MEC_2

Title of the doctoral program

Mechanical Engineering

Title of the research activity

Innovative reduced order models for bladed disks dynamics

Short description of the research activity

Bladed disks are critical components of turbo-machinery and extensive dynamic analyses are necessary to design them against high cycle fatigue. Due to the size of the finite element models developed for industrial applications, reduced order models (ROMs) are mandatory to reduce the calculation time without decreasing accuracy.

The research activity will focus on the development and the numerical validation of **reduced order models** for the forced response analysis of **bladed disks** with emphasis on the following configurations: bladed disks with **friction contacts** (i.e. ring dampers, shrouds or underplatform dampers), **multi-stage bladed disks** and **dual-flow path** configurations. The problem has high engineering and scientific relevance for the following reasons:

- **friction contacts** introduce local nonlinearities to the structure and therefore customized ROMs for nonlinear systems are necessary for the forced response analysis;
- **multi-stage models** (necessary to correctly predict the resonance vibration of rotors made of multiple inter-connected stages) and **dual-flow path** systems (currently designed in order to transfer mechanical energy from the shaft to the by-passed flow) require customized ROMs since (i) the size of the industrial models does not allow full system analysis, (ii) the number of blades of each sector/row is different from the others and cyclic symmetry is thus broken, (iii) the presence of random mistuning (i.e. small differences among blades) requires time consuming probabilistic analyses.

The research activity will be, in principle, divided into 3 steps:

- development of CAD and FE models of mockup bladed disks for preliminary modal and harmonic analysis in ANSYS;
- development of reduced order models and their numerical implementation in Matlab;
- development and implementation of numerical codes in Matlab for the forced response analysis of the reduced systems and for validation against ANSYS results;

Scientific responsible (name, surname, role, email)

Stefano Zucca, Associate Professor, stefano.zucca@polito.it

Number of vacancies for XXXI cycle (3 years program)

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Specific requirements (experiences, skills)

Basic knowledge of vibration mechanics, finite element method (FEM) and Matlab.

Website of the research group (if any)

www.aermec-dimec.polito.it