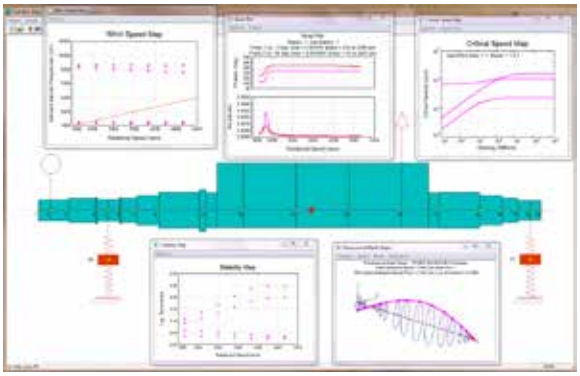
Concepts NREC

The Experts in Turbomachinery

Modeling Dynamics of Rotor Bearing Systems

Dyrobes™

This powerful and sophisticated software tool for rotor dynamics includes comprehensive bearing analysis. Based on Finite Element Analysis (FEA), it allows for multishaft designs and modeling of bearing housings and mix at continuous/discrete elements. The FEA technique also provides more accurate predictions of natural frequencies, forced response, and rotor stability. There are also three rotordynamics modules which analyze lateral, torsional, and axial vibrations of multishaft and multibranch systems.



Typical Rotor Model and Outputs

Dyrobes provides engineers with the tool to analyze a rotor/bearing system. The user can modify the design and investigate the sensitivity of the dynamics of the rotor geometry, unbalance, seal wear, bearing changes, and low frequency excitation. It is a Windows®-based program and contains extensive modeling, analysis, and pre- and postprocessing capabilities. Dyrobes is also very user-friendly and easy to use.

Lateral Vibration

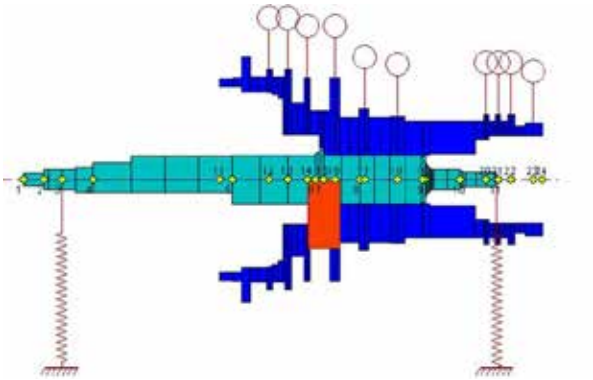
The lateral vibration of the system is described by two translational and two rotational coordinates at each finite element station. The motion of a flexible support is described by two translational displacements. The analysis for lateral vibration contains:

- Multishaft, multi-material capability
- Static deflection & bearing/constraint reactions
- Critical speed analysis of multilevel rotors
- Whirl speed & stability analysis with 3D animation
- Steady-state unbalance response analysis
  - linear and nonlinear
  — Rotor unbalance
  — Skewed Disks
  — Bowed Rotors
- Systems with linear bearings
- Systems with nonlinear squeeze film dampers and floating bush bearings
- Time-transient analysis for variable speed blade loss rubs on nonlinear, rolling element, fluid film, or magnetic bearing effects

Torsional and Axial Vibrations

For torsional and axial vibrations, the motion of each finite element station is described by a rotational displacement for torsional vibration and a translational displacement for axial vibration. The systems can be continuous and discrete. The modal damping can be specified if the direct damping is not readily available. The analyses for the torsional and axial vibrations are:

- Undamped natural frequency calculation of multilevel geared rotors
- Steady-state forced response analysis
- Time-transient analysis with synchronous or inductive motion



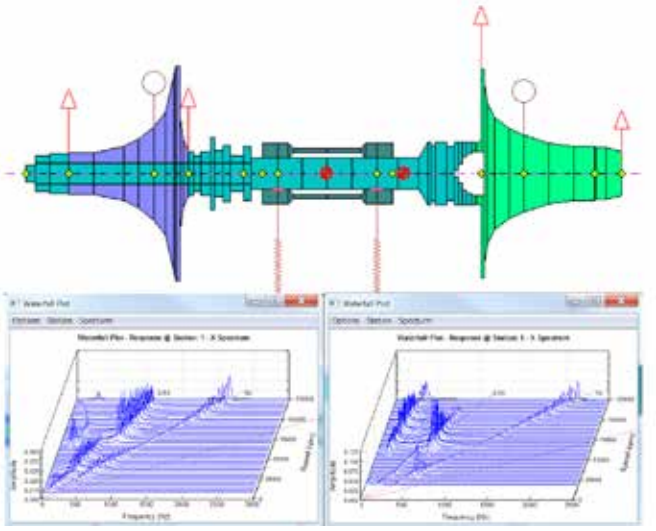
Dyrobes-generated Model of a Compressor

Rotor Balancing

- Multi-plane, multispeed balancing calculations
- Trim balancing
- Balancing predictions based on previous influence coefficients
- Balance plane graphics showing balance and trim weight placement

Concepts NREC's Agile Engineering Design System®		Radial				Axial			
		Compressors	Fans	Pumps	Turbines	Compressors	Fans	Pumps	Turbines
CAE Preliminary Design									
Meanline Approach	AXIAL™					√			√
Meanline Approach	COMPAL*	√							
Meanline Approach	FANPAL™		√				√		
Meanline Approach	PUMPAL*			√				√	
Meanline Approach	RITAL™				√				
CAE Detailed Design									
3D Geometric Design	AxCent*	√	√	√	√	√	√	√	√
CFD Option for AxCent	FINE™/Turbo™*	√	√	√	√	√	√	√	√
Pre- & Post-Processor for AxCent	pbPost™	√	√	√	√	√	√	√	√
FEA Option for AxCent	Pushbutton FEA™	√	√	√	√	√	√	√	√
CAE Specialized Design Software									
Gas Turbine Blade Cooling	CFAADS™								√
Optimization	TurboOPT II™	√	√	√	√	√	√	√	√
Rotor Dynamics	Dyrobes®	√	√	√	√	√	√	√	√
Gas Turbine Cycle Analysis	GasTurb®	√				√			√
CAM Toolpaths									
Base Platform	MAX-PAC™	√	√	√	√	√	√	√	√
Flank Milling Option	MAX-5™	√	√	√	√	√	√	√	√
Point Milling Option	MAX-AB™	√	√	√	√	√	√	√	√
Closed Impeller Option	MAX-5i™	√	√	√	√	√	√	√	√
Single Blade Option	MAX-BB™	√	√	√	√	√	√	√	√
3+2 Roughing Option	3+2 Roughing	√	√	√	√	√	√	√	√

*Offered in partnership with NUMECA International® as part of the FINE/Agile™ integrated suite.



Turbocharger Startup Vibration Spectrum with different Bearing Clearance

Bearing Capabilities

The following predefined bearing options are provided in the program:

- Journal bearings
- Fixed lobe bearings
- Floating ring bearings
- Gas bearings
- Multi-lobe pad bearings
- Tilting pad bearings
- Pressure dam bearings
- Ball and roller element bearings
- Squeeze film damper
- Rolling elements with clearance
- User defined bearings
- Lubricant properties

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