

IL DIPARTIMENTO

Università degli Studi di Perugia
Dipartimento di Ingegneria

DI INGEGNERIA INCONTRA INFN



Lunedì 11 Gennaio 2021
10.00– 12.30
Mini Workshop Telematico

LA DINAMICA PER LO SPAZIO

Dalla meccanica del volo alla valutazione della sicurezza strutturale

Gruppo di
Progettazione Meccanica e Costruzione di Macchine

La dinamica per lo spazio

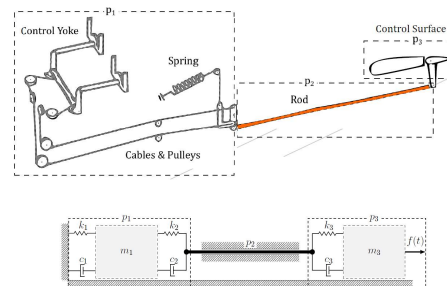
Dalla meccanica del volo alla valutazione della sicurezza strutturale

Modellazione e Simulazione Dinamica (MBS + FEA)

Dinamica Teorica

Dinamica Sperimentale

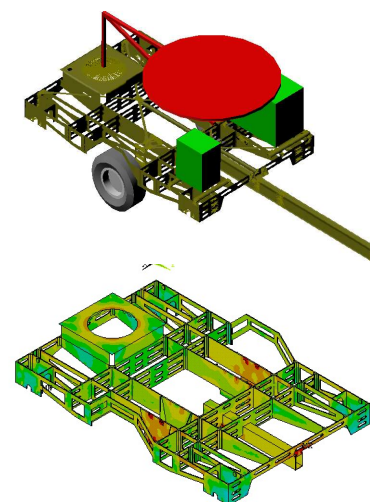
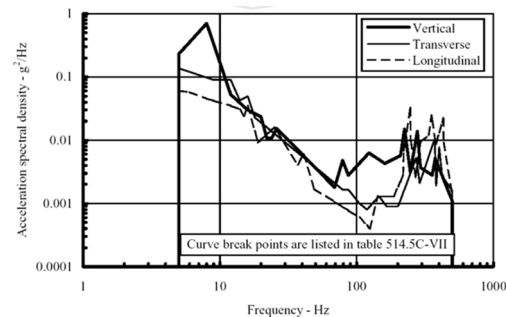
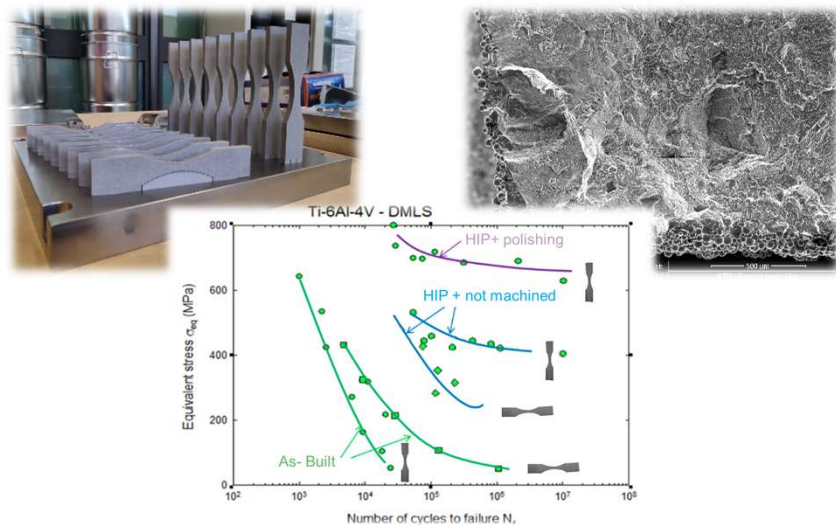
ss_Run Time= 0.0000 Equilibrium Frame=0001



Caratterizzazione di materiali e processi di produzione

Dynamic Durability Test

Dynamic Dur. Simulation



F. Cianetti - **La dinamica per lo spazio**

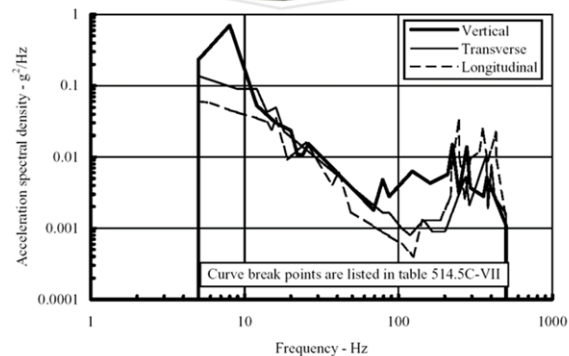
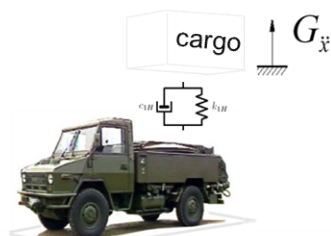


Dynamic Durability

La qualifica dei sistemi e dei component meccanici

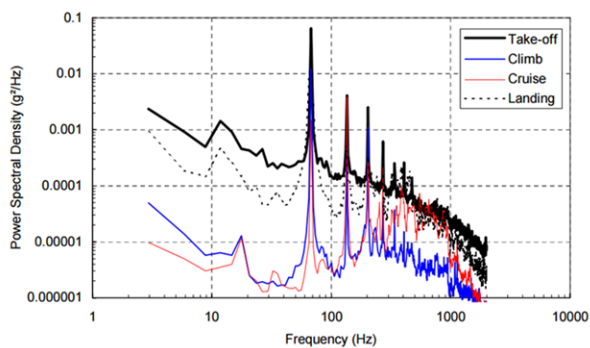
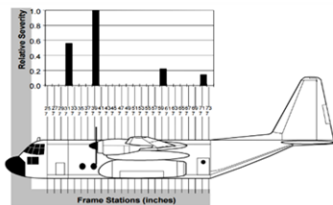
SETTORE MILITARE

MIL – STD 810 G

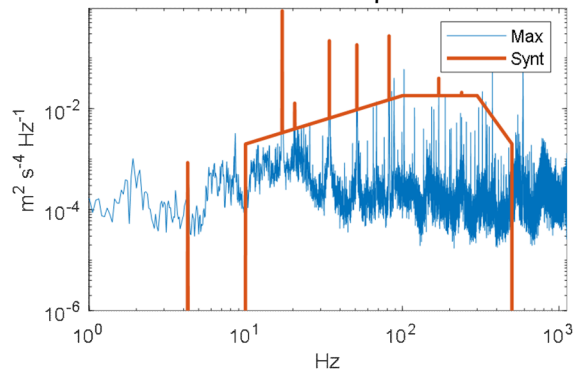


SETTORE AERONAUTICO

DEF STAN 00-35

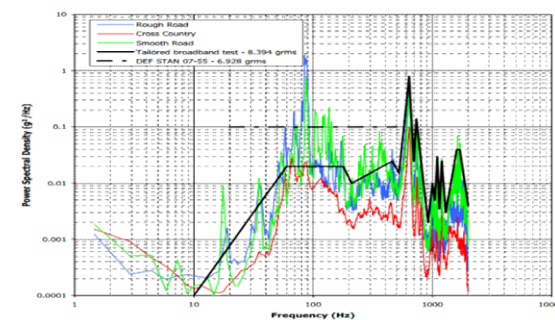


Maximum Enveloped PSD



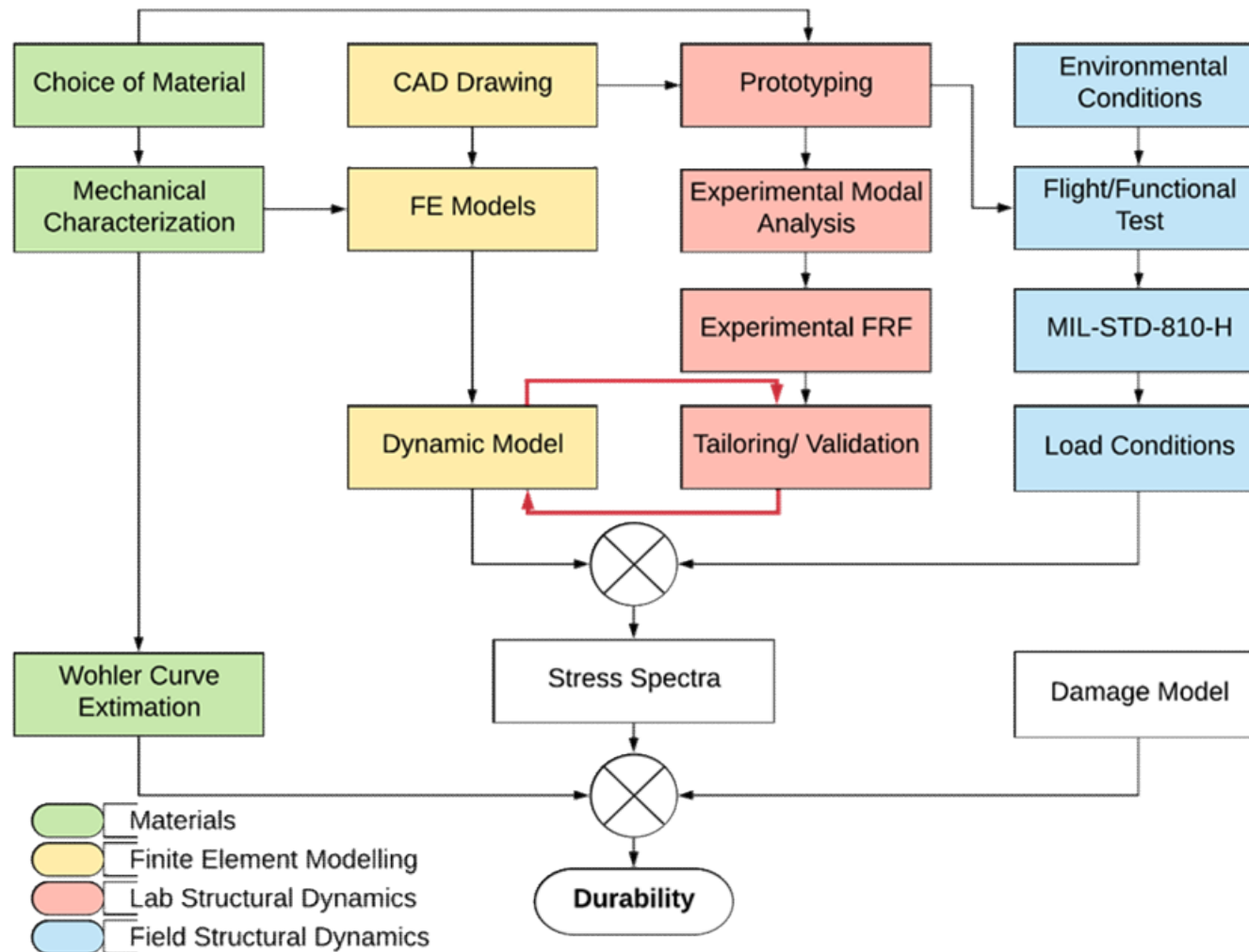
SETTORE AUTOMOTIVE

SAE J1455



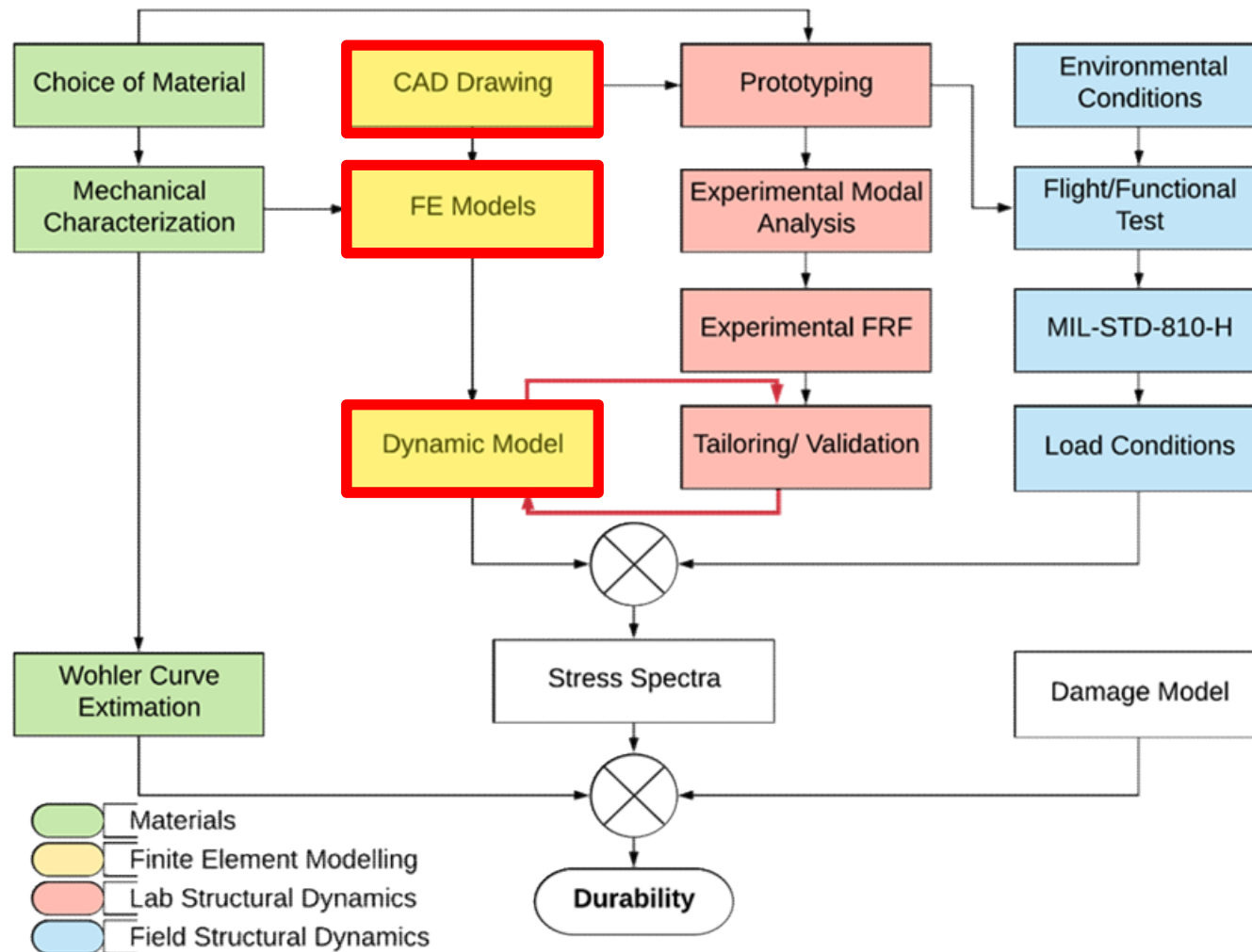
Dynamic Durability

La progettazione per la qualifica



Dynamic Durability

La progettazione per la qualifica



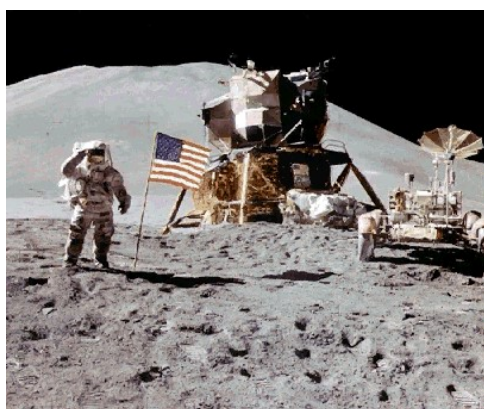
Simulazione Dinamica - MultiBody (MBS) ed Elementi Finiti (FEA)

La simulazione dinamica

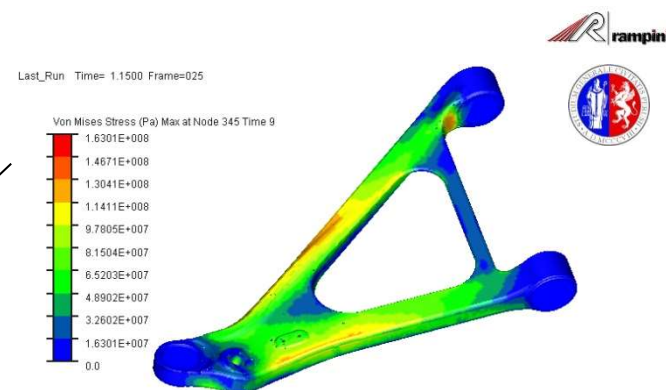


**MultiBody
Modeling and Simulation (MBS)**

**Programma APOLLO
1961-1975**

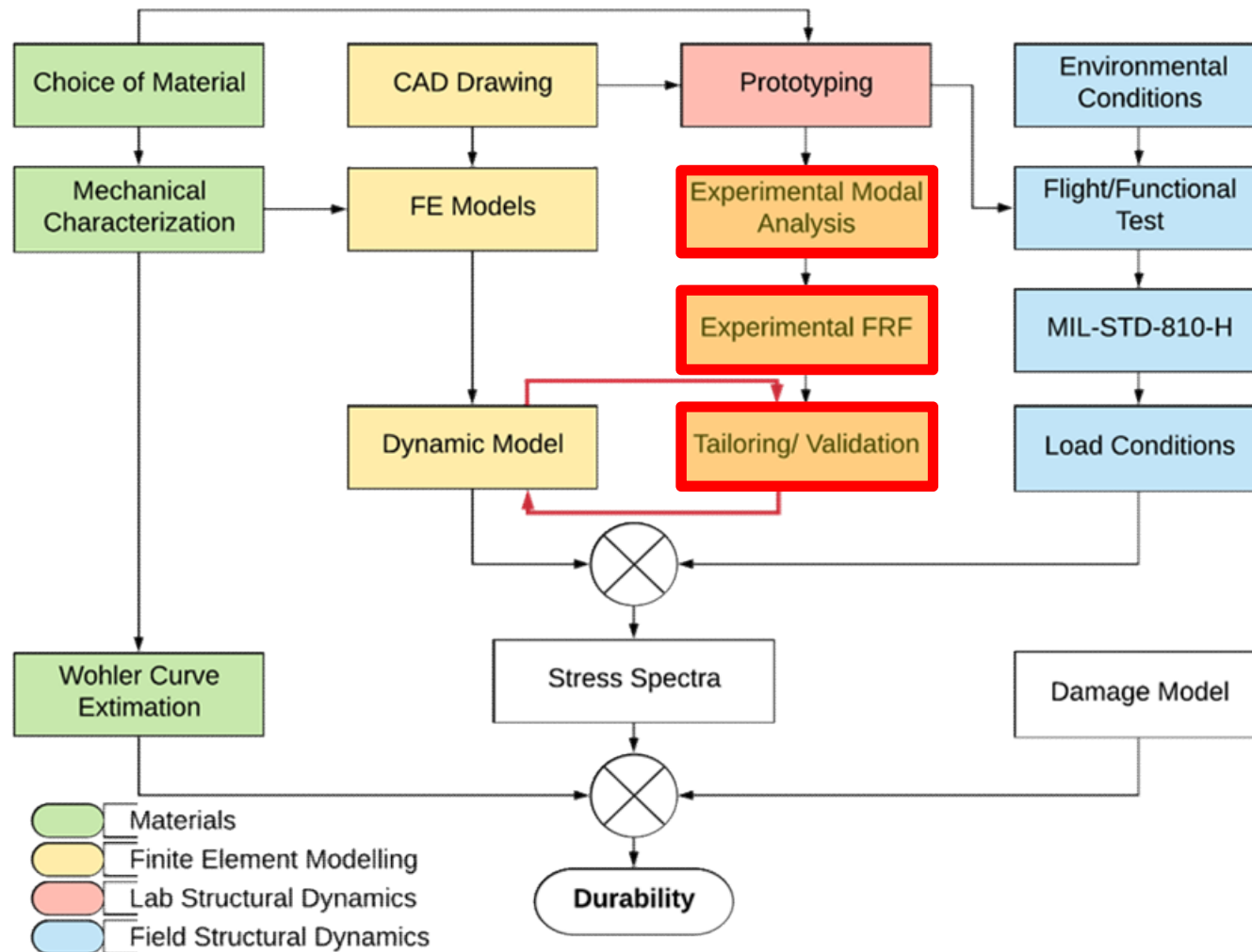


**Finite Element
Modeling and Analysis (FEA)**



Dynamic Durability

La progettazione per la qualifica



Dinamica Sperimentale

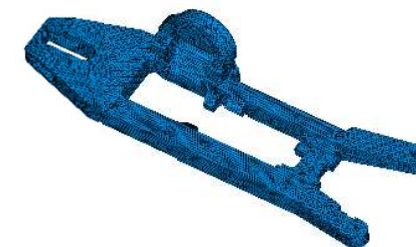
Caratterizzazione dinamica e tuning di modelli numerici



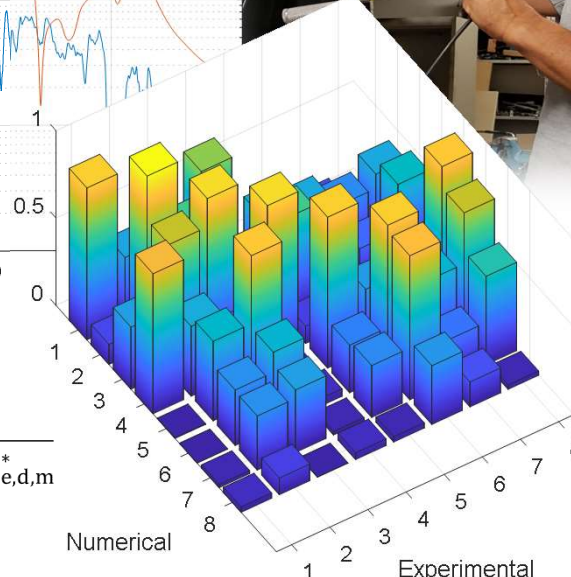
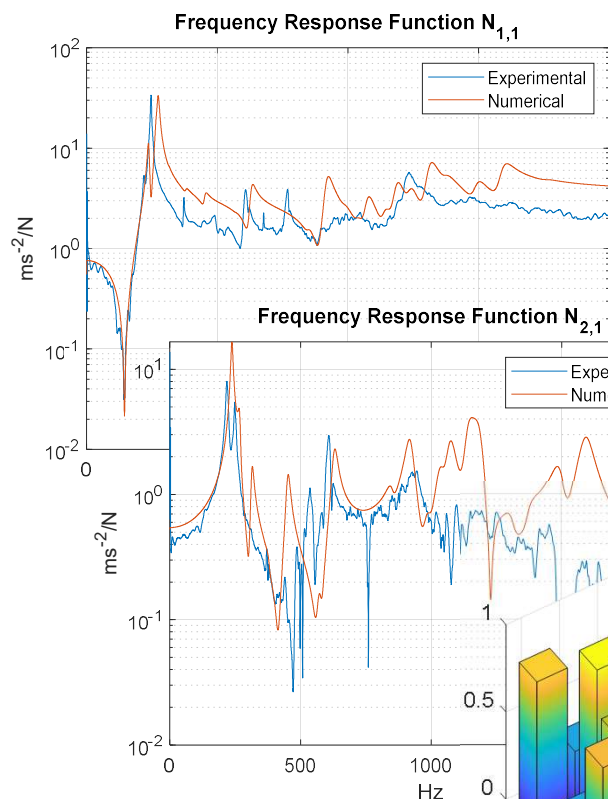
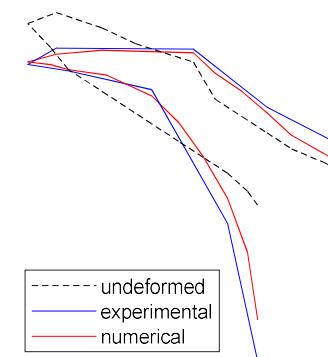
Aeronautica Militare
Centro Sperimentale di Volo



Modello Numerico FEM



Modo n.2

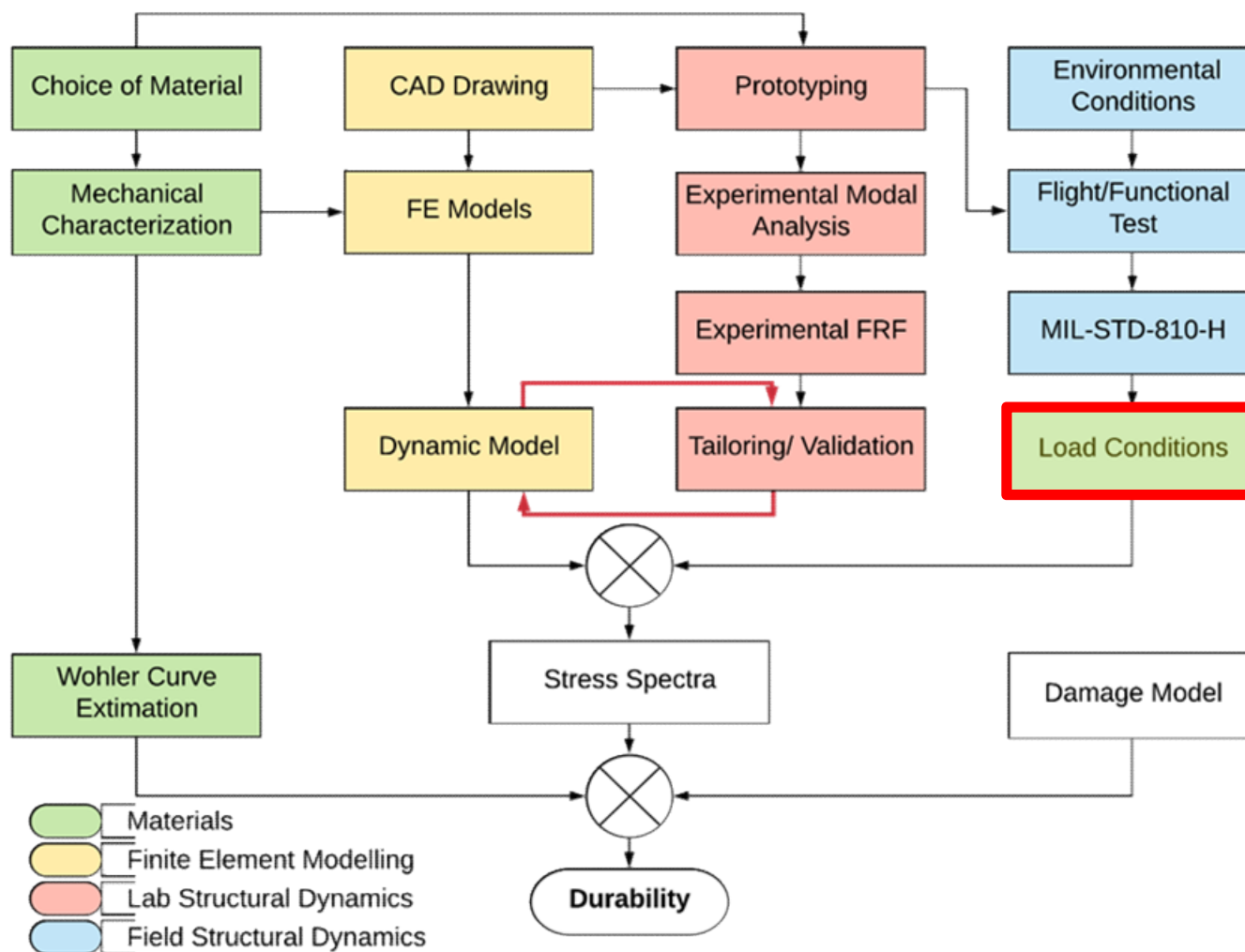


$$MAC_m = \frac{\sum_{d=1}^{N_d} \varphi_{n,d,m} \cdot \varphi_{e,d,m}^*}{\sum_{d=1}^{N_d} \varphi_{n,d,m} \cdot \varphi_{n,d,m}^* \sum_{d=1}^{N_d} \varphi_{e,d,m} \cdot \varphi_{e,d,m}^*}$$



Dynamic Durability

La progettazione per la qualifica



Dinamica Teorica ed analisi dei segnali

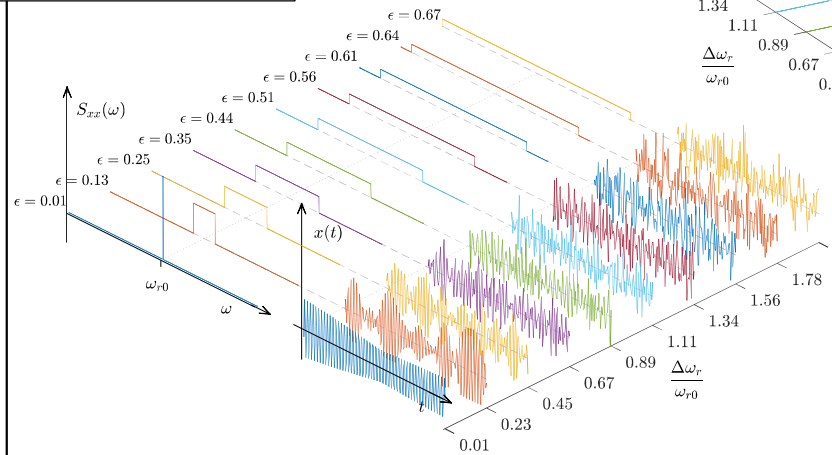
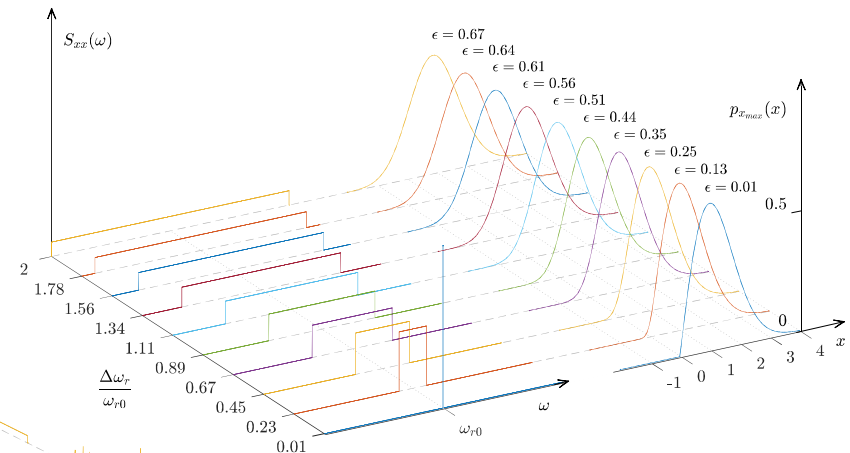
Processi Random



$$p_{z_{max}}(z) \Big|_{\epsilon=1} = \frac{1}{\sqrt{2}\pi^{\frac{3}{2}}} \int_{-a}^a \exp \left[\frac{(z-\tau)^2}{2\sigma^2} \right] (a^2 - \tau^2)^{-\frac{1}{2}} d\tau$$

$$Z(t) \Big|_{\max} = X(t) \Big|_{\max} + Y(t)$$

$$p_{z_{max}}(z) = \int_{-\infty}^{\infty} p_y(z-x) p_{x_{max}}(x, \epsilon) dx$$

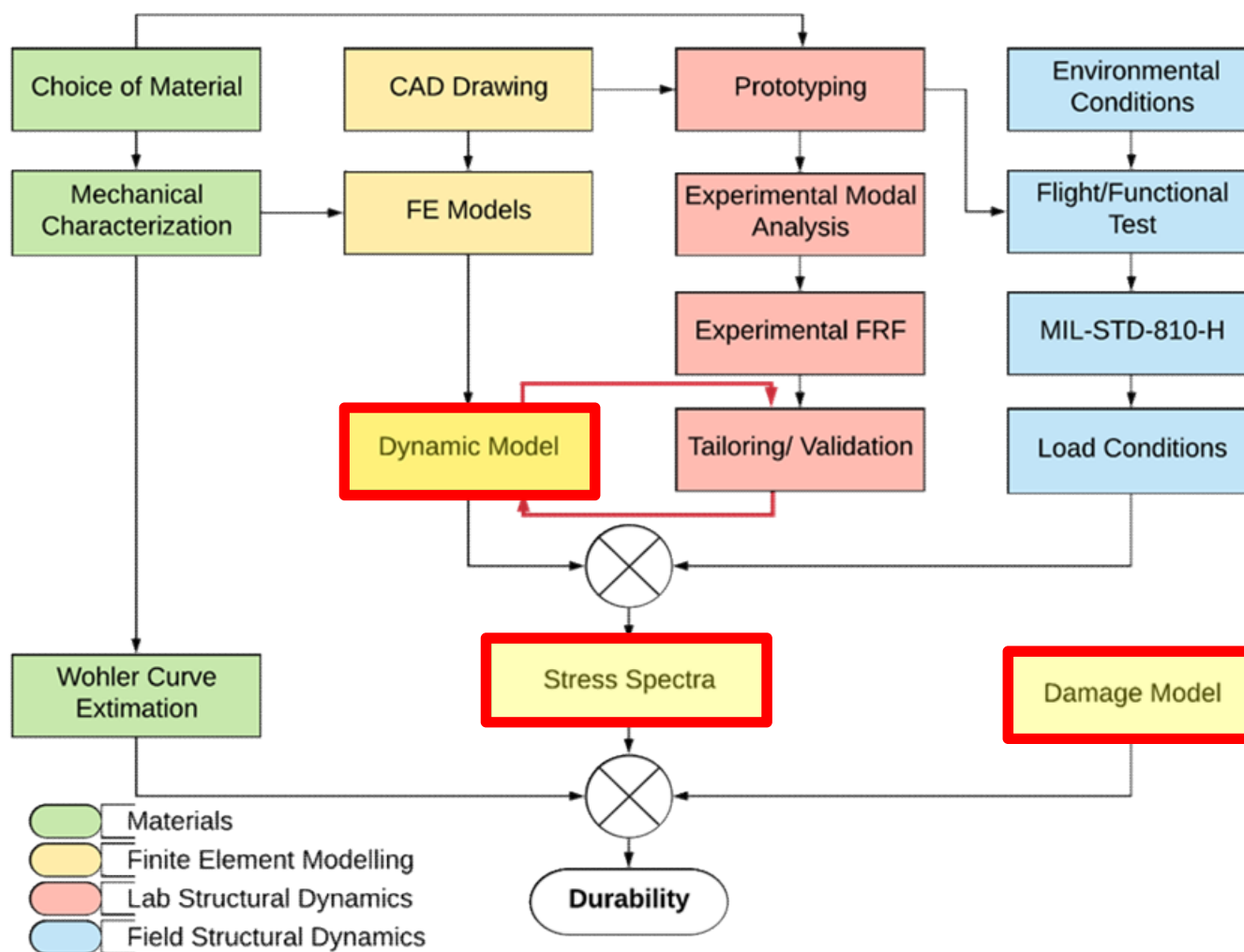


$$p_{z_{max}}(z) \Big|_{\epsilon=0} = \begin{cases} \frac{1}{\pi\sigma^2 \left(2 - \frac{\pi}{2}\right)} \int_{-a}^a \frac{z-\tau}{(a^2 - \tau^2)^{\frac{1}{2}}} \exp \left[\frac{(z-\tau)^2}{\sigma^2(4-\pi)} \right] d\tau, & z > -a \\ 0, & \text{otherwise} \end{cases}$$



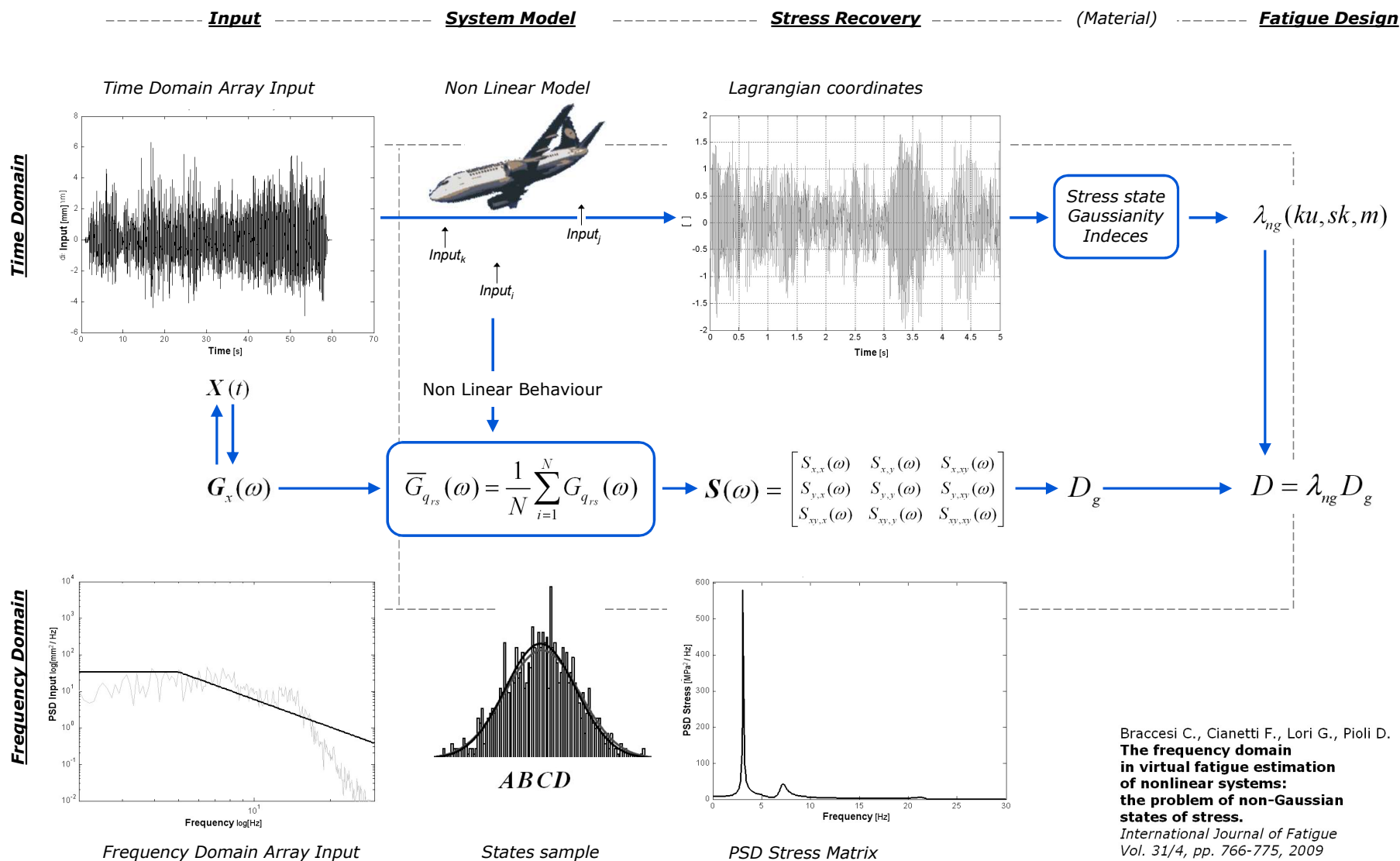
Dynamic Durability

La progettazione per la qualifica



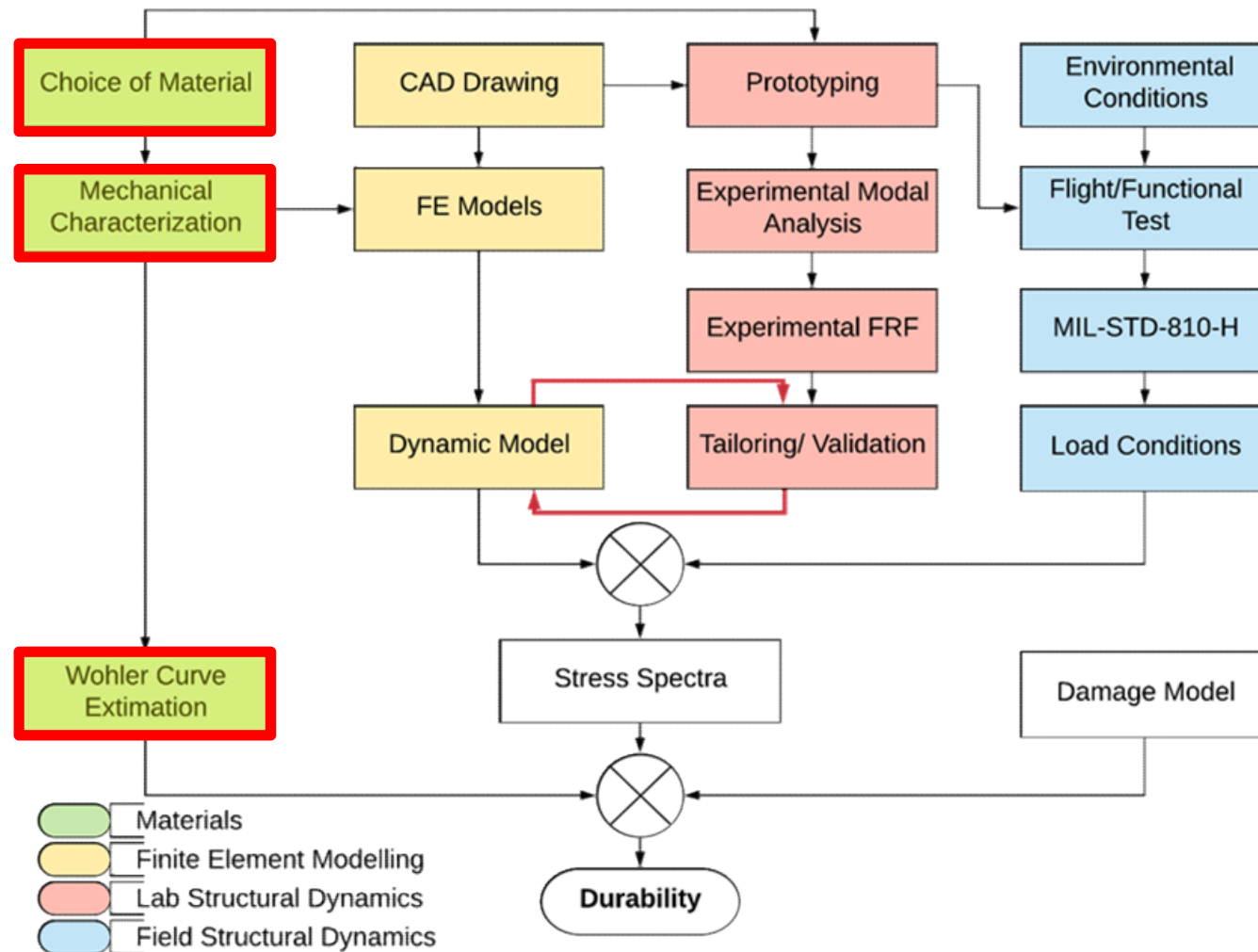
Dynamic Durability

La qualifica virtuale



Dynamic Durability

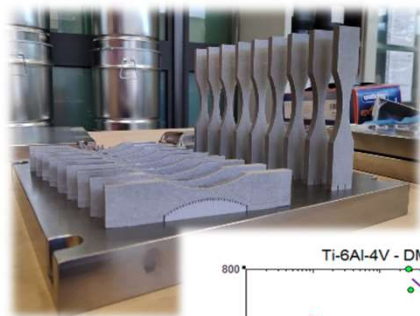
La progettazione per la qualifica



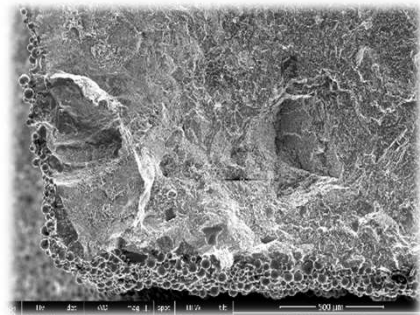
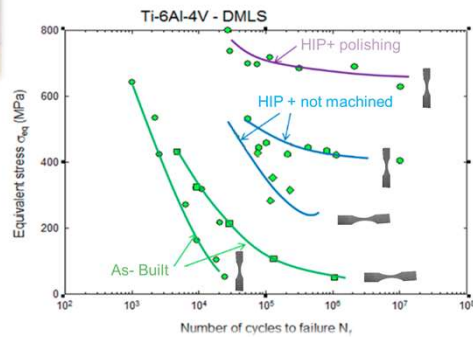
Caratterizzazione dei materiali e dei processi produttivi

La qualifica dei materiali

Caratterizzazione a fatica di materiali metallici realizzati in ADM



NTNU
University of Trondheim
Laboratories

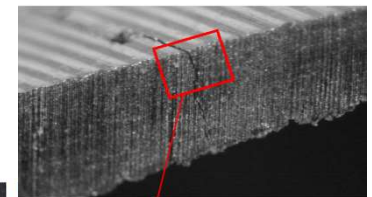


Caratterizzazione a fatica multiassiale in campo dinamico



S.E.R.M.S.
INFN

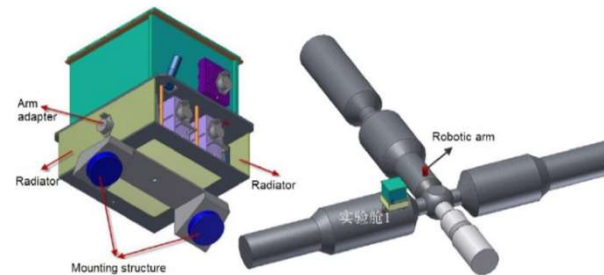
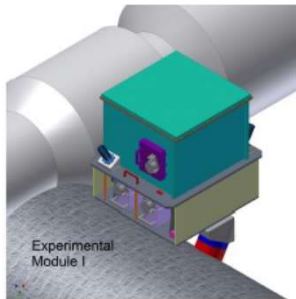
Laboratorio Sermis
Pentima Bassa (TR)



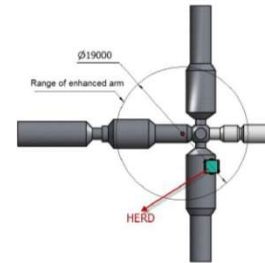
F. Cianetti - *La dinamica per lo spazio*



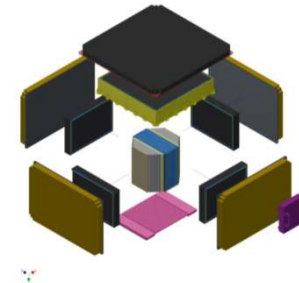
Progetto HERD
High Energy cosmic-Radiation Detection



(a) Position of the HERD mounting point



(b) Operation range of the enhanced robotic arm

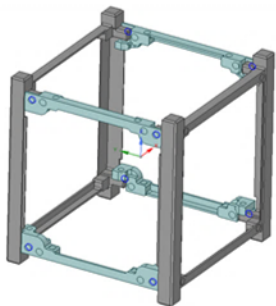


Department of Engineering goals

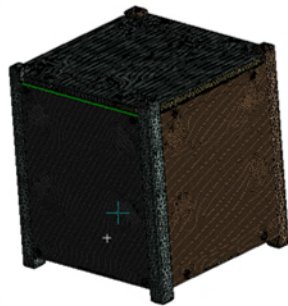
- Optimization of system and components structural design
- Simulation of qualification tests and durability numerical evaluation

Progetto CubeSat

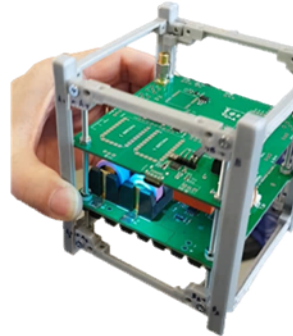
Design



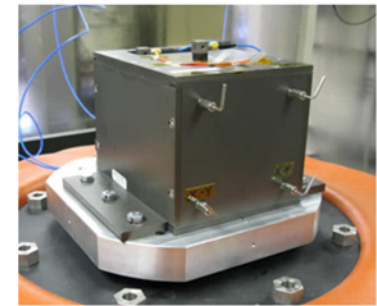
Numerical Model



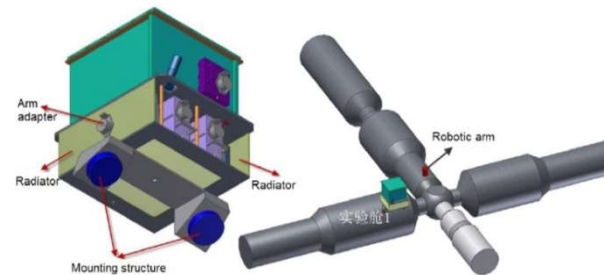
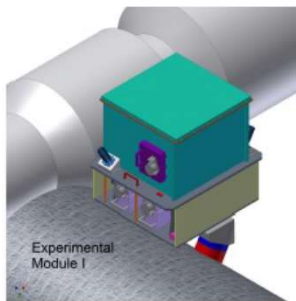
Realization and assembly



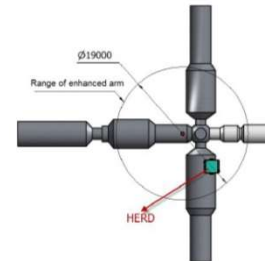
Tests



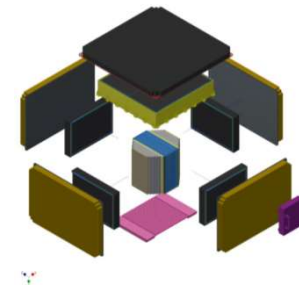
Progetto HERD
High Energy cosmic-Radiation Detection



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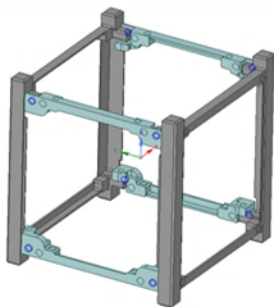


Department of Engineering goals

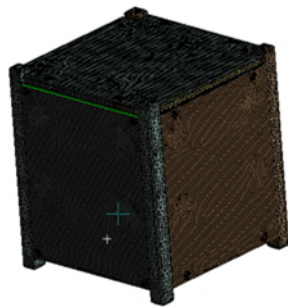
- Optimization of system and components structural design
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Progetto CubeSat

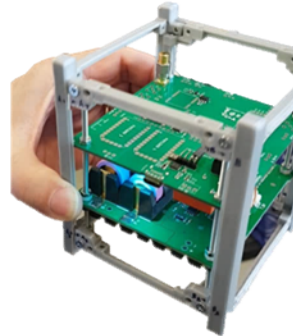
Design



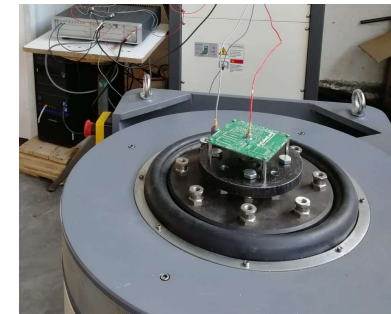
Numerical Model



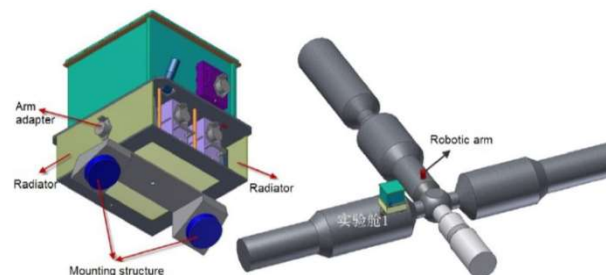
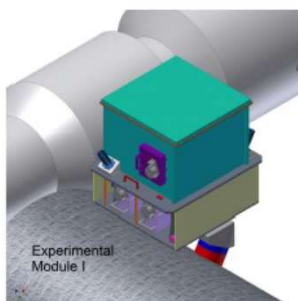
Realization and assembly



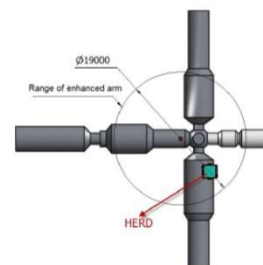
Tests



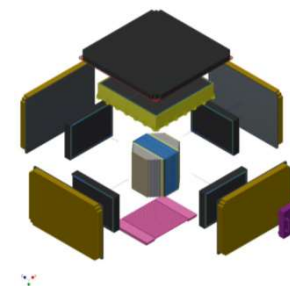
Progetto HERD High Energy cosmic-Radiation Detection



(a) Position of the HERD mounting point



(b) Operation range of the enhanced robotic arm

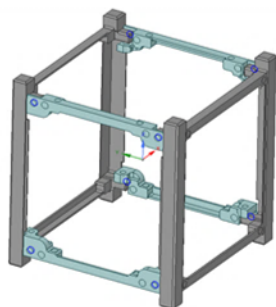


Department of Engineering goals

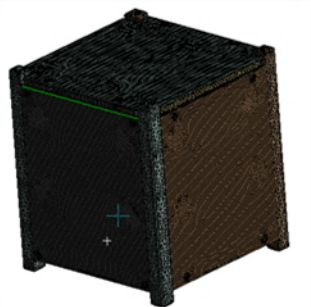
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Progetto CubeSat

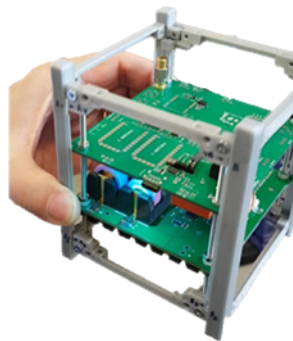
Design



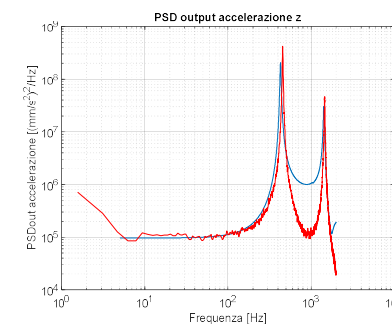
Numerical Model



Realization and assembly

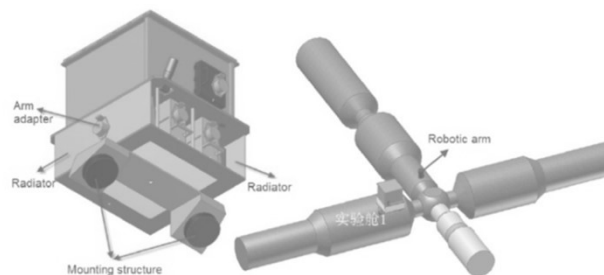
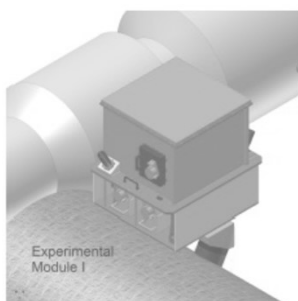


Tests

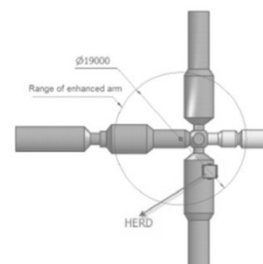


Progetto HERD

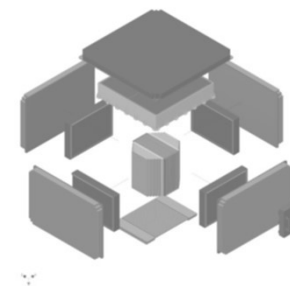
Responsabilità scientifica di n.1 Dottorando senza borsa finanziato esternamente da INFN



(a) Position of the HERD mounting point



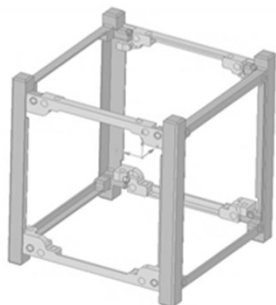
(b) Operation range of the enhanced robotic arm



Progetto Cubesat

Responsabilità scientifica di n.2 Assegni di ricerca (ASI/INFN)

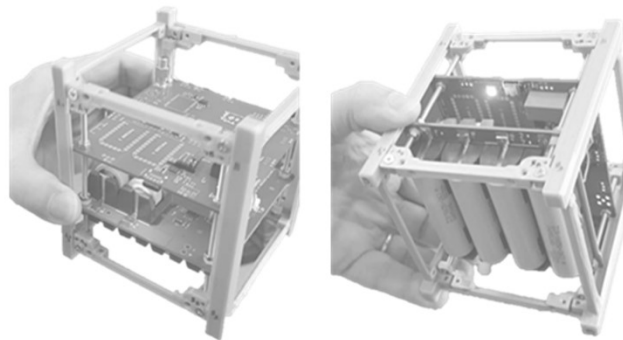
Design



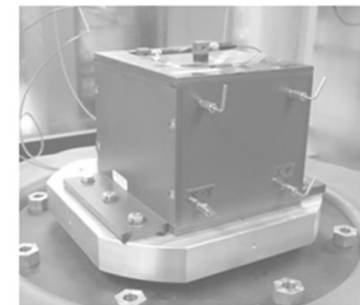
Numerical Model



Realization and assembly



Tests



Dipartimento di Ingegneria

I rapporti con l'esterno

▪ Cooperation

Gruppo di **Progettazione Meccanica e Costruzione di Macchine**

C. Braccesi, F. Cianetti, L. Landi, G. Morettini, M. Palmieri, G. Zucca (AM)

▪ Academic

Lubjana University (2015-2020)

Opole University (2015-2020)

Trondheim University (NTNU) (2017-2020)

▪ Automotive

HPE - Coxa (2018-2020)

Elasis (1999-2004)

CRF (1997-2002)

Alfa Romeo (1998)

Ferrari (1999)

Tecnokar (2002-2020)

▪ Software House

MDI (1995-2002)

MSC Software (2002-2006)

VI-grade (2006-2020)

▪ Aerospace

Alenia (1997)

Umbra Group (1997-2020)

Oma (2019-2020)

Lockeed (2001)

Agusta (1997)

Aeronautica Militare (2018-2020)

INFN (2017-2020)

▪ Rail

De Dietrich (1998)

Alstom (1999-2004)

Ferrovie Olandesi NS (1999)

Fiat Ferroviaria (1998-1999)

▪ Mechanical

Rampini (1996-2020)

Officine Piccini (2000)

Tiberina Group - ARIES (2018-2020)

Terex (2019-2020)

SCAI (2006)

Metalprogetti (2001)

VIPAL (2005-2007)

COLUSSI (2005-2007)

Zamperla (Rides) (1998-2020)

Scienza Machinale (Robotics) (2011-2013)

Bonfiglioli (Gears) (2000)

Prinoth (Snowmobiles) (1996-2000)

MBDA (Military) (2007-2013)

Synergy process (2017-2020)



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Lunedì 11 Gennaio 2021
10.00– 12.30
Mini Workshop Telematico

LA DINAMICA PER LO SPAZIO

Dalla meccanica del volo alla valutazione della sicurezza strutturale

Gruppo di
Progettazione Meccanica e Costruzione di Macchine