SAPIENZA
UNIVERSITÀ DI ROMA

DIMA

DIPARTIMENTO DI INGEGNERIA MECCANICA E AEROSPAZIALE

MISSION

- Empower students to achieve their goals through the highest quality education and research
- Advance research and innovation technologies to tackle society challenges
- Contribute to the strategic goals of La Sapienza University as a prominent player for research and education in the national and international context

VISION

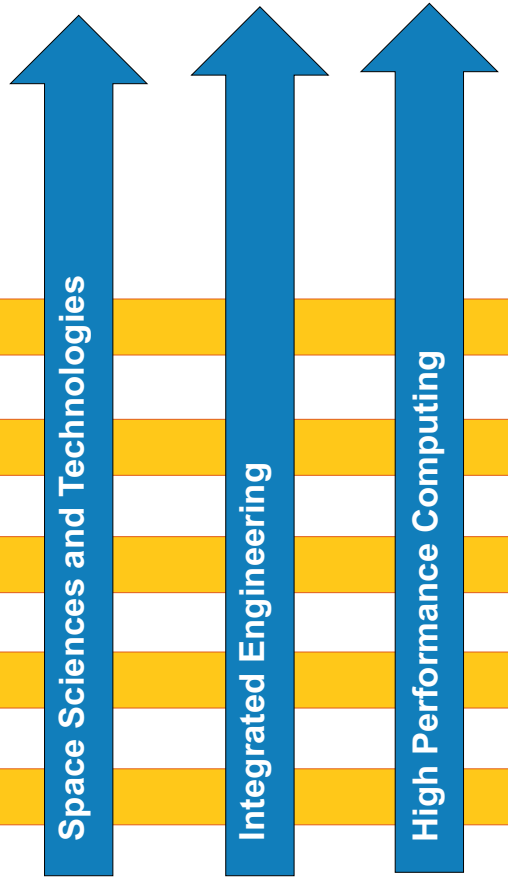
- Build a multi-disciplinary network sharing ideas and knowledge to look at excellence and innovation
- Promote and develop the major areas of scientific knowledge and competencies to foster international collaborations and partnerships along major strategic research lines
- Support our greatest asset: Students, Faculty and Staff to improve community cooperation

STRATEGIC VISION

Innovation and frontier research in Mechanical and Aerospace engineering requires key enabling capabilities, a result of an integrated and multidisciplinary vision

"Horizontal" lines
Enabling technologies

- Mathematical modeling and numerical simulation
- Experimental research
- Design and construction
- Complex Systems
- Bioengineering and human-machine interface



"Vertical" lines
Multidisciplinary Competence Centers

- **AERO SPACE SYSTEMS**
- **HPC (high performance computing)**
- **INTEGRATED ENGINEERING (Industria 4.0)**

COMPETENCE CENTERS

DIMA intends to develop an integrated vision of **education, research and innovation** through the establishment of **Competence Centers** on specific strategic lines

Competence Centers:

- are open spaces with the role of scientific and technological hubs
- coordinate DIMA research groups
- operate in multidisciplinary and cross-disciplinary way on scientific lines of DIMA
- develop business relationships through specific "labs for design"

In **Competence Centers**, researchers and students can share design lines collaborating with other universities, institutional agencies, research centers and companies.

THEMATIC AREAS

1. AEROSPACE SYSTEMS – SMALL SAT, SPACE SCIENCE AND ACCESS TO SPACE

Conception and design of **satellite constellations**, of **small SAT platforms** and of the enabling technologies. **Space access**: development and evolution of small **launchers** (VEGA) and related technologies. Solar System **exploration** and development of **space science** on small satellites. New aeronautical systems, remotely piloted systems, suborbital flights.

2. COMPUTATIONAL MECHANICS – HIGH PERFORMANCE COMPUTING

Development of **algorithmic capabilities** on advanced computing systems (**Exascale Supercomputers**, hybrid **GPU/CPU clusters**) according to the European road map for Exascale Computing. Multiscale and multiphysics analysis for the design of complex systems for future engineering applications.

3. INTEGRATED ENGINEERING: DIGITAL MODELLING AND ADDITIVE MANUFACTURING

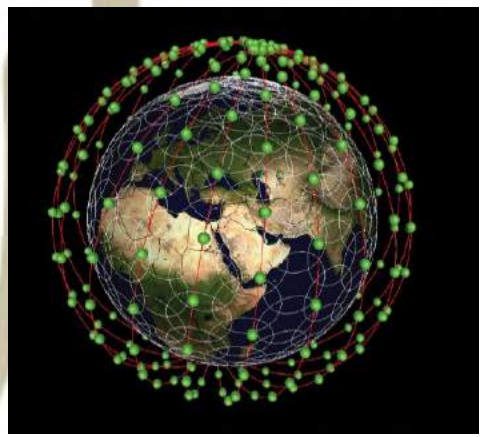
Establishment of **integrated engineering** approaches **(INDUSTRIA 4.0)**, for the development of products in a **long-life cycle perspective**, by combining methodologies of Inventive and Innovative Design with **Digital Design** and **Additive Manufacturing** technologies.

AEROSPACE SYSTEMS

Competence Center

The future of the **space field** foresees the development of systems capable of undertaking **complex scientific and practical missions.**
The policies of the major Space Agencies (e.g. ESA's **Space 4.0**), the initiatives promoted for the development of **mega-constellations** in the US, and the **Space Economy** define the development trends:

- Design of innovative Space Systems, to satisfy **final user** demands, reducing manufacturing costs.
- Promote the development of the Space Economy, a **value chain generating products and innovative services**, "**Downstream**", from research, development and enabling space infrastructures "**Upstream**"



COMPUTATIONAL MECHANICS – HIGH PERFORMANCE COMPUTING

Competence Center

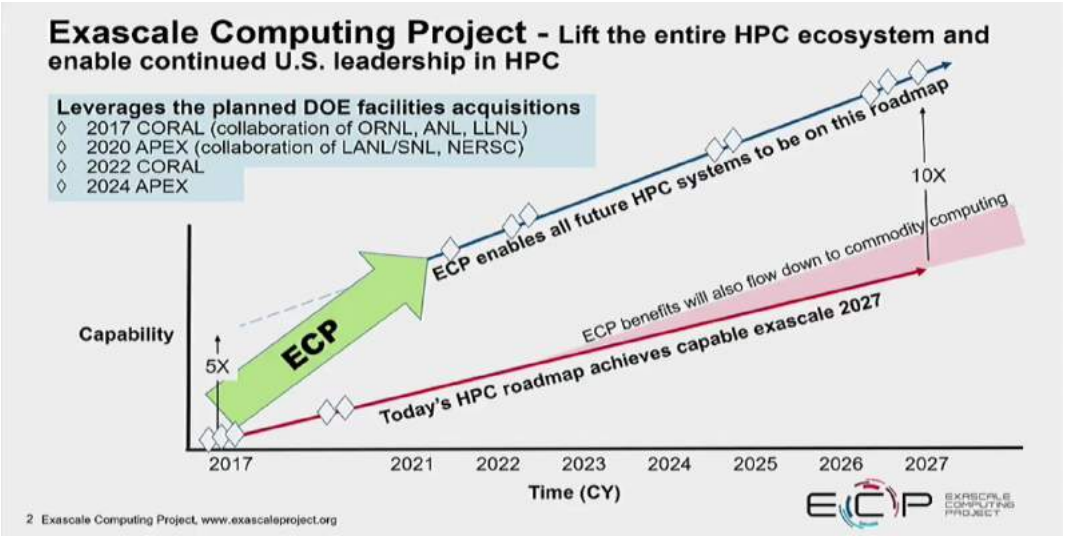
Exascale Supercomputers available in the next future (1 exaflop= 10^18 flops)

HPC enabling technology to design future complex systems

The aim is to develop **models** for new **complex, multiscales and multiphysics mechanical systems**, according to the new paradigm *Mathematical Model, Algorithm, Implementation, Simulation*

Courtesy of CINECA

From ECP



INTEGRATED ENGINEERING DESIGN FOR INNOVATION

Competence Center

INDUSTRIA 4.0: a **change in the manufacturing and logistic paradigm**

Development of analysis and design capabilities for the future Engineering challenges **(IoT, digital factory, machine learning**, **cobotics, virtual prototyping**, **additive manufacturing)**

DIMA OVERVIEW

58 Faculty Members

30 Research Associate

21 Staff

3000+ Students

1 Main Site

2 Complementary Sites

24 Labs

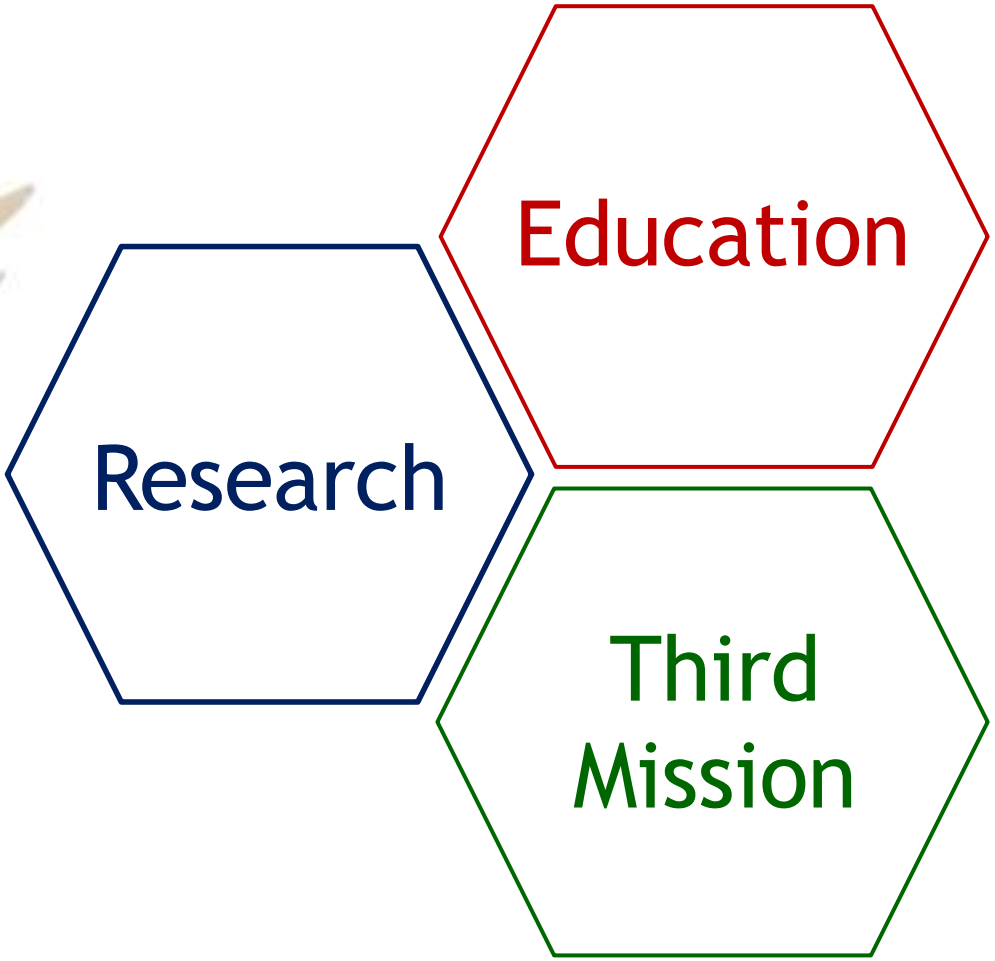
2 Bachelor Degrees

3 Master Degrees

3 PhD Programs

5 Professional Master Programs

OBJECTIVES



EDUCATION

ACADEMIC PARTNERSHIPS

BACHELOR AND MASTER OF SCIENCE

DIMA offers two Bachelor of Science and three Master of Science courses lasting three and two years respectively. Undergraduate application requires an admission test.

Bachelor of Science

- Aerospace Engineering
- Mechanical Engineering

Master of Science

- Aeronautical Engineering
- Space and Astronautical Engineering
- Mechanical Engineering

Ph.D.

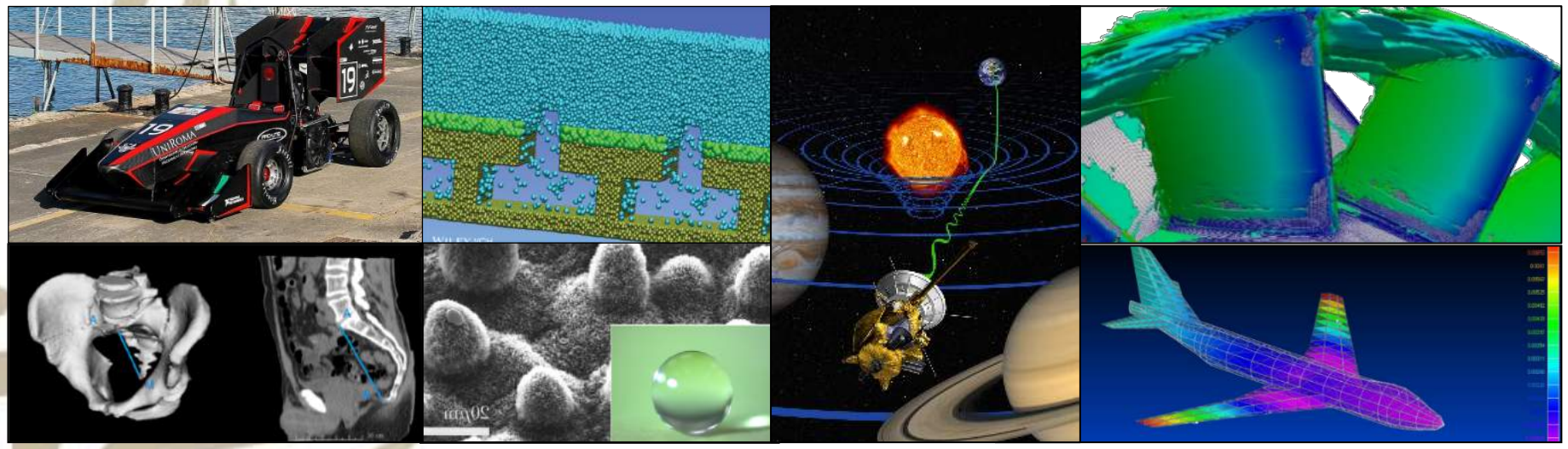
PhD programs aim at training the skills needed to carry out high quality research activities in the aerospace, industrial and mechanic field.

- Aeronautics and Space Engineering
- Theoretical and Applied Mechanics
- Industrial and Management Engineering

PROFESSIONAL MASTER PROGRAMS

These post-graduated programs last one years and admission requires MSc degree.

- Satellite Systems and Services
- Space Transportation Systems
- Civil Aviation Managment
- Energy Efficency and Renewable Energy Sources
- Inventive Engineering



RESEARCH

FUNDING AND GOVERNAMENTAL AGENCIES

MARINA Mmilitare

ENEA
ENTE PER LE NUOVE TECNOLOGIE, L'ENERGIA E L'AMBIENTE

MINISTERO DELL' ISTRUZIONE, DELL'UNIVERSITÀ E DELLA RICERCA

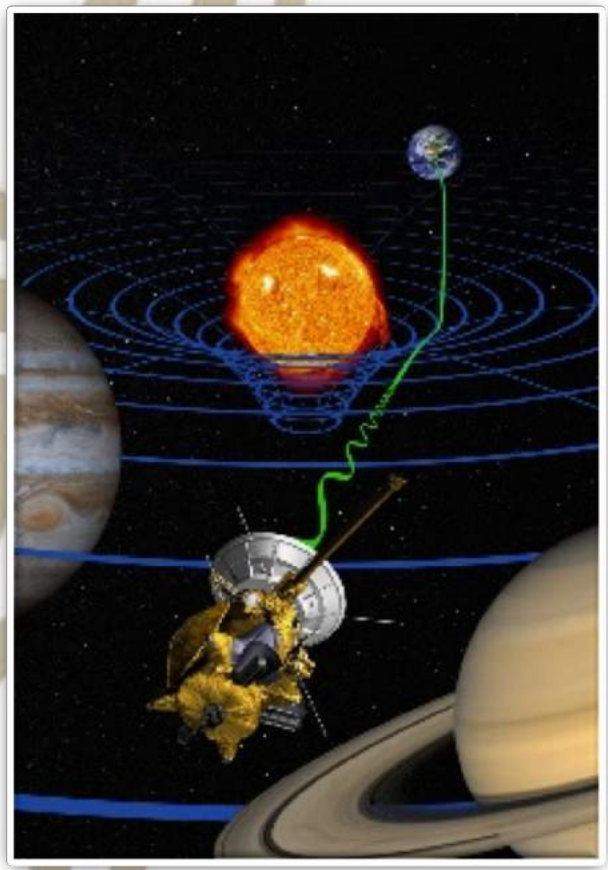
EUROPEAN DEFENCE AGENCY

Coni

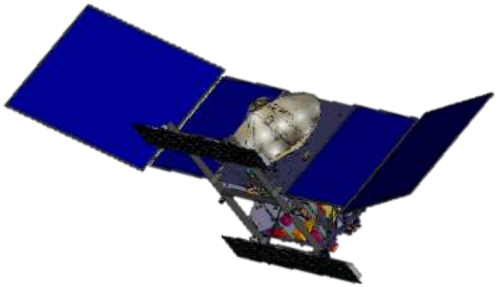
RESEARCH LINES

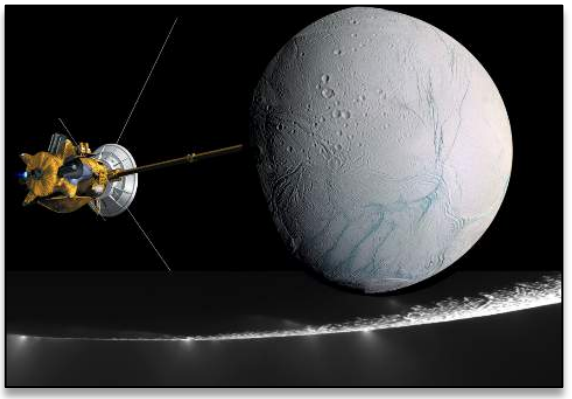
Space Science
Computational Mechanics
Energy and turbomachinery
Space Propulsion
Aerospace Technologies
Advanced Composite structures
Additive Manufacturing
Automotive
Engineering for Cultural Heritage
Advanced Design & Production Processes
Engineering for Health

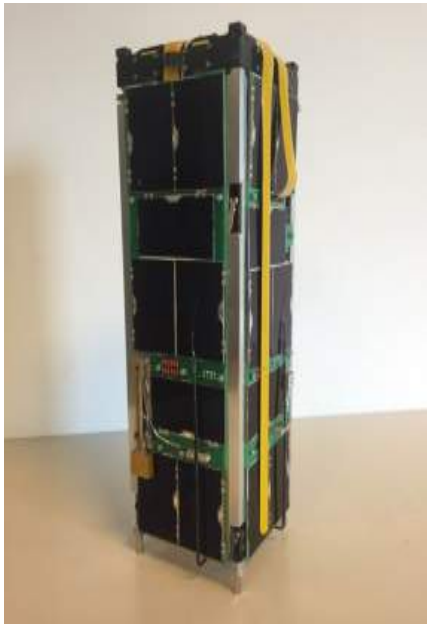
SPACE SCIENCE



Bertotti B., Iess L. and Tortora P., 'A test of general relativity using radio links with the Cassini spacecraft' *Nature*, 425, 374, (2003)

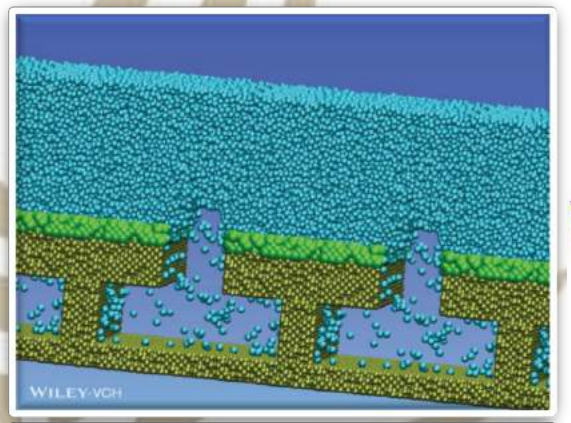


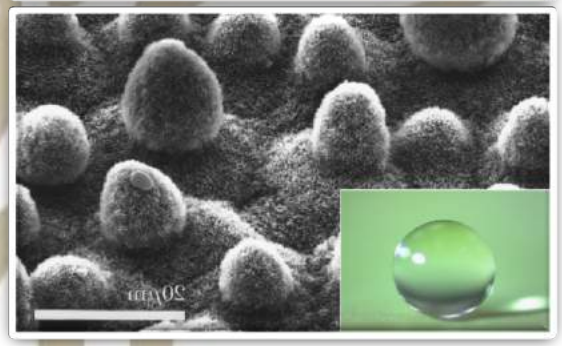




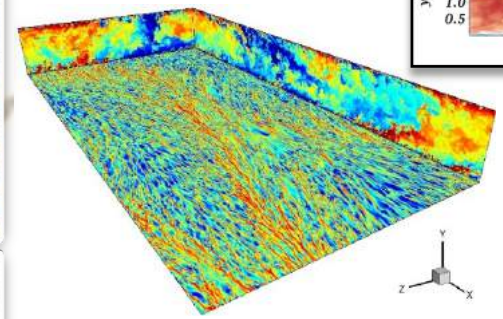
- Participation in deep space missions: Cassini (Saturn) – Juno (Jupiter) - BepiColombo (Mercury)
- Tests of relativistic gravity
- Determination of planetary mass distribution
- Space Surveillance and tracking
- Development of satellites systems

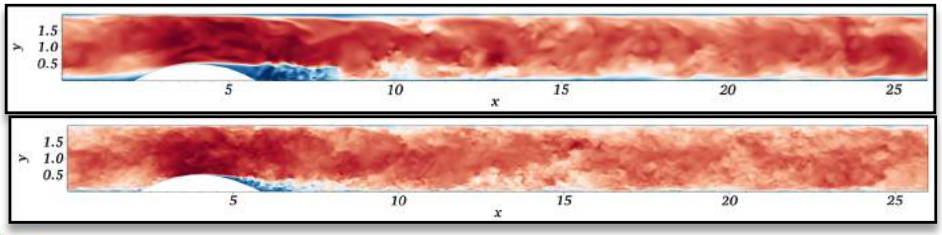
COMPUTATIONAL MECHANICS

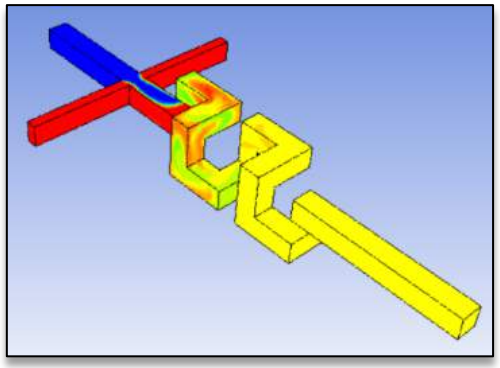


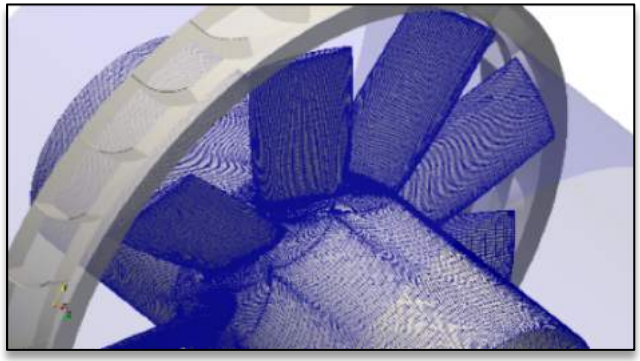


Amabili M., Giacomello A., Meloni S. and Casciola C.M. 'Unraveling the Salvinia paradox: design principles for submergedsuperhydrophobicity' *Advanced Materials Interfaces*, Vol. 2, (2015)







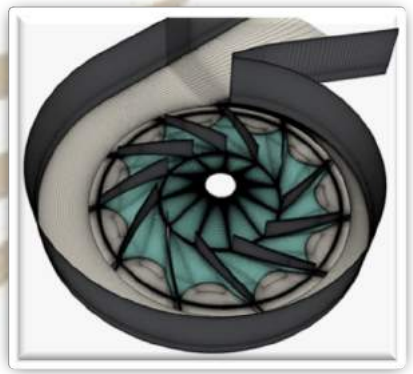


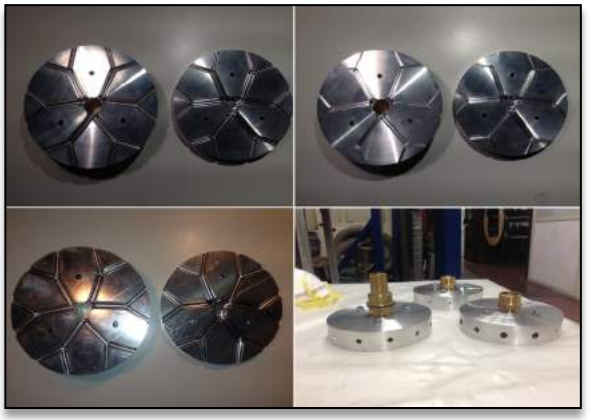
- Numerical simulations of nanoscale wetting and cavitation
- Cavitation at the mesoscale and multiphase flow physics
- Transport of bubbles and particles in turbulent flows
- Large scale DNS of high-Reynolds-number turbulent flows
- Supercritical Combustion in LRE Chambers

ENERGY AND TURBOMACHINERY

DMFC7. Test rig for a 1.5 kW Direct Methanol Fuel Cell system for 800 h of permanent degradation test

Wells Turbines for open sea applications

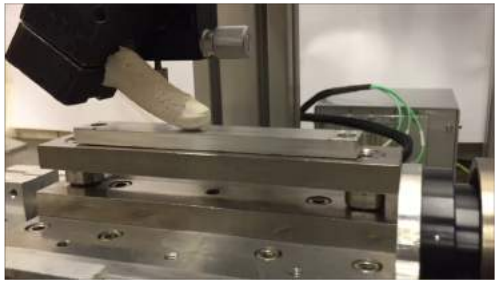


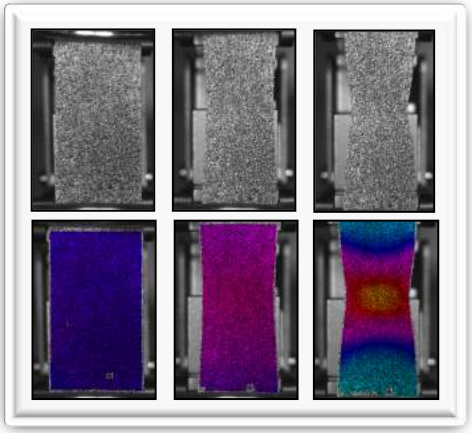


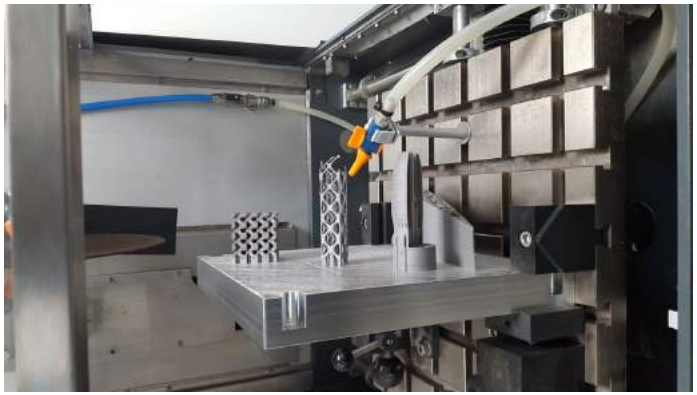
Vegetable oils fuelled common-rail engine installed at DIMA Lab

- Internal and film cooling in gas turbine blades
- Analysis of impact deposit and erosion in turbomachines
- Design of innovative fans and compressors
- Large unstructured data sets analysis and optimization
- Simulation and optimization of energy systems and micro grids
- Fuel cells and storage
- Biomasses and biofuels

MECHANICAL TECHNOLOGIES AND MANUFACTURING





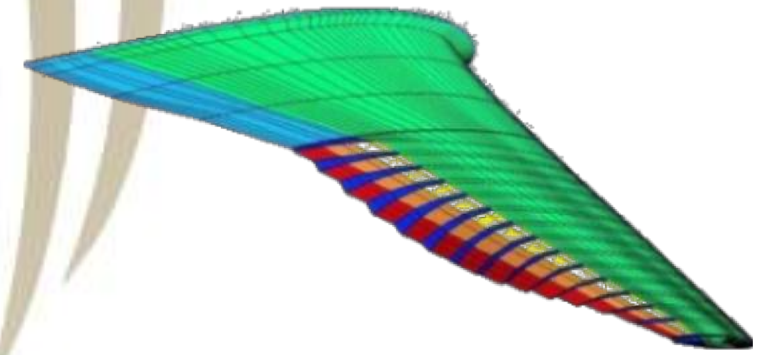


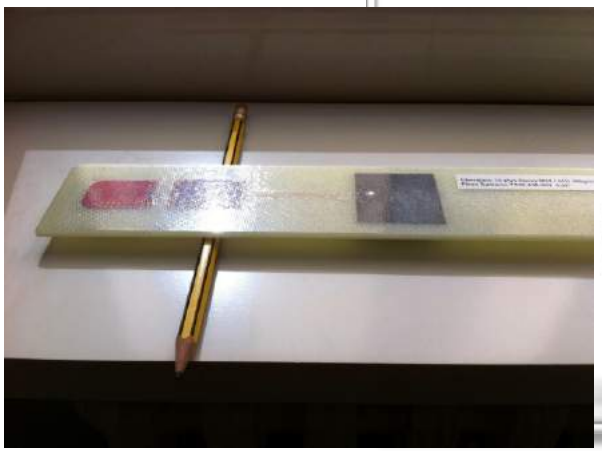
EOS M 290 for manufacturing of high-quality metal serial components

- Additive manufacturing
- Foam fabrication and powder characterization
- Laser processes of materials
- Advanced testing of materials
- Digital image correlation (DIC) measurements
- Design and topological optimization
- Virtual prototyping and process design
- Tactile perception experiments

ADVANCED MATERIALS AND STRUCTURES

Composite material component with embedded self-powered wireless sensor device for structural monitoring
Patent RM2013A000584
P. Gaudenzi L. Lampani





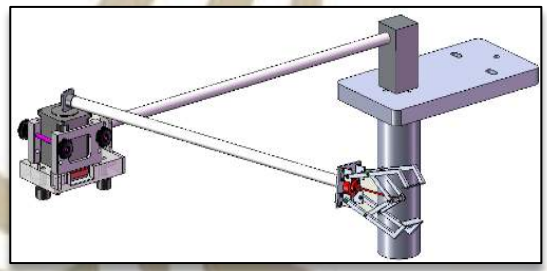
- Wireless smart composite structures
- Damage detection on sensorized composite structures
- Composite structures manufacturing lab
- Nonlinear aeroelastic modeling for flexible airfoils

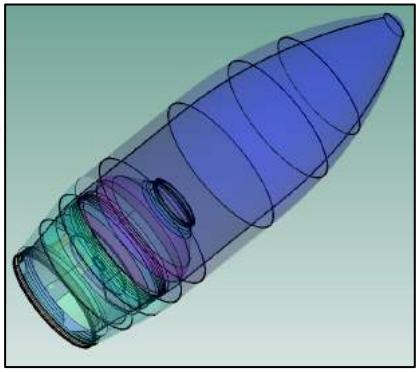
AUTOMOTIVE

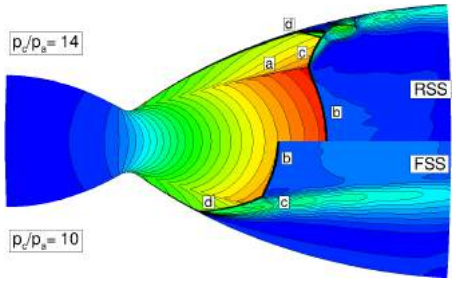
Coppo, F.; Pepe, G.; Roveri, N.; Carcaterra, A.
A Multisensing Setup for the Intelligent Tire Monitoring.
Sensors 2017, 17, 576.

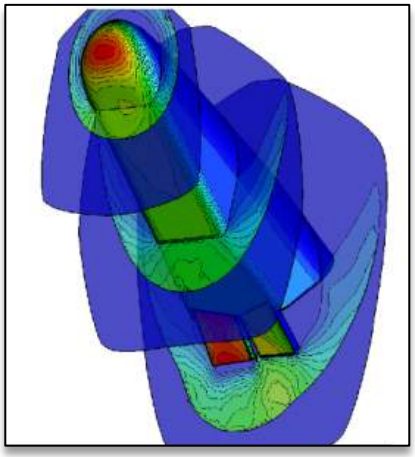
- Robust IP protection
- Vibration and acoustics prediction
- Smart suspension and tyre control
- Damping Control and Energy Harvesting
- Signal analysis on board
- Structural design of vehicle and its parts
- Analysis of aerodynamics and materials
- Vehicle dynamics
- Composite structure testing for racing car design
- Innovative drivetrain devising for racing car design

SPACE PROPULSION AEROSPACE TECHNOLOGIES





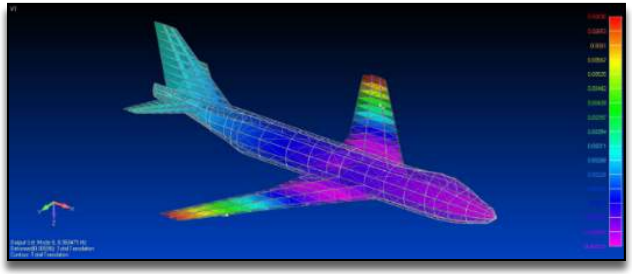


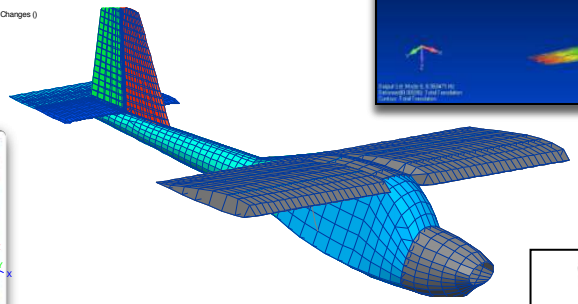


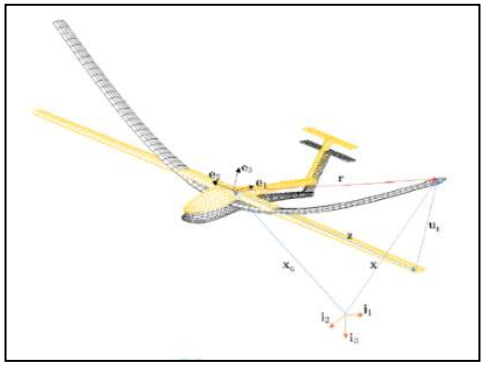
Vega space launcher

- Analysis of liquid and solid rocket engine performance
- Space launchers vibroacoustics (Vega)
- Wall heat flux estimation in thrust chambers
- Multibody dynamics for space applications
- Transonic nozzles and shock/turbulence interaction
- Numerical Simulations of Hybrid Rockets
- Nozzle design and operations
- Wall heat flux estimation in thrust chambers
- Combustion study with different approachess (Turbulent combustion closure – ignition transient in CC – supercritical combustion in LRE chambers…)

AERONAUTICS



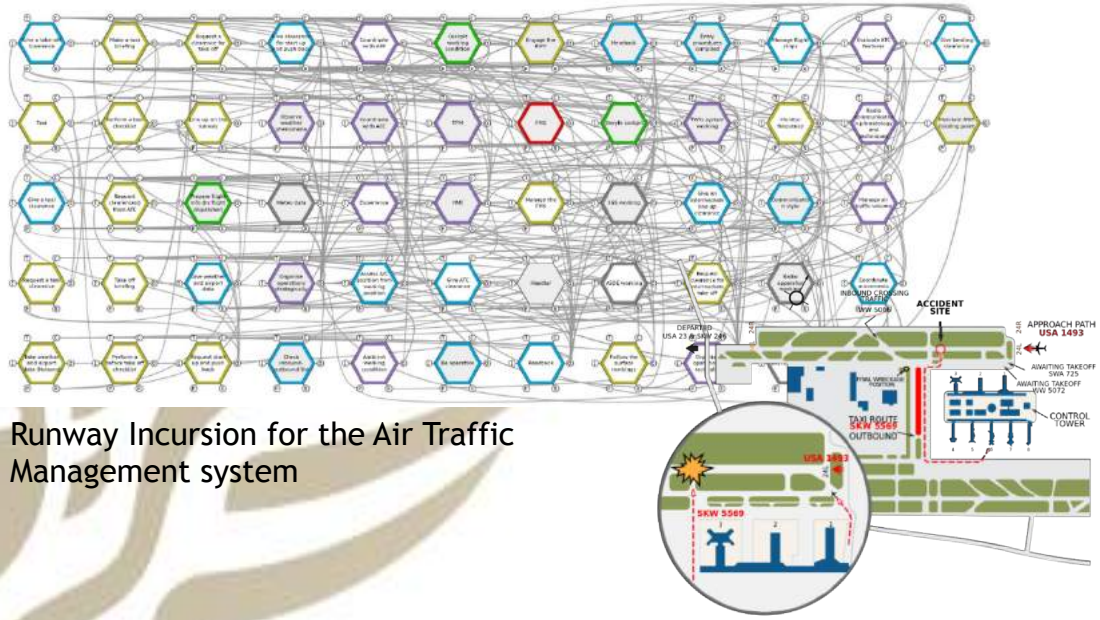




Facility for flight simulations (Flight Dynamics Lab)

- Small vehicle design and FCS developments
- Flight dynamics of flexible aircraft
- Aeroelastic modelling
- Blade vortex interaction noise control
- FE model structural updating

INDUSTRIAL MECHANICAL SYSTEMS ENG.



Runway Incursion for the Air Traffic Management system

Tele-Maintenance and predictive Safety Intelligent System

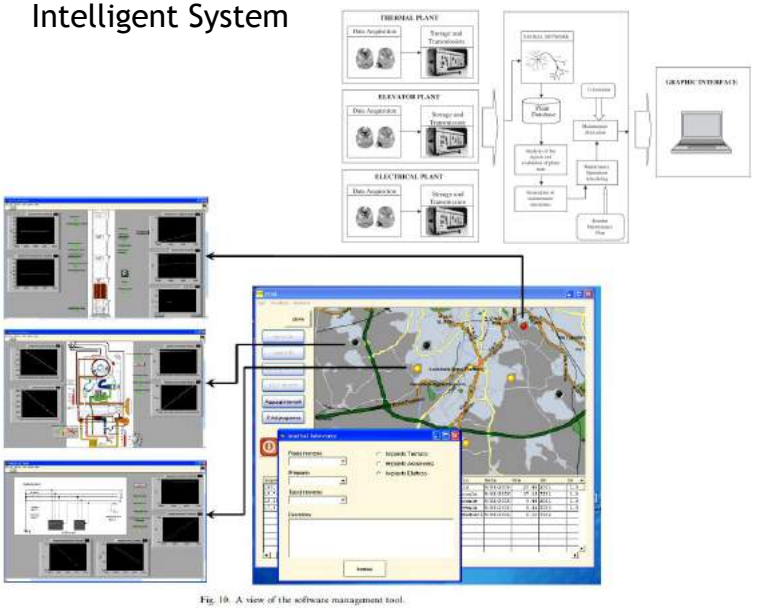
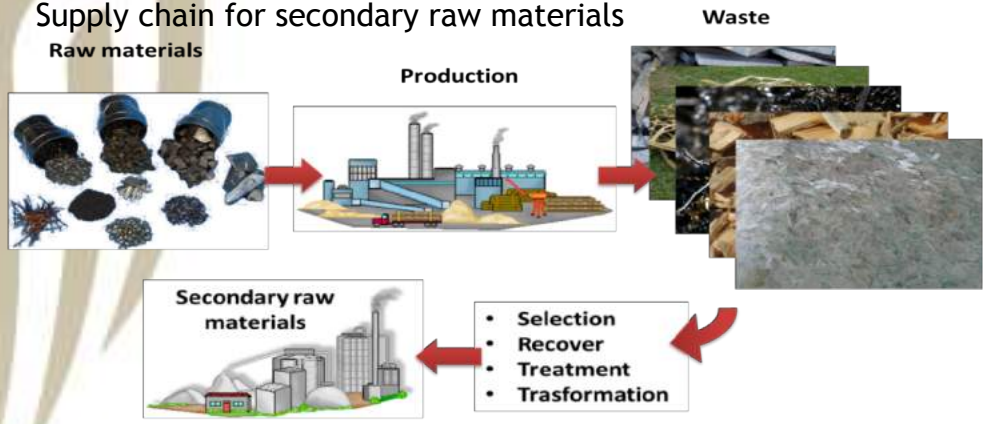


Fig. 10. A view of the software management tool.

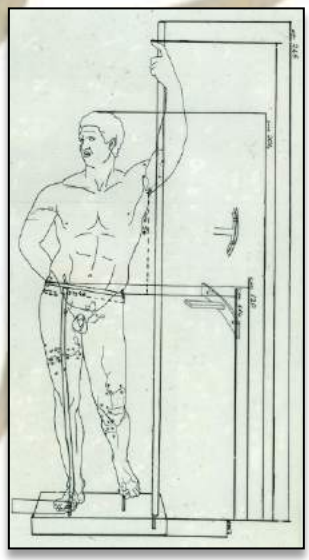
Supply chain for secondary raw materials

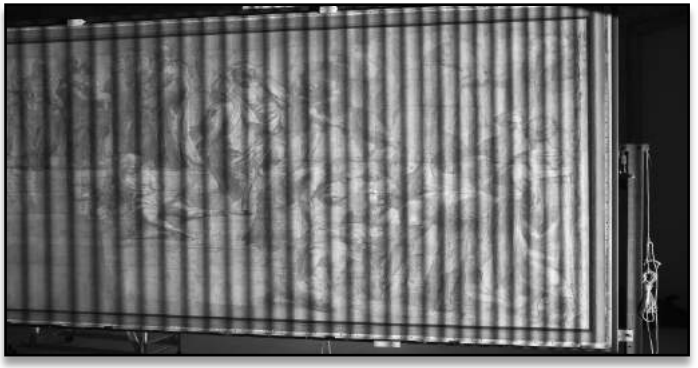


- Rating model for Health and Safety
- Spare parts management for complex systems
- Quality monitoring for airport ground handlers
- Industry 4.0
- Resilience Engineering for complex systems
- Supply Chain rating model

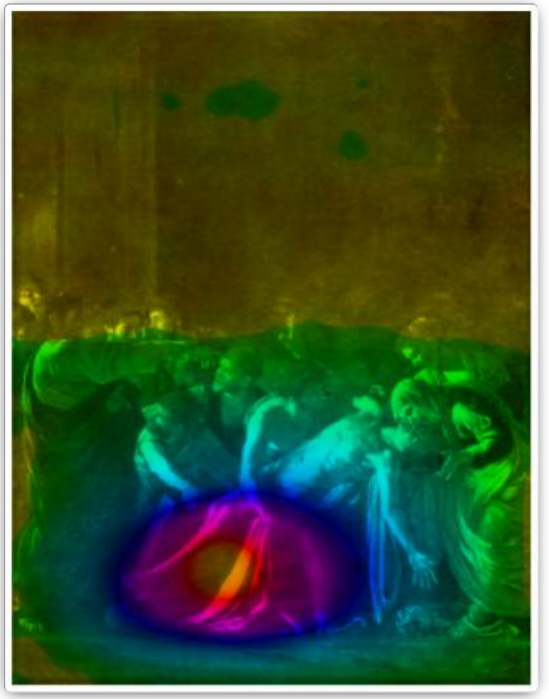
CULTURAL HERITAGE

"Il principe ellenistico"





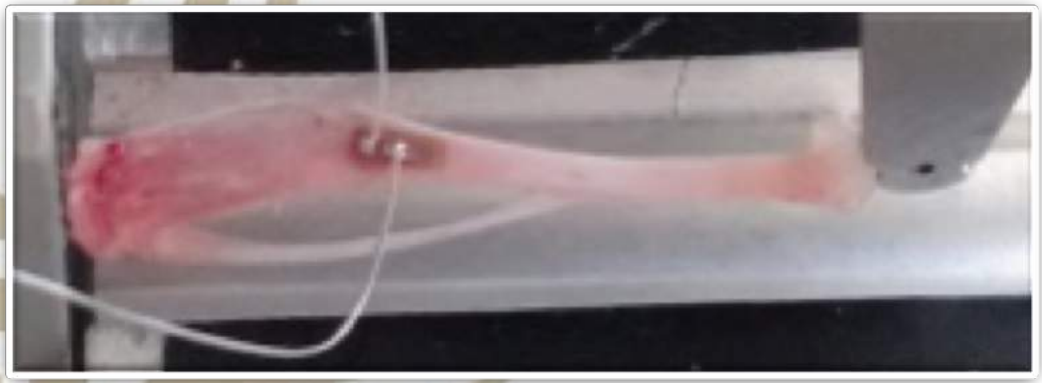
"Il Cartone per la scuola di Atene"
Raffaello



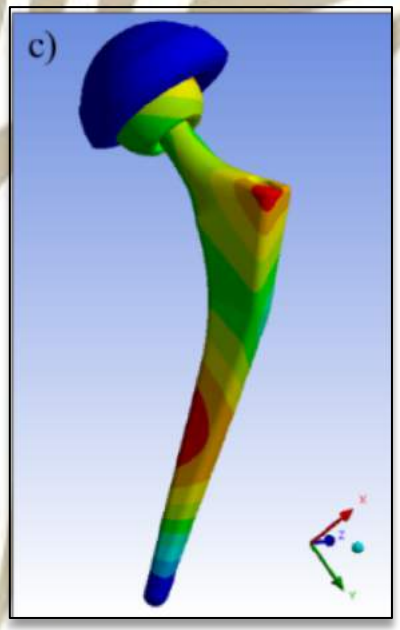
"La resurrezione di Lazzaro"
Caravaggio

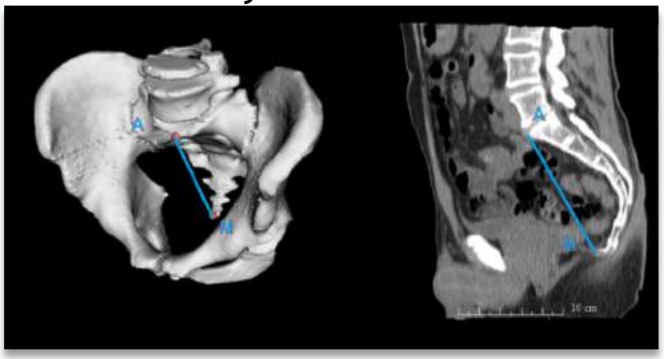
- Experimental-numerical techniques applied to the restoration of cultural heritage
  - Phase-shift measurment techiqnue
  - White light speckle DIC
- Reverse engineering + FE analysis

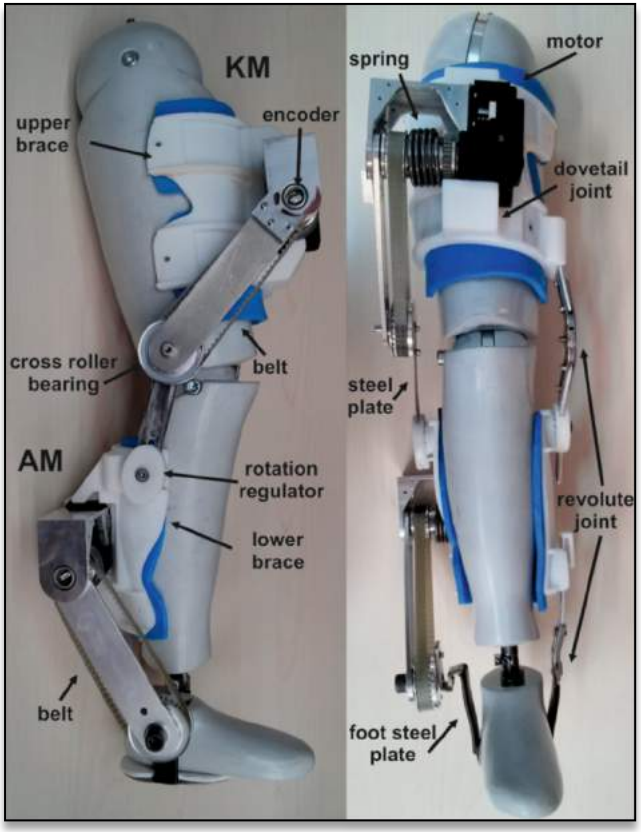
ENGINEERING FOR HEALTH



Characterization of mouse tibia mechanical properties through the Digital Image Correlation System







- Measurements for tissue egineering
- Motion Analysis
- Robot Mediated Therapy
- Medical Imaging
- Wearable monitoring systems for medical and sport applications


SAPIENZA
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19

Smart Structures Solutions

SED

aiComply

c A ESA R

Spin-off Companies promoted by DIMA members

THIRD MISSION

INDUSTRIAL PARTNERSHIPS

SAPIENZA
UNIVERSITÀ DI ROMA

www.dima.uniroma1.it