Politecnico di Torino
Department of Mechanical and Aerospace Engineering

MARINE OFFSHORE RENEWABLE ENERGY LAB

DIMEAS
Department of Mechanical and Aerospace Engineering

MSC THESIS PROPOSAL | MORENERGY LAB

Keeping offshore equipment still: validating and improving a nonlinear vibration isolator

Low-frequency isolation without huge, soft springs: test the idea, then make it better.

Nonlinear dynamics | Floating wind | 6-month MSc thesis

THE CHALLENGE

Sensitive equipment on floating structures and vessels, such as instrumentation, electronics and mechanical components, is exposed to low-frequency wave-induced motions and to machinery vibrations. Isolating low frequencies with linear springs requires very soft supports and large static deflections. Nonlinear concepts, such as quasi-zero-stiffness (QZS) isolators combining positive and negative stiffness elements, provide high static and low dynamic stiffness, extending isolation towards lower frequencies, but introduce nonlinear phenomena that must be understood. A first isolator prototype is already available at the MOREnergy Lab: validating it experimentally is the starting point to design an improved version.

WHAT YOU WILL DO

1. Develop nonlinear models of the existing isolator prototype (e.g. Duffing-type) and analyse its transmissibility with harmonic balance and numerical continuation.
2. Validate the models through experimental tests on the existing prototype, using the lab Stewart platform as a multi-axis excitation source.
3. Identify the limits of the current design (e.g. isolation bandwidth, stability, jump phenomena, payload range).
4. Design an upgraded prototype for a target payload and excitation spectrum, also assessing semi-active or active options, up to a detailed CAD design ready for manufacturing.

WORK PLAN

MONTHS 1-2
Nonlinear isolation literature, existing prototype, modelling

MONTHS 3-4
Experimental tests and model validation

MONTHS 5-6
Design of the upgraded prototype, writing

REQUIRED SKILLS

Mechanical vibrations; dynamics of mechanical systems; basics of machine design; MATLAB or Python. Basic knowledge of nonlinear dynamics, CAD or experimental techniques is a plus.

WHO WE ARE LOOKING FOR

- Mechanical, Mechatronic or Aerospace student
- Interested in vibrations and nonlinear dynamics
- Enjoys combining models, experiments and design

WHAT YOU WILL GAIN

- Strong skills in vibration analysis and nonlinear dynamics
- Experience in experimental validation and model-based design
- Competences relevant to aerospace, automotive and precision engineering

TOOLS

MATLAB/Simulink or Python, continuation tools (e.g. MatCont), CAD, data acquisition

Interested? Send a short email with your CV and transcript of records. Informal chats are welcome.

giuseppe.giorgi@polito.it

WHERE YOU WILL WORK

A young and informal working environment: you will be fully integrated within a large lab of MSc students, PhD students and researchers, working side by side in a shared open space.

BEYOND THE THESIS

For motivated students, research opportunities beyond the thesis will be promoted: scientific publications, research grants and PhD positions at the MOREnergy Lab.

Giuseppe Giorgi, PhD
Assistant Professor, DIMEAS, Politecnico di Torino

Email giuseppe.giorgi@polito.it **ORCID** 0000-0002-1649-9438
Web morenergylab.polito.it **Office** Corso Duca degli Abruzzi 24, 10129 Torino