Panoramica su visori e applicazione modelli ridotti

Dal CAE ai Digital Twin interattivi

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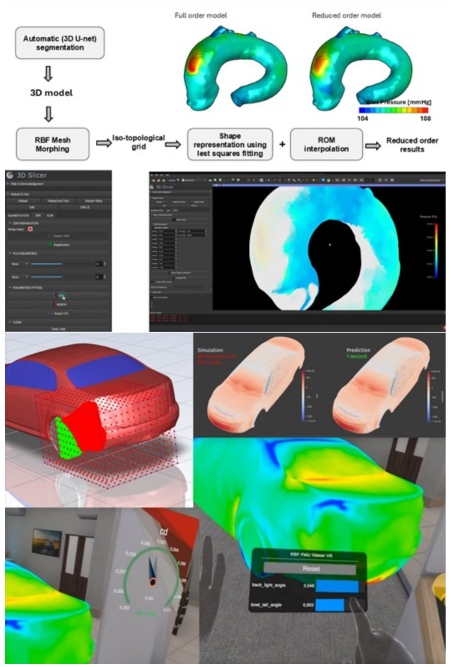
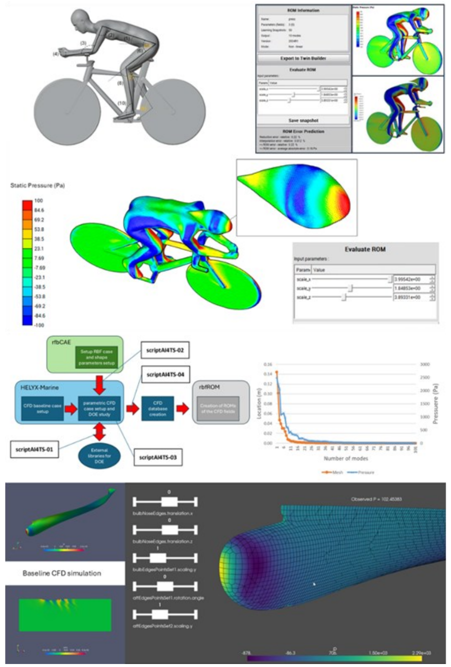
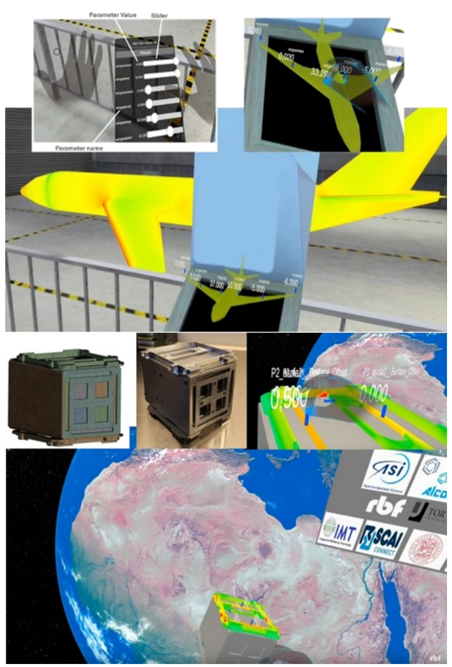
Organizzazione del laboratorio didattico

- Tre incontri settimanali (calendario da definire)
- 1° incontro – Introduzione alle tecnologie
- 2° incontro – Laboratorio informatico CAE
- 3° incontro – Laboratorio informatico VR
- Valutazione finale – questionario a risposta multipla su piattaforma Teams

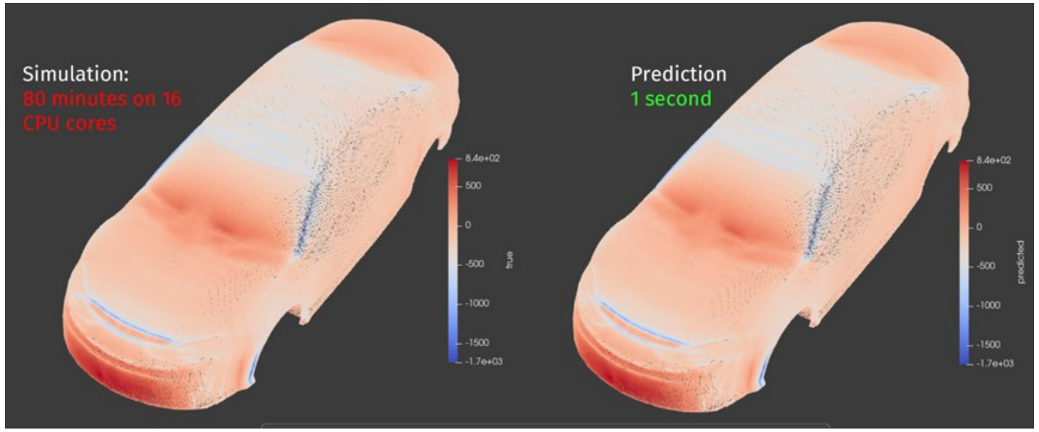


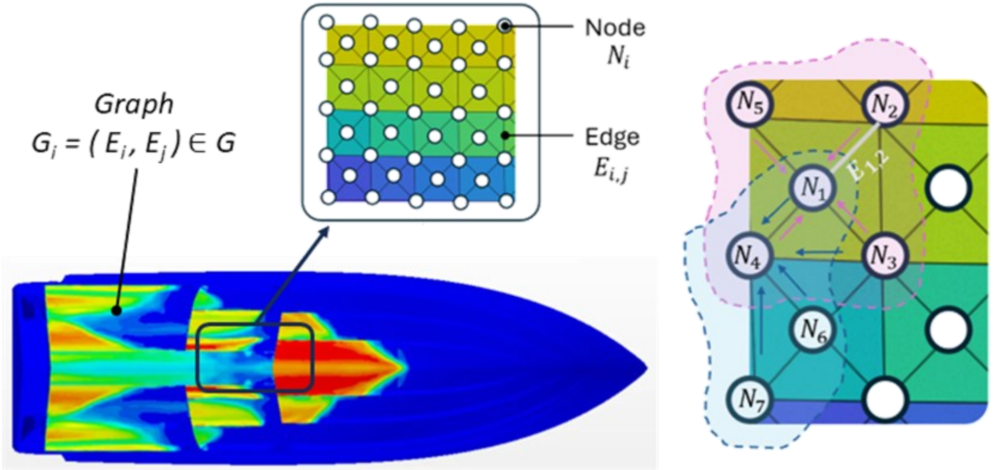




Introduzione alle tecnologie

- Presentazione delle tecnologie per l'ingegneria digitale
- Simulazioni CAE (FEM e CFD)
- Modelli ridotti (Reduced Order Models)
- Realtà virtuale e modelli immersivi

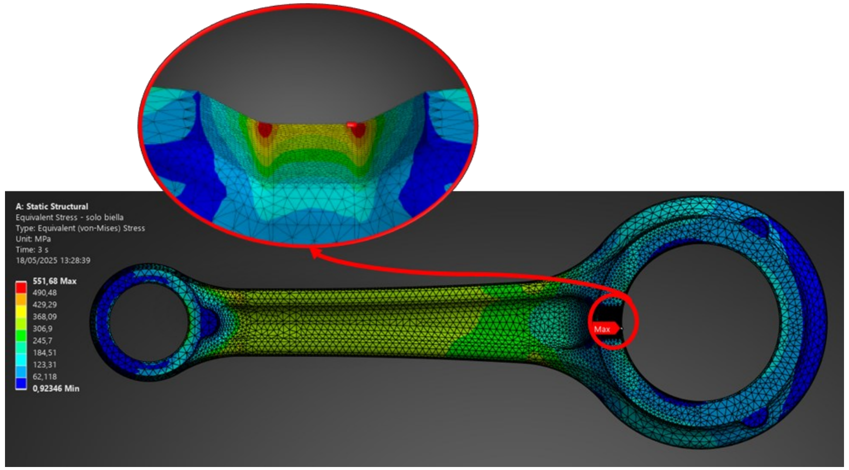


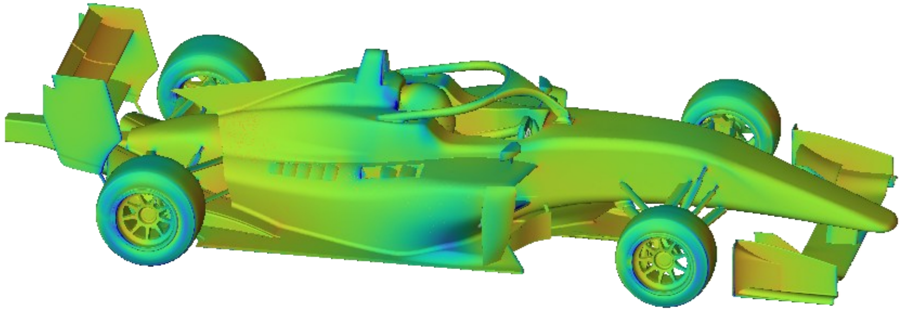


TOR VERGATA
UNIVERSITÀ DEGLI STUDI DI ROMA

Laboratorio informatico – Esperienza CAE

- Analisi di modelli CAE e risultati di simulazione
- Introduzione ai modelli ridotti
- Utilizzo di FMU per modelli digitali interattivi
- Visualizzazione dei modelli tramite VR





Laboratorio informatico - Esperienza VR

- Esplorazione di modelli immersivi
- Analisi interattiva dei risultati di simulazione
- Discussione sulle applicazioni industriali

Esempio: Aeronautical

SPOTLIGHT

Revolutionizing aerodynamic design with a VR-enabled workflow

by Andrea Lopez[1], Marco Camponeschi[2], Marco E. Biancolini[1,2]
1. University of Rome Tor Vergata - 2. RBF Morph

The aerospace industry is undergoing a rapid digital transformation, embracing innovative technologies to streamline design workflows, increase efficiency, and drive innovation like never before. One of the most exciting breakthroughs is the integration of virtual reality (VR) with reduced order models (ROMs), to enable real-time aerodynamic design exploration.

Traditionally, engineering workflows have been slow and resource-intensive, with design iterations relying on lengthy computational fluid dynamics (CFD) simulations. This article presents a game-changing approach – one that seamlessly links CAD modelling, CFD, and ROMs within an interactive VR dashboard. The result? A fast, immersive, and intuitive tool that allows engineers to explore designs in real-time, making the whole process more dynamic and efficient.

Bridging the gap: from CAD to VR

Aerodynamic performance optimization has traditionally been a highly iterative process. Engineers must analyse multiple design variants using high-fidelity CFD simulations, which are accurate but computationally expensive and time-consuming. Integrating VR and ROMs into the workflow helps overcome these challenges by providing a real-time design environment with interactive parameter exploration.

By incorporating CAD parameterization and mesh morphing, engineers can seamlessly

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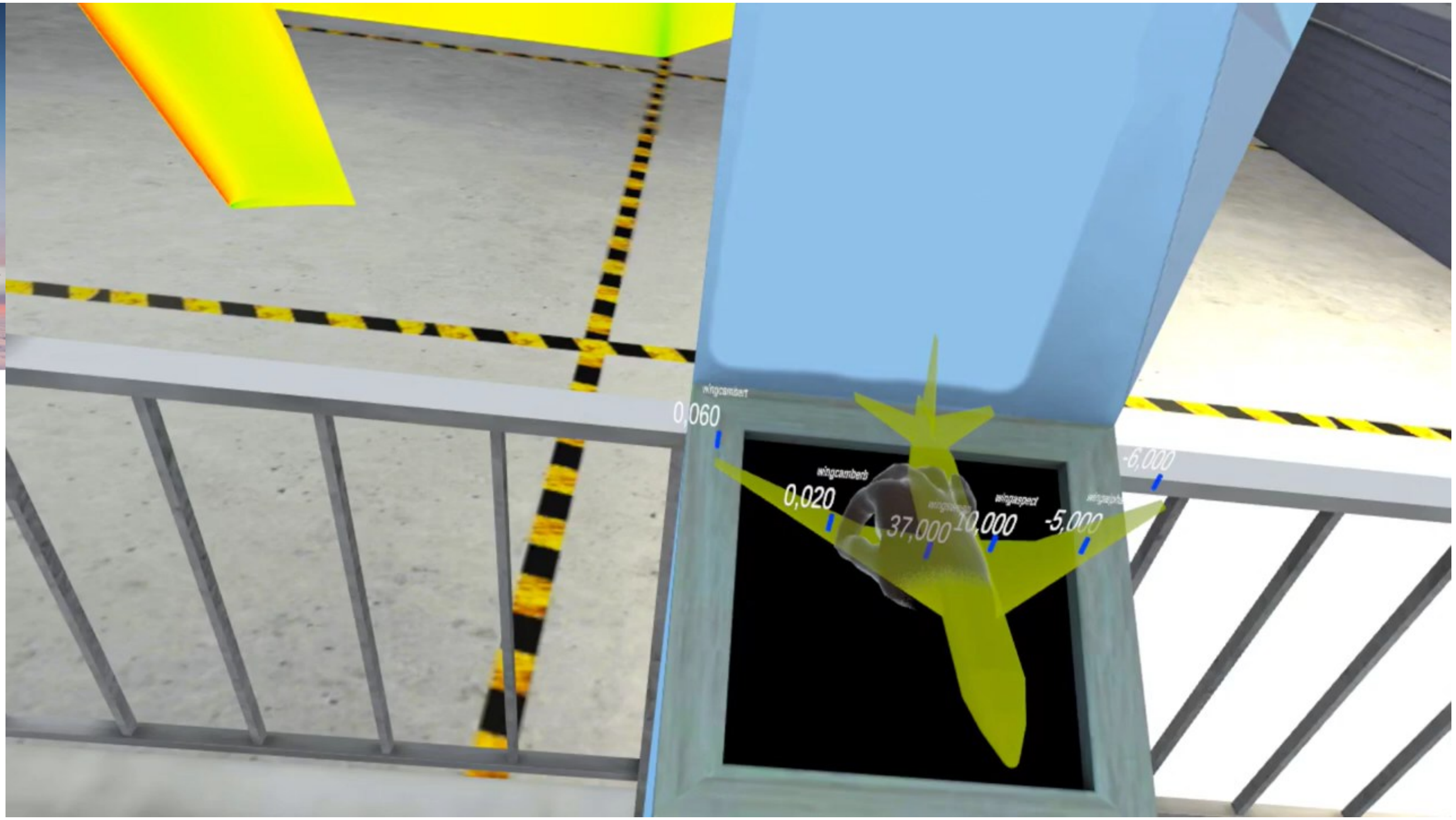

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Esempio: Space

engineering proceedings

MDPI

Proceeding Paper

The Payload Design of the CUbesat Solar Polarimeter (CUSP), for Space Weather and Solar Flares X-Ray Polarimetry

Giovanni Lombardi [1,2,*], Sergio Fabiani [1], Ettore Del Monte [1], Emanuele Di Meo [2], Andrea Lopez [2], Marco Camponeschi [3], Marco E. Biancolini [2], Daniele Brienza [4], Immacolata Donnarumma [4], Silvia Natalucci [4], Andrea Terracciano [4] and Emanuele Zaccagnino [4]

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Abstract: The CUbesat Solar Polarimeter (CUSP) project is a CubeSat mission orbiting the Earth aimed to measure the linear polarization of solar flares in the hard X-ray band by means of a Compton scattering polarimeter. CUSP is a project in the framework of the Alcor Program of the Italian Space Agency aimed to develop new CubeSat missions. It is approved for a Phase B study. In this work we describe some design solutions adopted for the most important design drivers of the payload. In particular, we report on the payload preliminary multi-physical design, including an orbital thermal environment preliminary assessment and a implementation of the static/dynamic finite element analysis. Moreover, a method for topology optimization of relevant components is discussed.

Keywords: CUSP, space weather, solar flare, mechanical design, multi−physical analysis, payload

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1. Introduction

The **CUbesat Solar Polarimeter** (CUSP) [1] is a CubeSat mission in low Earth orbit, specifically conceived to measure the linear polarization of solar flares in the hard X-ray range (25–100 keV) through a Compton scattering polarimeter. This cutting-edge mission is expected to provide new insights into magnetic reconnection and particle acceleration mechanisms occurring within the Sun's flaring magnetic structures, which are crucial processes underlying space weather dynamics.

Hard X-ray polarimetry offers a unique observational window into the physical mechanisms responsible for particle acceleration, as well as the temporal evolution of magnetic configurations during solar flares. These data are essential for refining current models of solar activity and understanding its influence on the heliosphere. Such improved knowledge will contribute to the development of more accurate space weather predictions, which are essential to mitigate the risks for satellite systems, communication infrastructures, and terrestrial power grids.

CUSP is developed within the framework of the **Alcor Program**, a strategic initiative led by the Italian Space Agency (ASI) to promote innovative CubeSat missions. Having

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Esempio: Healthcare

electronics

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Article

The Hemodynamic Effect of Modified Blalock–Taussig Shunt Morphologies: A Computational Analysis Based on Reduced Order Modeling

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Abstract: The Modified Blalock Taussig Shunt (MBTS) is one of the most common palliative operations in case of cyanotic heart diseases. Thus far, the decision on the position, size, and geometry of the implant relies on clinicians' experience. In this paper, a Medical Digital Twin pipeline based on reduced order modeling is presented for fast and interactive evaluation of the hemodynamic parameters of MBTS. An infant case affected by complete pulmonary atresia was selected for this study. A three-dimensional digital model of the infant's MBTS morphology was generated. A wide spectrum of MBTS geometries was explored by introducing twelve Radial Basis Function mesh modifiers. The combination of these modifiers allowed for analysis of various MBTS shapes. The final results proved the potential of the proposed approach for the investigation of significant hemodynamic features such as velocity, pressure, and wall shear stress as a function of the shunt's morphology in real-time. In particular, it was demonstrated that the modifications of the MBTS morphology had a profound effect on the hemodynamic indices. The adoption of reduced models turned out to be a promising path to follow for MBTS numerical evaluation, with the potential to support patient-specific preoperative planning.

Keywords: computational fluid dynamics; reduced order modeling; hemodynamics; Modified Blalock–Taussig Shunt; RBF mesh morphing; Medical Digital Twin

check for updates

Citation: Kardampiki, E.; Vignali, E.; Haxhiademi, D.; Federici, D.; Ferrante, E.; Porziani, S.; Chiappa, A.; Groth, C.; Cioffi, M.; Biancolini, M.E.; et al. The Hemodynamic Effect of Modified Blalock–Taussig Shunt Morphologies: A Computational Analysis Based on Reduced Order Modeling. *Electronics* **2022**, *11*, 1930. https://doi.org/10.3390/electronics11131930

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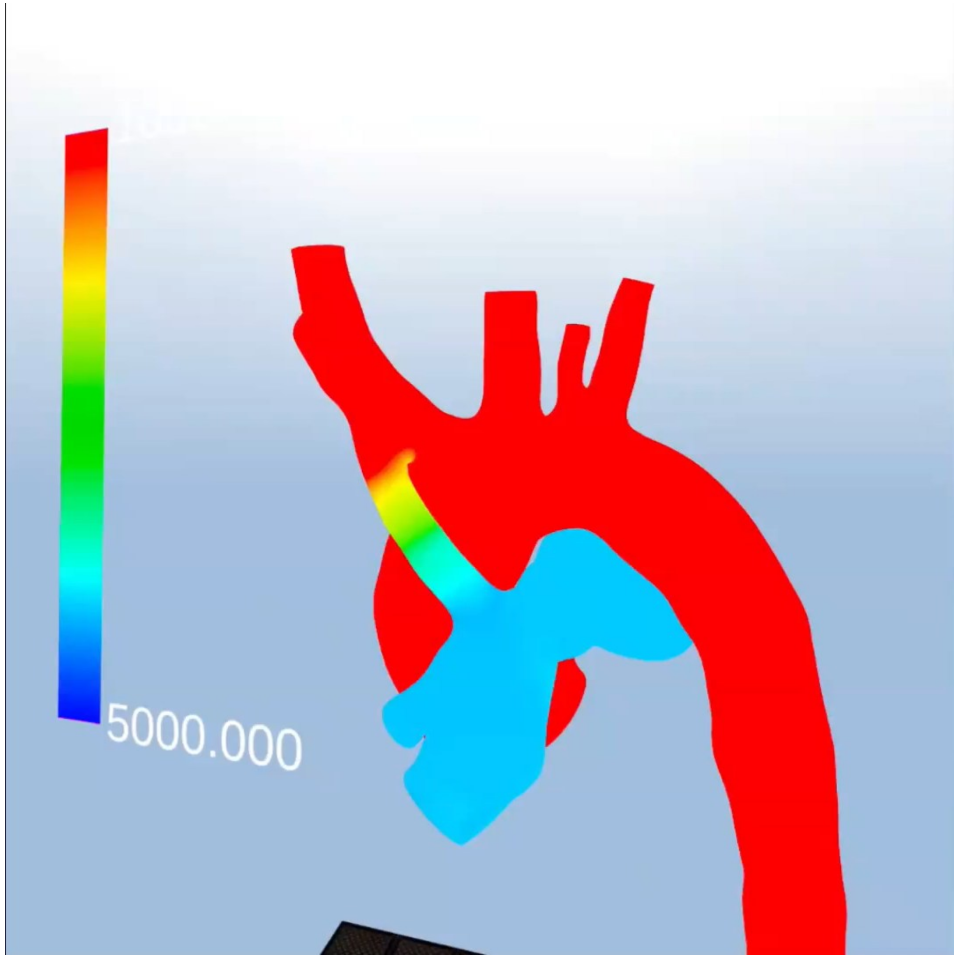
1. Introduction

Congenital heart defects are currently present in about 9 of every 1000 live-born children [1,2]. Several of these pathologies, such as pulmonary atresia and Tetralogy of Fallot, are linked with cyanotic heart diseases in which low levels of oxygen in the blood are encountered. Especially in the case of the pulmonary atresia, the pulmonary valve plane is absent, leading to full blockage of the blood flow towards the lungs. Among the most diffused approaches to tackle these complications, the modified Blalock–Taussig shunt (MBTS) is a surgical procedure which consists of implanting a synthetic shunt between the subclavian and pulmonary artery. The MBTS is frequently adopted for the treatment of newborn children suffering from pulmonary hypoperfusion triggered by congenital heart diseases [3]. In this way, sufficient levels of oxygenated blood are delivered to the



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Riferimenti

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