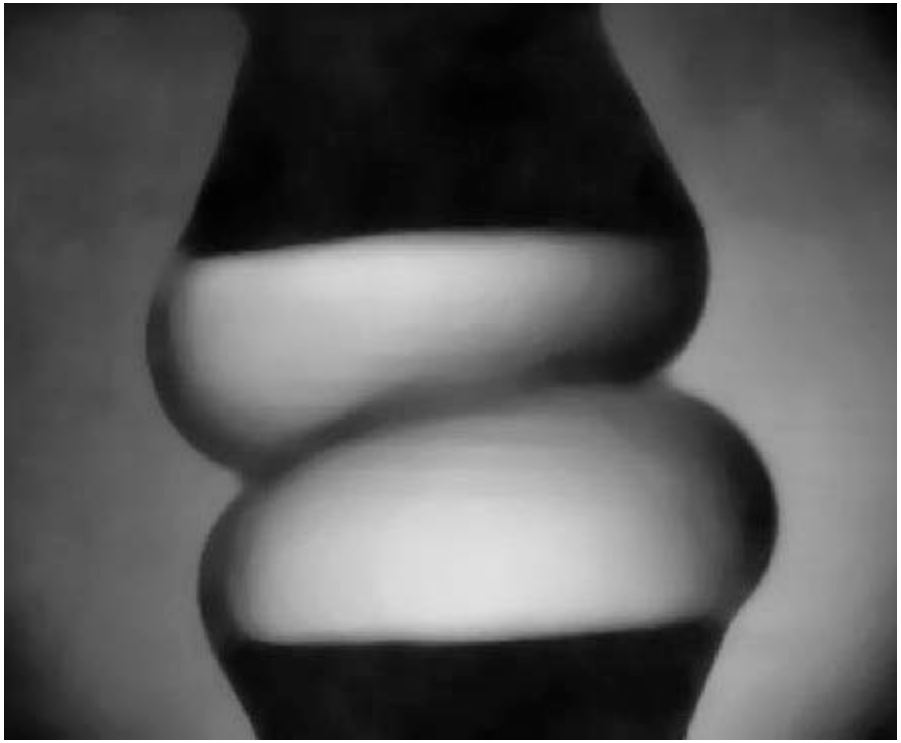

Fluid dynamics in microgravity environment
Laboratory and flight tests

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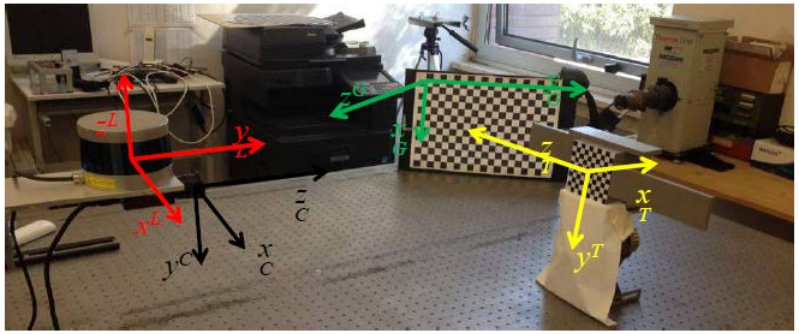
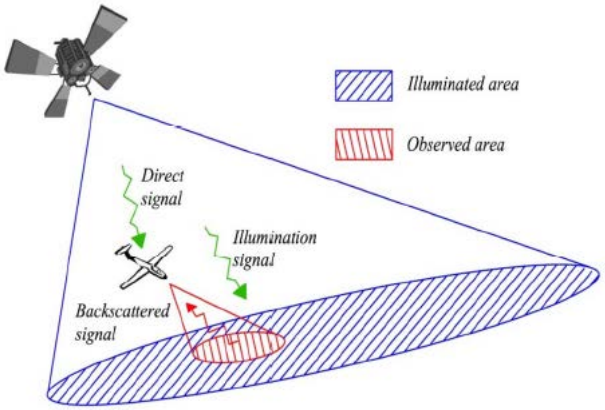
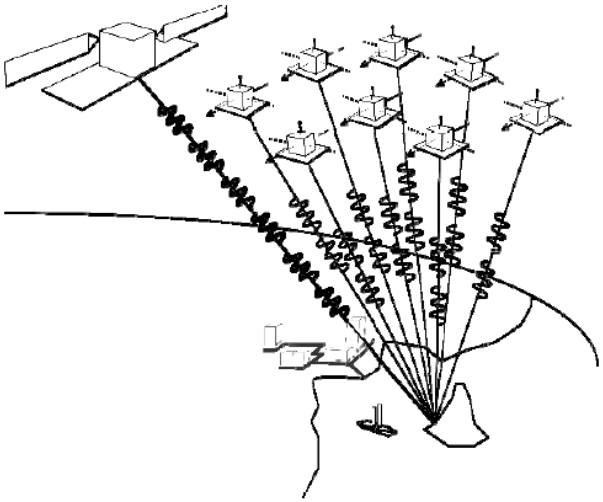
Aerospace System Laboratory



FF Technologies

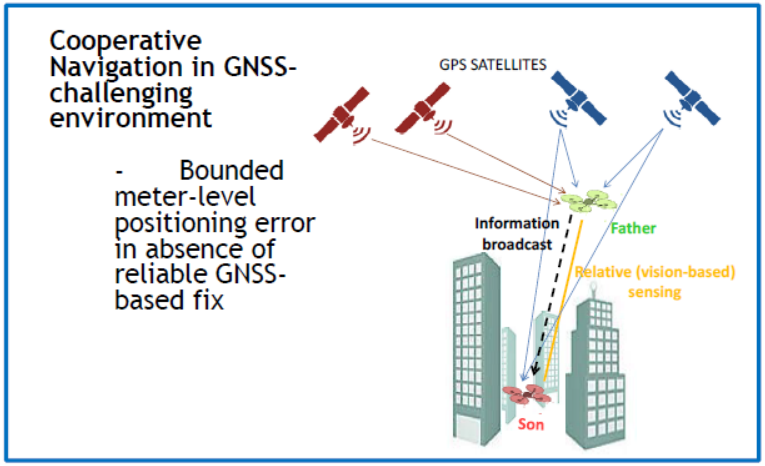


Space-Aerial System Integrated Operation



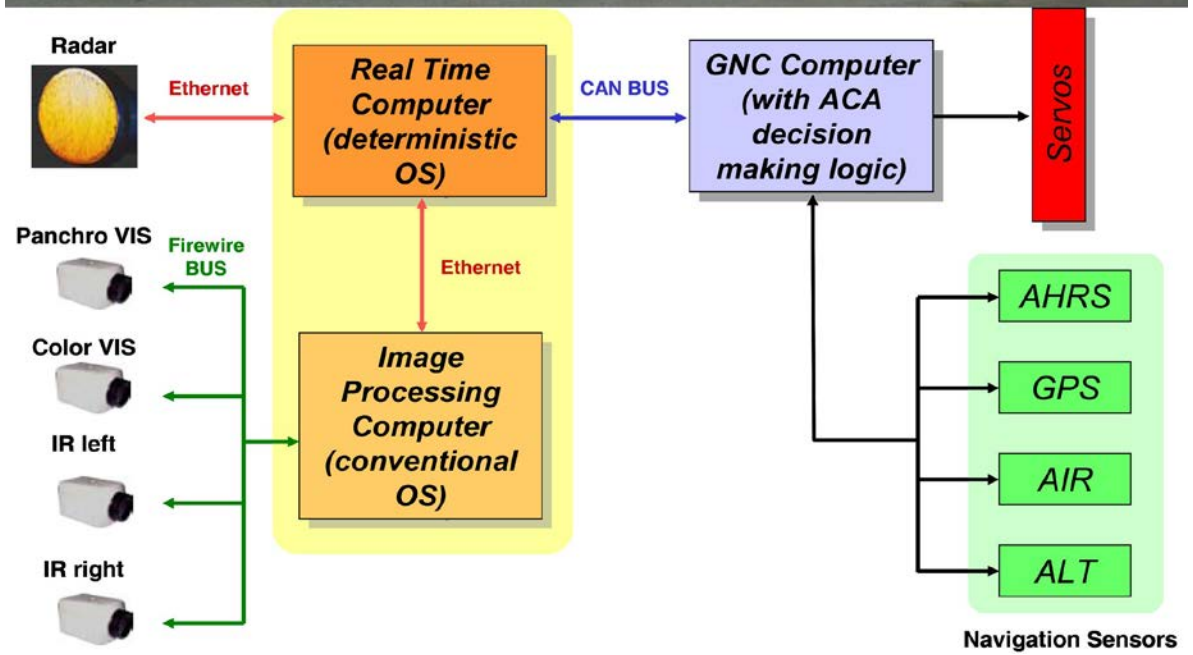
Distributed SAR Systems

Space Technology



UAS Cooperation for surveillance applications

Guidance, Navigation and Control Laboratory



Flight tests of Unmanned Aircraft Systems Radar-EO sensor fusion for Sense and Avoid capability

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Reduced order modelling and data-driven analysis for flow control

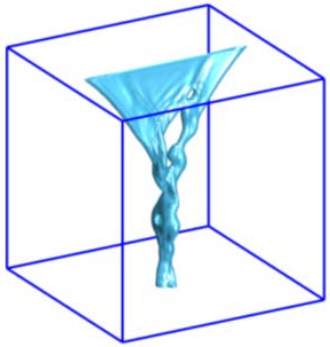
Main activities:

- Modal analysis of two-phase fluid flows.
- Data-driven stability analysis.
- Robust spectral analysis.

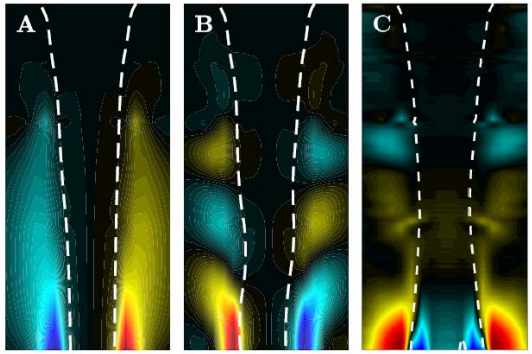
Collaboration with:

Prof. Oliver T. Schmidt, University of California San Diego, USA

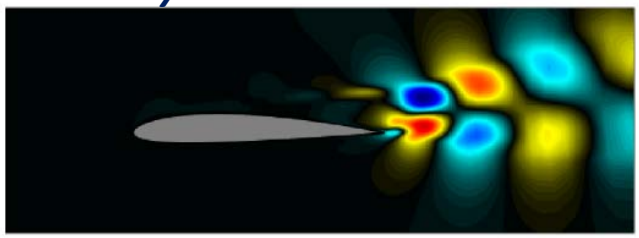
New methodologies for robust data-driven modal analysis



Vertical liquid curtain.



Less stable modes of vertical liquid curtain.



Leading axial velocity mode.

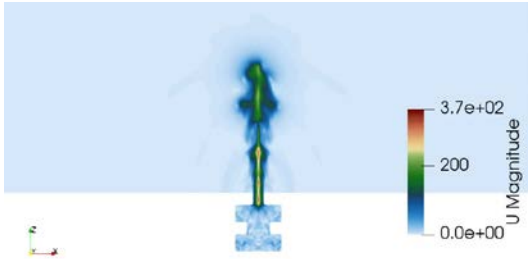
- Reduced Order Modelling of airfoil configurations.
- Cluster based Network Modelling (CNM).

Collaboration with:

Prof. Bernd R. Noack, Harbin Institute of Technology, Shenzhen, Peoples' Republic of China

New approaches for cluster-based machine learning for reduced order modelling and flow control

- Numerical simulations of piezo-driven synthetic jet actuators.
- Numerical simulations of Plasma Synthetic Actuators (PSJ).



PSJ flow field.

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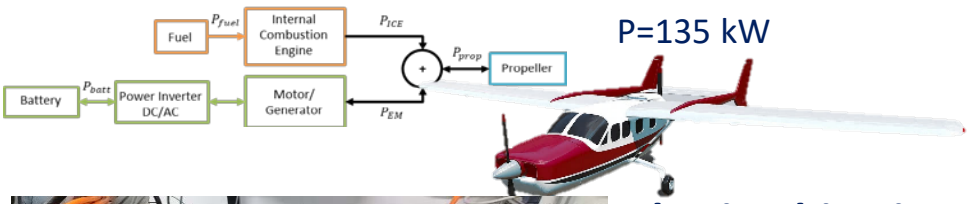
Management Strategies for Hybrid Propulsion System

Parallel Hybrid Propulsion for Aircraft application



P=135 kW

Parallel Hybrid Propulsion for Naval application

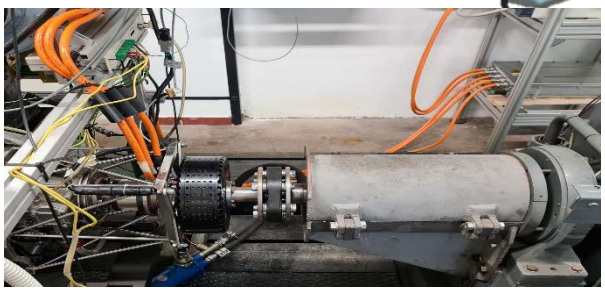


Fig.1: Experimental setup CMD22 + EMRAX 268 at Unina Test bench

Thesis Objective: Testing activities and formulation of an optimal energy management control, based on an Adaptive Equivalent Consumption Minimization Strategies (A-ECMS).

Fig.3: Experimental setup FNM 300HPE + 2 PARKER GVI at STEAMS Test bench

Minimization Problem based on HEMILTONIAN

$$H = P_{fuel}\big(t, u(t)\big) + s(t) \cdot P_{elec}\ (t, u(t))$$

In collaboration with:

CIRA Centro Italiano Ricerche Aerospaziali

CMD A LONCIN COMPANY

DYNA-H power in motion

Consiglio Nazionale delle Ricerche STEMS

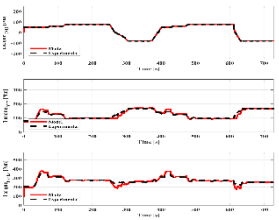


Fig.2: Matlab/Simulink Aircraft propulsion Model & Validation Results.

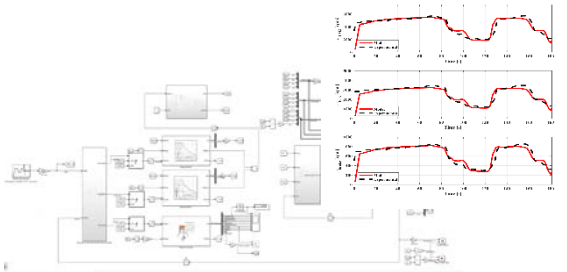


Fig.4: Matlab/Simulink Naval propulsion Model & Validation Results.

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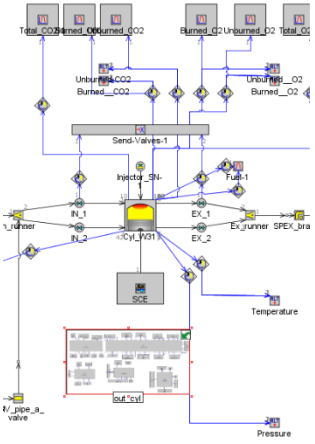
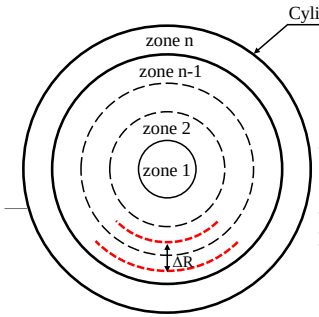
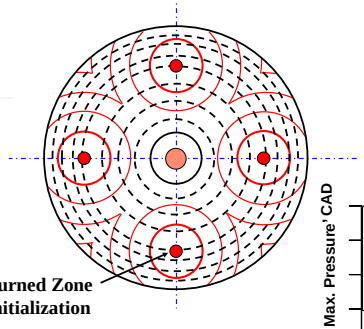
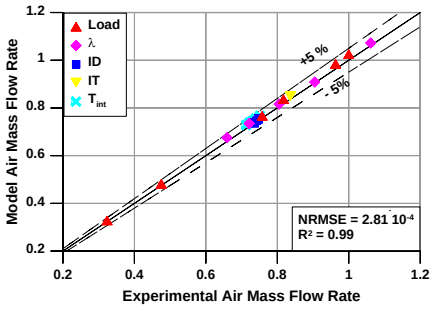
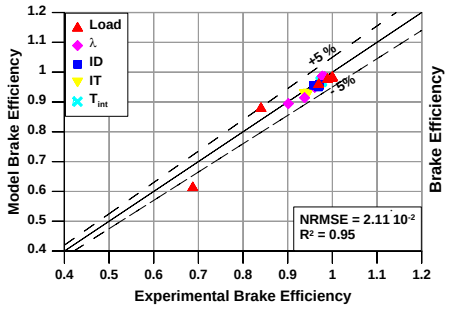
Numerical study of LTC combustion in marine engines

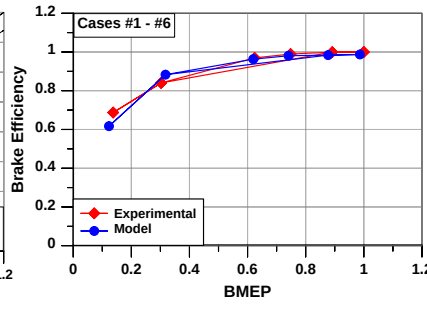


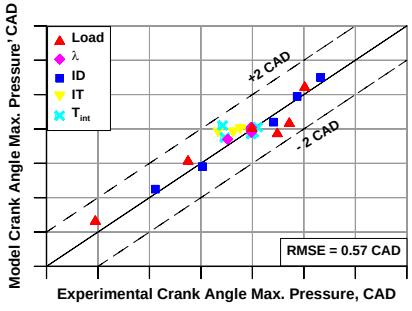


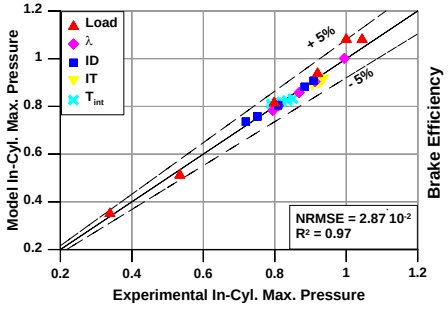


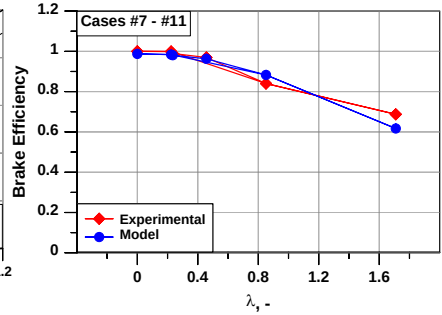












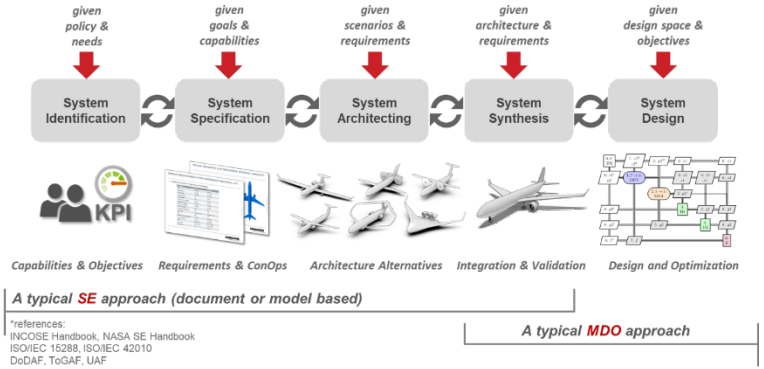
WÄRTSILÄ

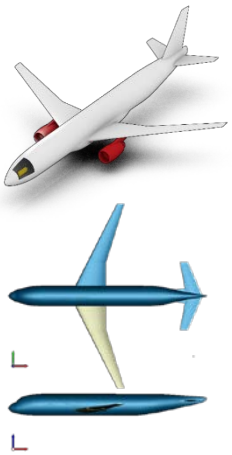
UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II

DIPARTIMENTO DI INGEGNERIA INDUSTRIALE

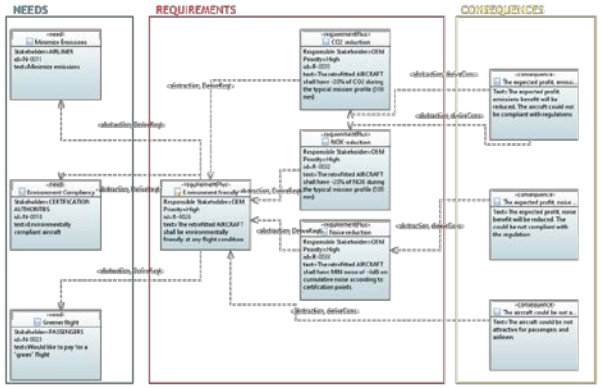
Multidisciplinary Analysis and Optimization of commercial aircraft design driven by Model Based System Engineering

1) A Systems Engineering Product Development process is followed to design commercial aircraft

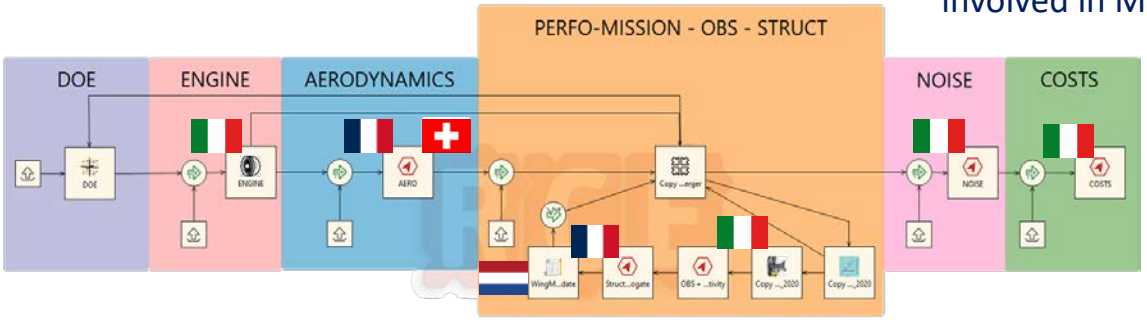




2) The process starts from Model Based System Engineering schema



3) The result is a collaborative remote multidisciplinary optimization workflow



3 Companies, 3 Research Centers and 3 Universities are involved in Models formalization and Workflow execution.

LEONARDO
KE-works
CFS Engineering
Deutsches Zentrum für Luft- und Raumfahrt
DLR
ONERA
nlr
UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II
Politecnico di Torino
TUDelft

UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II

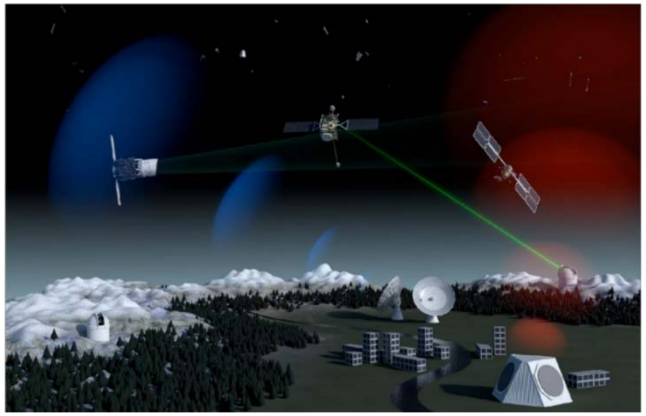
DIPARTIMENTO DI INGEGNERIA INDUSTRIALE

Event, object and mission characterization for Space Domain Awareness

The rising number of space launches in the last few decades , determined a dramatic increase of **space debris**

Resident Space Objects characterization

Need of a **Space Situational Awareness.** Development of tools for **Space Surveillance and Tracking** activities



Recognised Space Picture

Collaborations with Aeronautica Militare, Leonardo S.p.A., Imperial College London

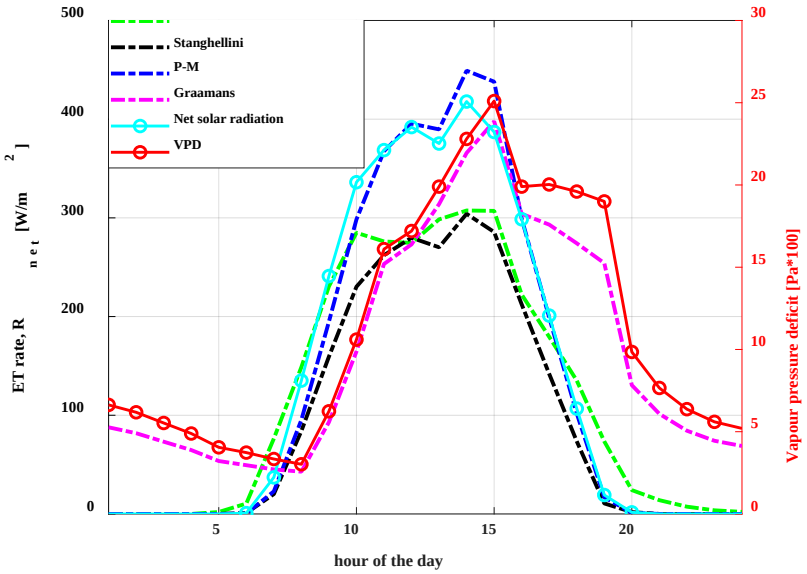
Breakup events modelling

UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II

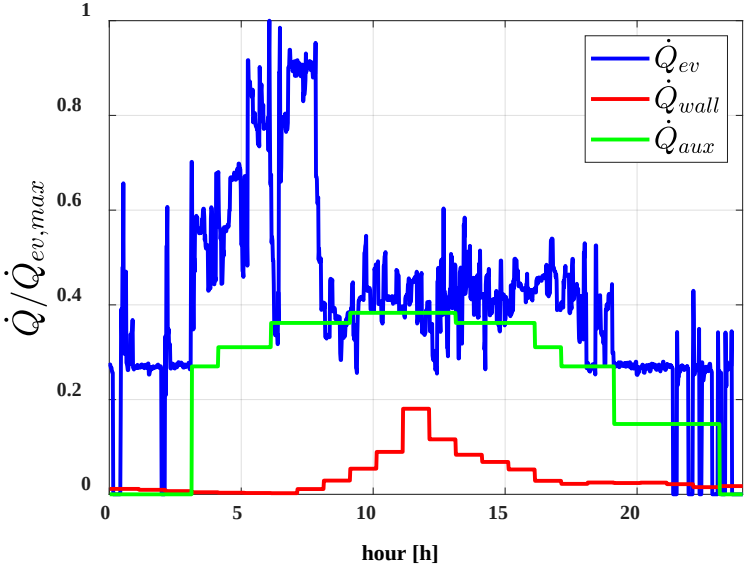
DIPARTIMENTO DI INGEGNERIA INDUSTRIALE

Thermo-economical characterization and simulation of innovative systems for the agrifood sector

- Assessment of the predictive methods



- Evaluation of the energy loads of the systems



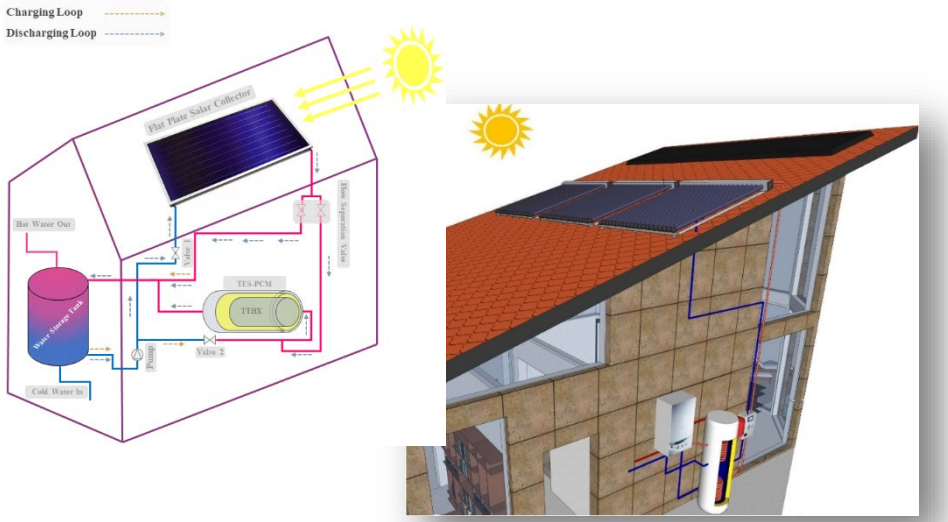
- This project is part of the Agritech research activities

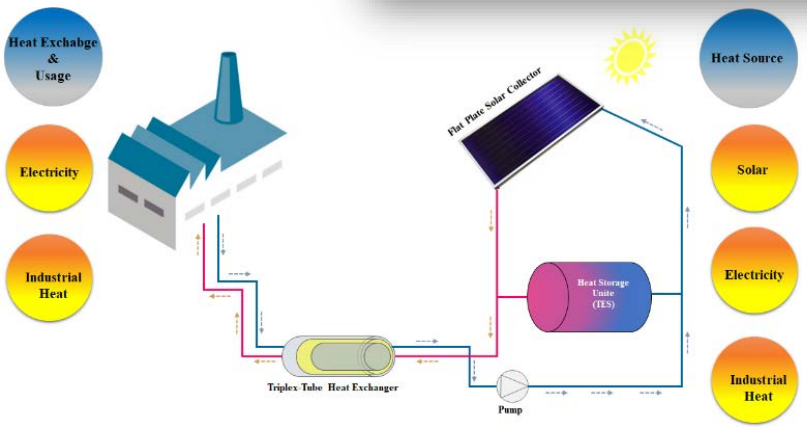
agritech
National Center for Technology in Agriculture

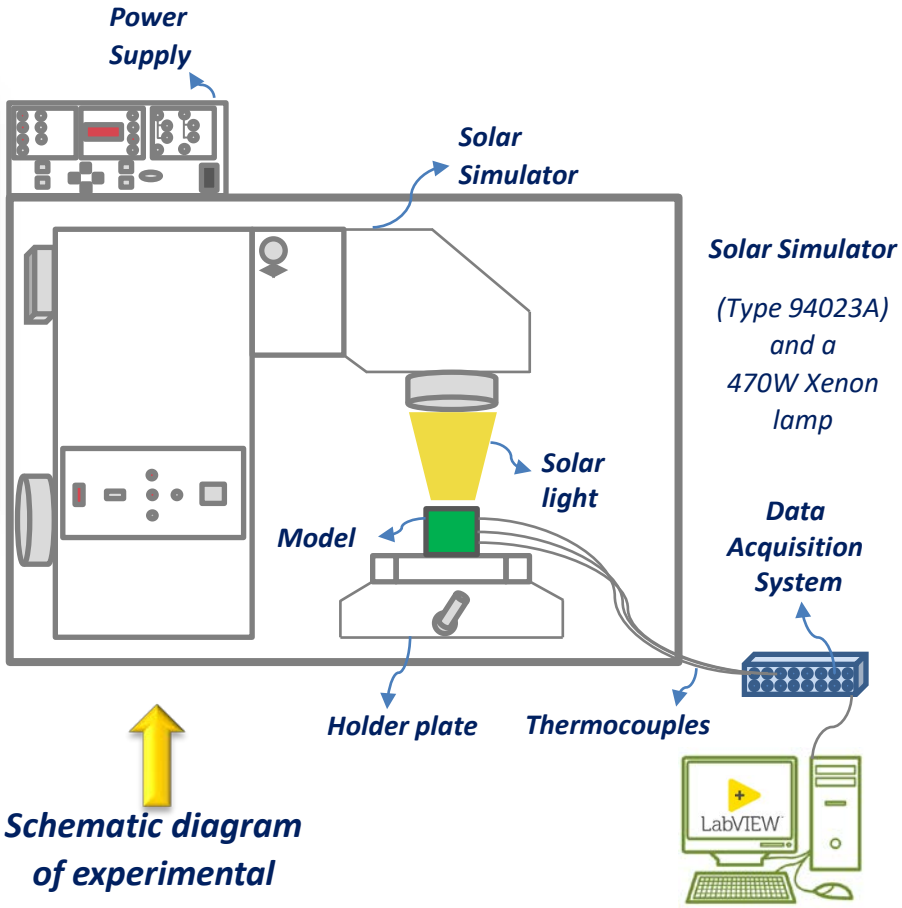
UNIVERSITÀ DEGLI STUDI DI NAPOLI
FEDERICO II

DIPARTIMENTO DI
INGEGNERIA
INDUSTRIALE

Experimental and numerical analysis of the thermal performance of PCM in a solar system with enhancement PCM thermal conductivity methods







Solar Simulator

(Type 94023A) and a 470W Xenon lamp

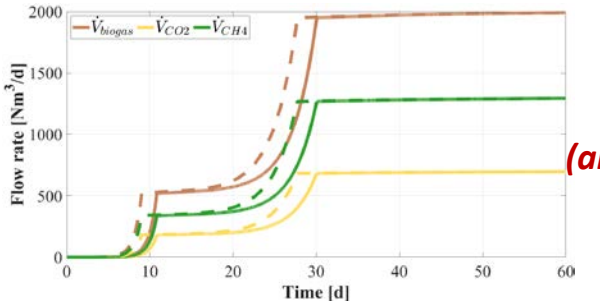
Schematic diagram of experimental setup

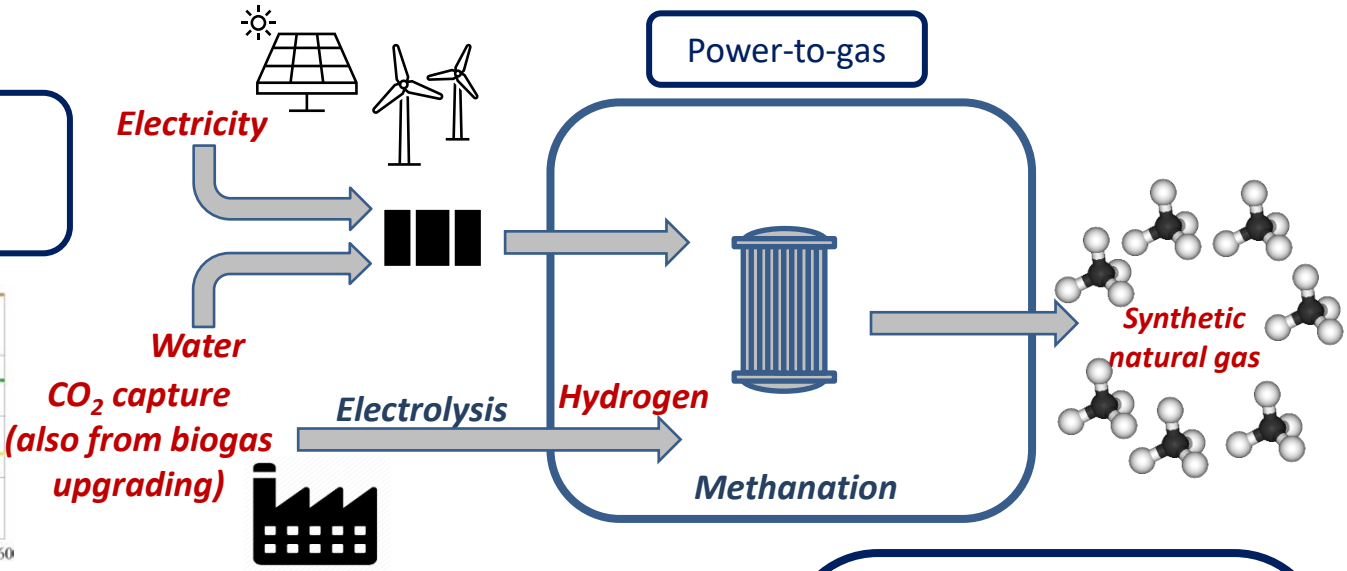
UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II

DIPARTIMENTO DI INGEGNERIA INDUSTRIALE

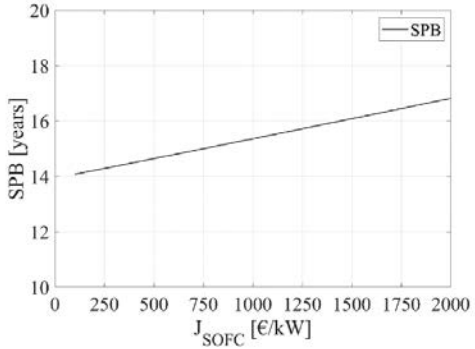
Dynamic simulation and modeling of renewable polygeneration systems

Anaerobic Digestion of biomass for biogas production

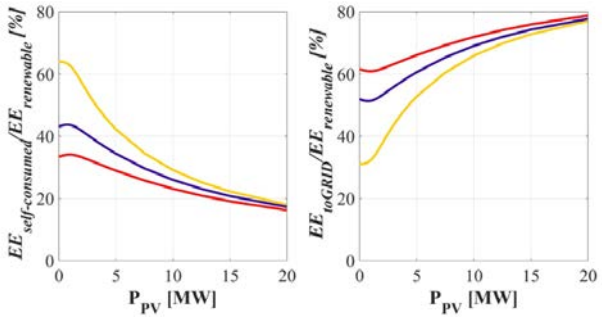




Electrolyzers and fuel cells are still too expensive



District heating and cooling coupled with renewable has great potential to reduce building energy consumption



Research activity in cooperation between the **Department of Industrial Engineering** of the **Federico II** University and the **Concordia University**

Concordia UNIVERSITY

UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II

Horizon 2020
European Union Funding
For Research & Innovation

DIPARTIMENTO DI INGEGNERIA INDUSTRIALE

Semi-active vibration control approaches

- Industrial doctorate (www.livei.fr), under Marie-Curie grant agreement No 860243.
- Recruiting University: UNINA, Italy
- Industry Partner: Adaptronica, Poland
- Academic collaborators: École Centrale de Lyon, Technical University of Darmstadt

❑ Research Objective

Reducing vehicle gearbox noise & vibration by designing a semi-active controller

- Metal cushion, actuator, power amplifier
- Data acquisition and control hardware
- Sensors (vibrometer, accelerometers, and force sensors)
- Software for data acquisition and control National instruments, Python, etc.
- Software for simulation: ANSYS

❑ Experimentation

Metal Cushion

Isolating bearing induced vibrations

Using Microcomputer to control the vibration isolator

Fiat gearbox component

❑ Highlighted Results/advantages

- ✓ A vibration isolation rate of 55.17%
- ✓ Wide-band tuning
- ✓ Metal rubber as a Light-weight material

❑ Published Results

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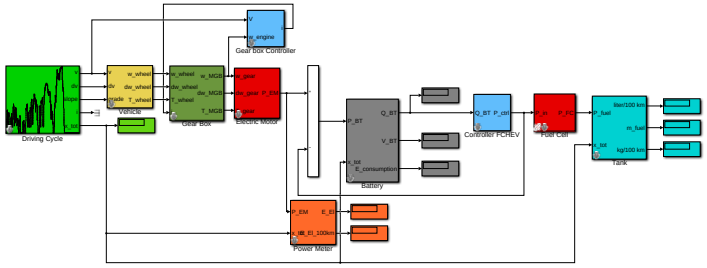
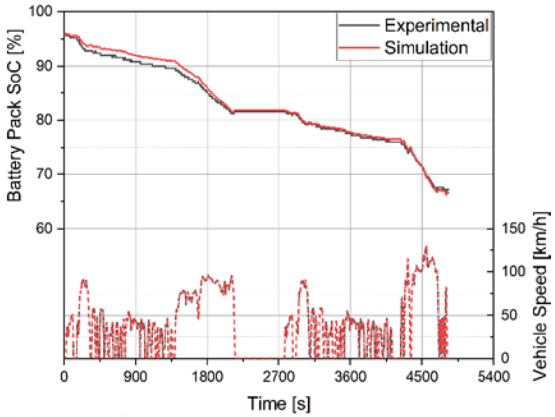
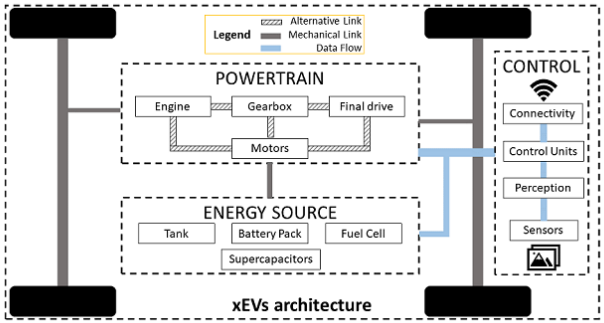
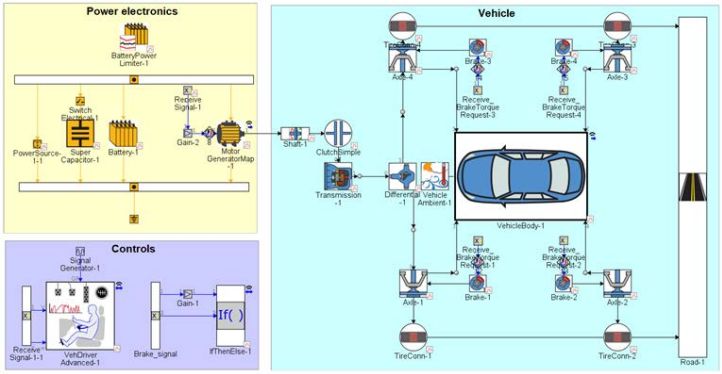
DIPARTIMENTO DI INGEGNERIA INDUSTRIALE

The paths towards the decarbonisation of the transport sector: a multi-objective analysis approach of electrified vehicles









STEMS

teorest group

Politecnico di Torino

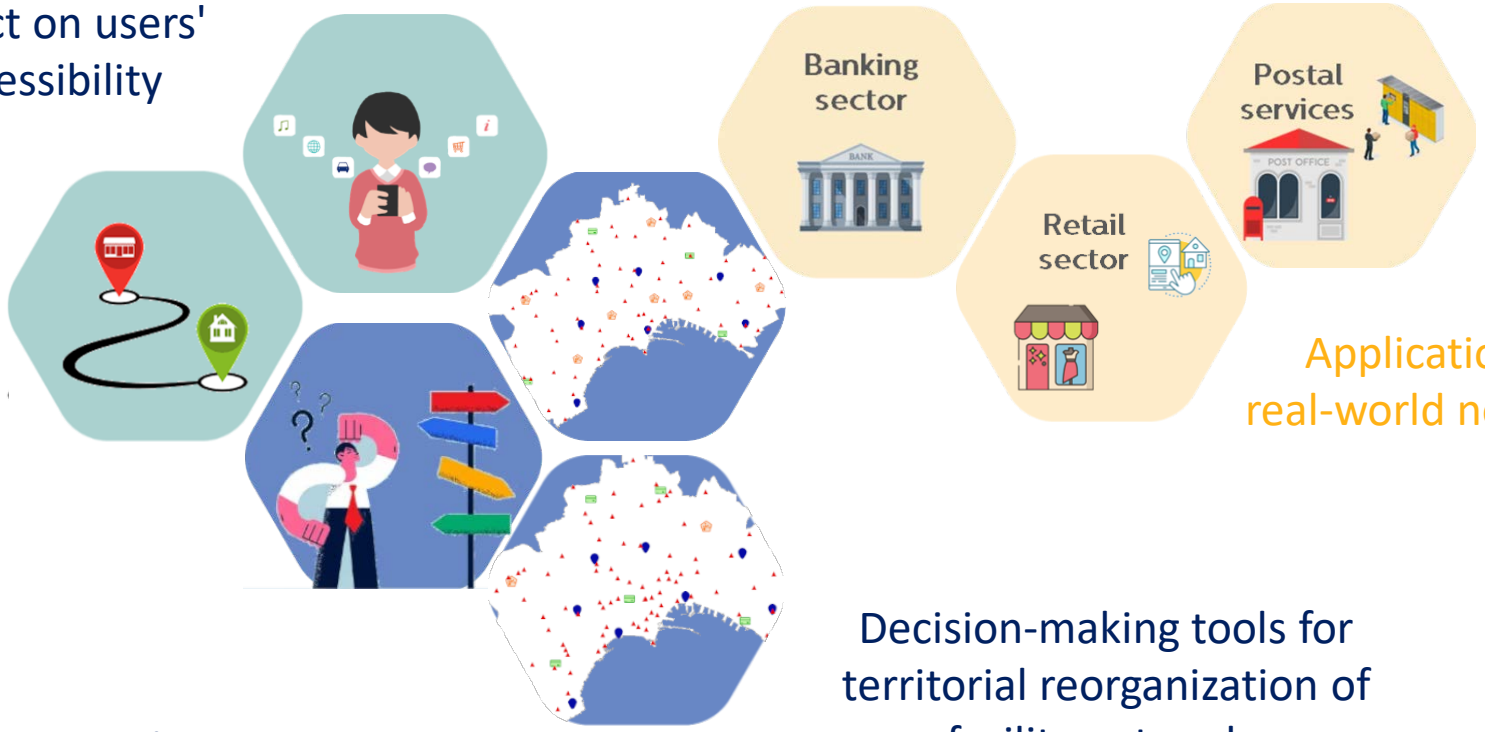
CHALMERS UNIVERSITY OF TECHNOLOGY

UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II

DIPARTIMENTO DI INGEGNERIA INDUSTRIALE

Models and methods for redesigning service networks in the digital transformation era

Analysis of digitalisation impact on users' accessibility



Application to real-world networks

Decision-making tools for territorial reorganization of facility networks

Collaboration with

UNIVERSITY OF PATRAS
ΠΑΝΕΠΙΣΤΗΜΙΟ ΠΑΤΡΩΝ

UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II

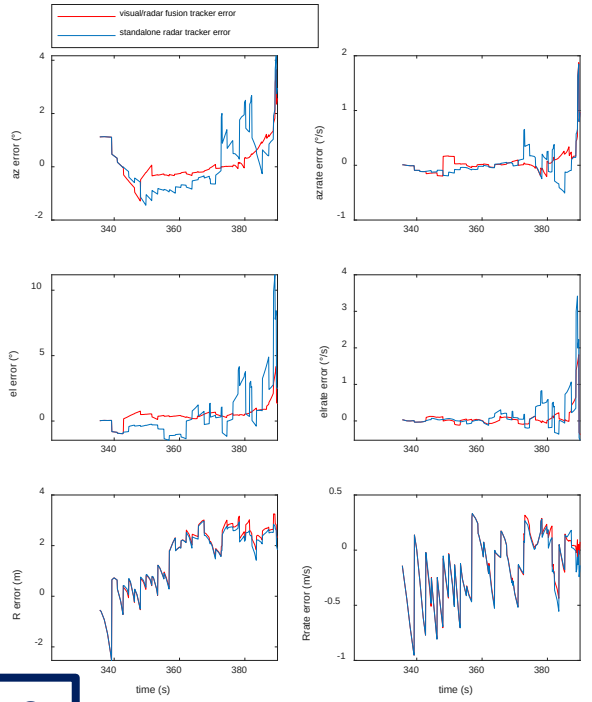
DIPARTIMENTO DI INGEGNERIA INDUSTRIALE

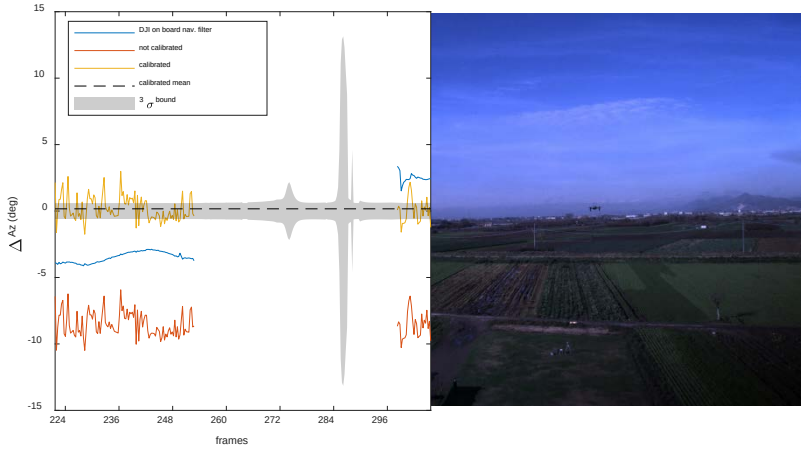
Navigation and surveillance strategies enabling autonomous operations of Unmanned Aerial Vehicles in low altitude conditions

SENSE AND AVOID

Visual/radar fusion strategies for detection and tracking of intruders UAVs during experimental flight tests. **Improving** performance of standalone sensors.

Collaboration and joint flight tests activities with **NASA Langley Research Center** starting this year.





COOPERATIVE STRATEGIES

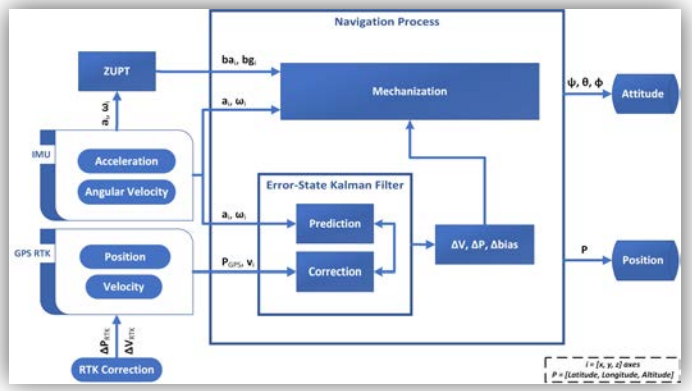
Magnetometer calibration exploiting visual sensors and cooperation between chief and deputy platforms.

Improving chief heading angle estimates accuracy and flight autonomy.

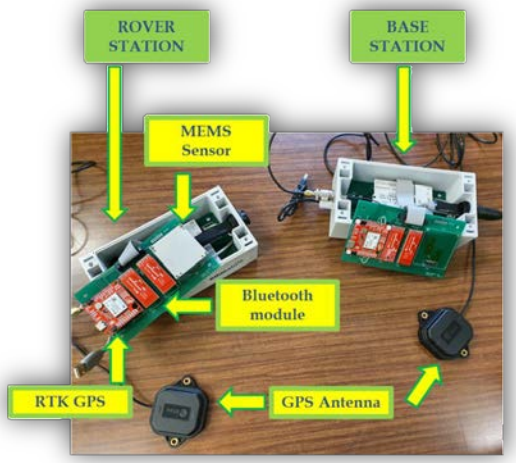
UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II

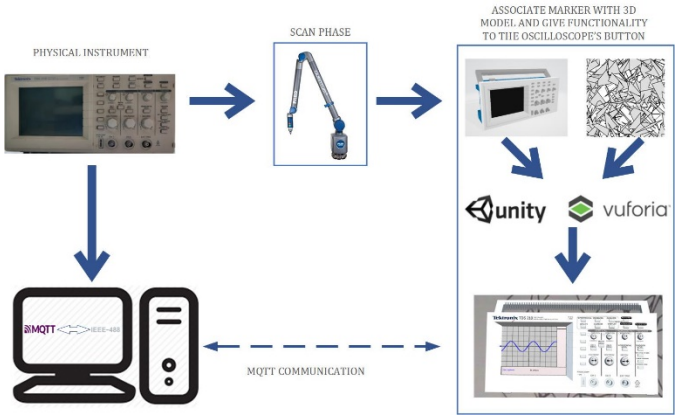
DIPARTIMENTO DI INGEGNERIA INDUSTRIALE

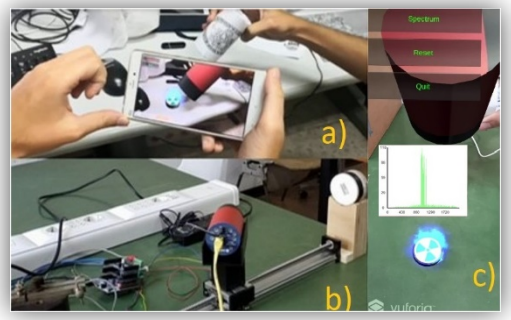
IoT-Based methods and solutions for monitoring and remote control



Definition, design and implementation of a systems for accurate attitude and position monitoring of large structures, such as bridges, tunnels, and offshore platforms, in collaboration with the Department of Management, Information and Production Engineering, University of Bergamo







Implementation of a framework, based on augmented reality, to allow students to make dangerous experiments in safe conditions in collaboration with Caen SpA and of a remote laboratory to control measurement instruments for educational purposes

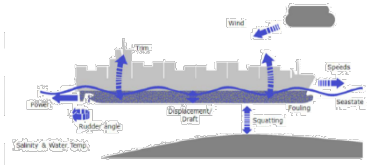
UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II

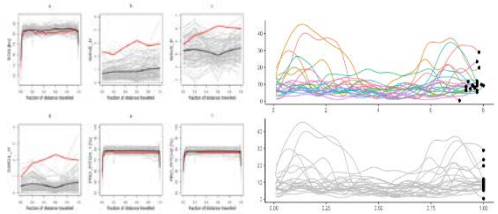
DIPARTIMENTO DI INGEGNERIA INDUSTRIALE

Artificial Intelligence & Statistics for Quality Technology

Monitoring of ship operating conditions and CO_2 emissions

GRIMALDI GROUP

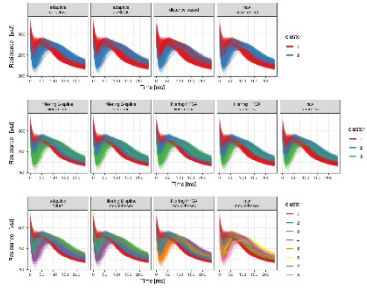




Monitoring a resistance spot welding process in the automotive industry

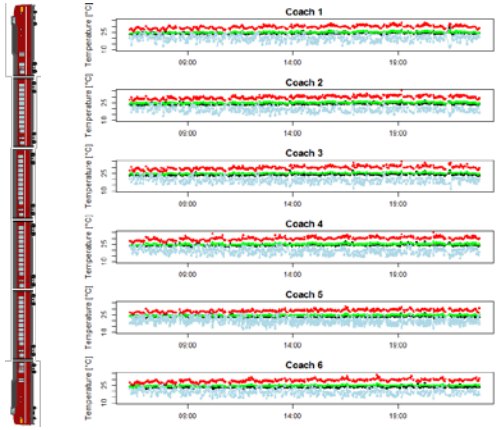
STELLANTIS

CRF CENTRO RICERCHE FIAT



Monitoring of complex systems installed on-board modern trains

HITACHI
Inspire the Next



Collaborations with other universities and research centers

DTU Technical University of Denmark

POLITECNICO MILANO 1863

ENEA
Agenzia Nazionale per le Nuove tecnologie, l'Energia e lo Sviluppo economico sostenibile

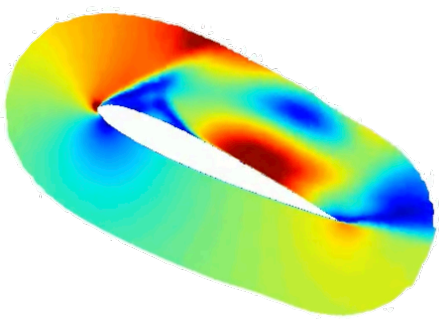
UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II

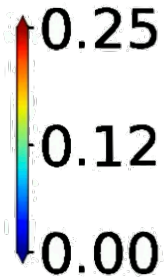
DIPARTIMENTO DI INGEGNERIA INDUSTRIALE

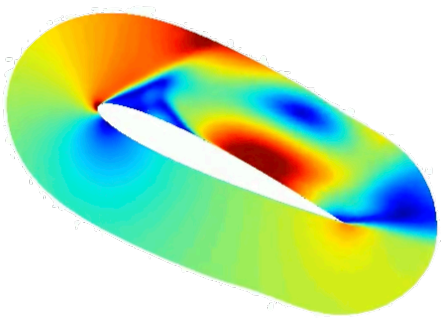
Machine Learning and Fluid Dynamics

- **Activity:**
  - In the frame of a cooperation between **University of Naples Federico II** and **Stanford University**.
  - Use of **Artificial Intelligence** for understanding the Physics of flight.

Mach number distribution in the flow around an airfoil

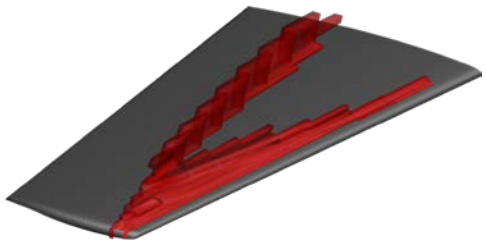






Flow generated by artificial intelligence

Flow generated by conventional method (CFD)



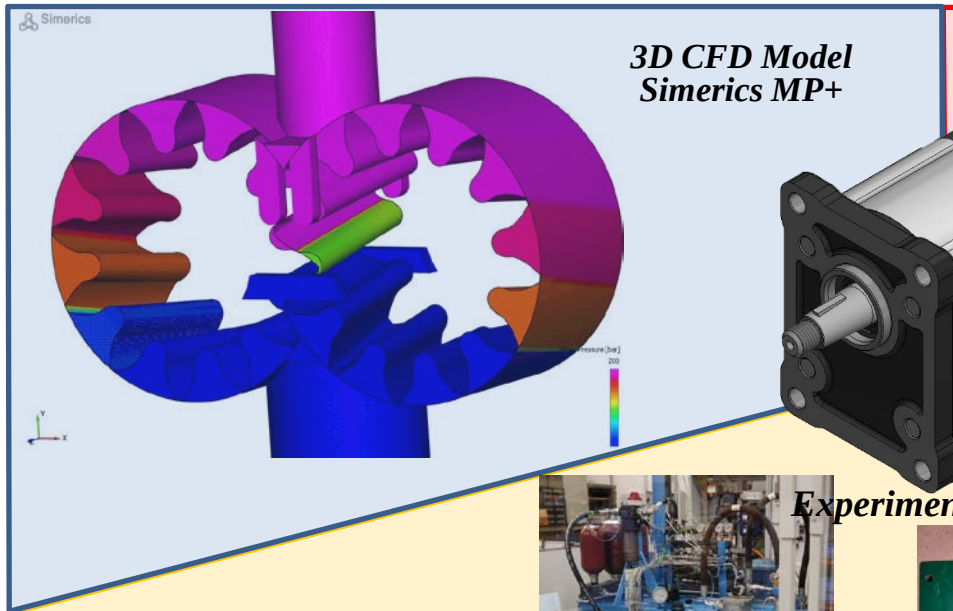
Shock wave on the wing identified by Machine Learning algorithm

- **Final goal:** “exact” aerodynamic performance of flying bodies in real-time.

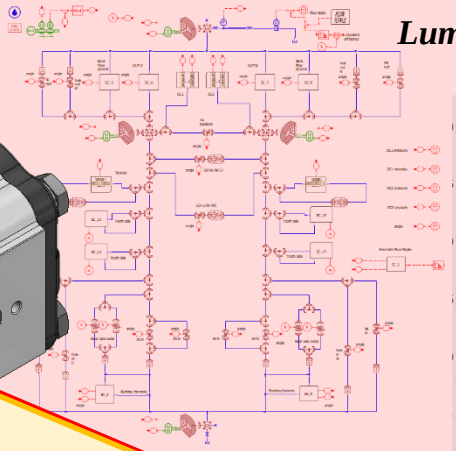
UNIVERSITÀ DEGLI STUDI DI NAPOLI
FEDERICO II

DIPARTIMENTO DI
INGEGNERIA
INDUSTRIALE

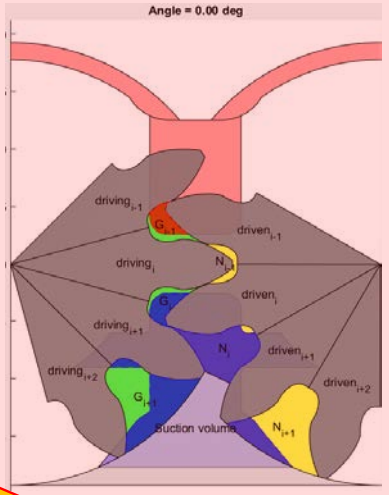
Efficiency improvements and noise reduction in external gear pumps through numerical modeling



3D CFD Model
Simerics MP+

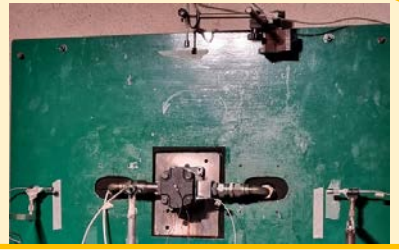


Lumped Parameter Model
EgeMATor MP+



Experimental Validation

Duplomatic MS
Test Bench



STEMS - IMAMOTER
Noise Test Bench

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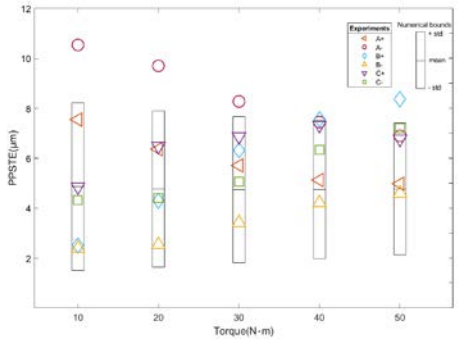
DIPARTIMENTO DI INGEGNERIA INDUSTRIALE

Manufacturing margins and robustness of NVH prediction for lightweight transmissions

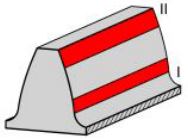


Numerical vs. experimental distribution of peak-to-peak STE: (max STE – min STE)

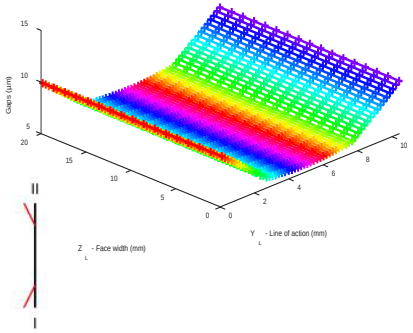
Tested gear pairs have the same macro geometry parameters with manufacturing errors;

A+, B+, C+: clockwise rotation

A- , B- , C- : counterclockwise rotation



Tip and Root Relief



Optimized gear flanks using tip relief correctio

Rank the effect of gear design and mounting **uncertainties** on static transmission error (STE)

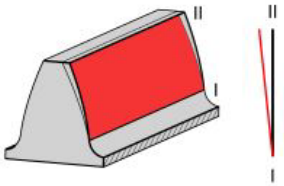
Dynamic and static experiments for **spur** and **helical gear** pairs (10 configurations)

Sensitivity analysis of gear parameters interaction on the STE response

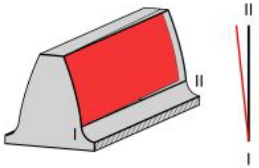
Robustness of predictive numerical tools for STE distribution

Optimization of gears **profile geometry** to reduce STE

Dynamic analysis to assess the effect of manufacturing errors on **NVH response**

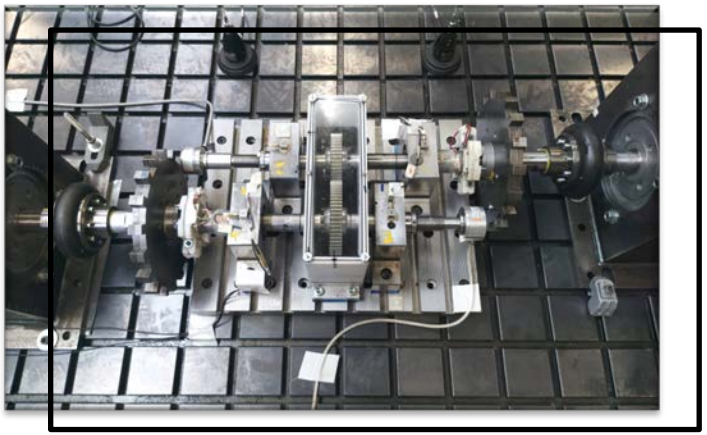


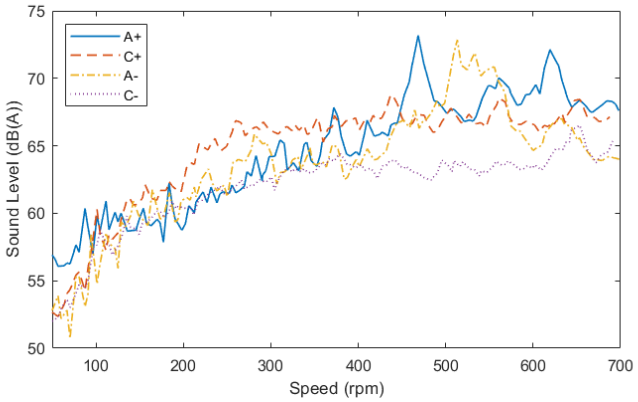
Profile Slope



Lead Slope

Experimental Test Bench





Evolution of Global Sound Level for gear pair configurations with different regimes

VibraTec

UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II

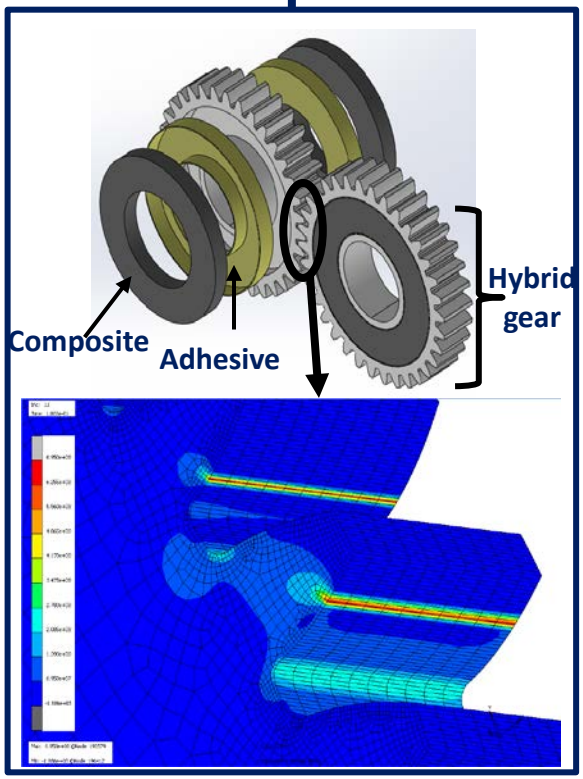
DIPARTIMENTO DI INGEGNERIA INDUSTRIALE

Materials optimization of lightweight gear transmission components

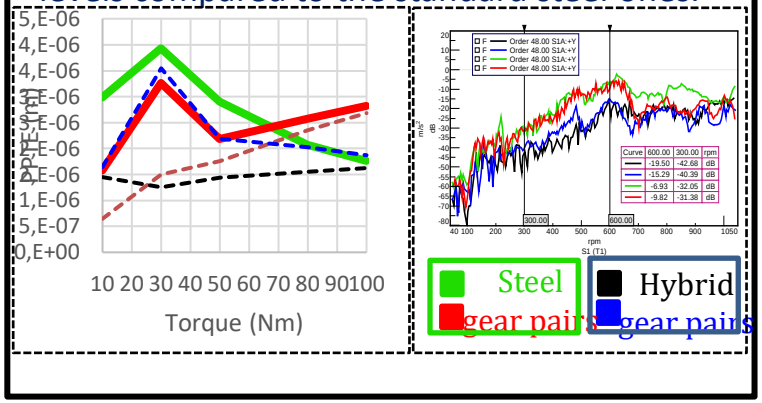
Developing a flexible multibody approach to design hybrid gears that balances mass reduction with optimal NVH performance

Introducing hybrid Metal-Carbon Fiber Reinforced Plastic gears while assessing their impact on NVH performances

Manufacturing hybrid gears with 50% weight Reduction and conducting an experimental campaign for static and dynamic analysis



Results show that most of the Hybrid gear pairs configurations present lower Vibration levels compared to the standard steel ones.



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