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# High speed modal balancing: modelling and testing of turbomachinery rotors

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## Sommario

Il lavoro di tesi è stato svolto presso la GE Oil & Gas Nuovo Pignone di Firenze, industria leader mondiale nella progettazione, costruzione ed installazione di turbomacchine per il business Oil & Gas. L'attività riguarda l'introduzione della nuova tecnologia di equilibratura modale dei rotori di turbomacchine. Più precisamente, la tesi si occupa di:

- Stato dell'arte dei metodi di equilibratura per rotori flessibili.
- Messa a punto di un banco prova rotori (Rotorkit) presso l'Università di Pisa.
- Progettazione in scala di una configurazione Rotorkit simile a un rotore di una turbomacchina GE.
- Prove sperimentali dell'equilibratura modale sul Rotorkit.

Dai risultati delle prove sperimentali in scala con il Rotorkit sono emersi sia aspetti essenziali per la prossima applicazione su scala industriale del metodo di equilibratura modale, sia risultati innovativi da un punto di vista scientifico, come la possibilità di equilibrare modi fuori dal campo operativo.



## **Abstract**

The thesis was carried out at GE Oil & Gas Nuovo Pignone in Florence, which is a worldwide company leader in the design and construction of turbomachinery for the Oil & Gas business. The work concerns the introduction of a new technology, modal balancing of turbomachinery rotors. More specifically, the thesis deals with:

- State of the art of methods for balancing of flexible rotors.
- Setup of a rotor test rig (Rotorkit) at the University of Pisa.
- Design of a scaled Rotorkit configuration similar to a GE turbomachinery rotor.
- Experimental tests of modal balancing on Rotorkit.

Test results demonstrate both essential infos for the future application in an industrial scale of the modal balancing method, and some innovation results from a scientific perspective, like the possibility to balance out of speed-range modes.



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