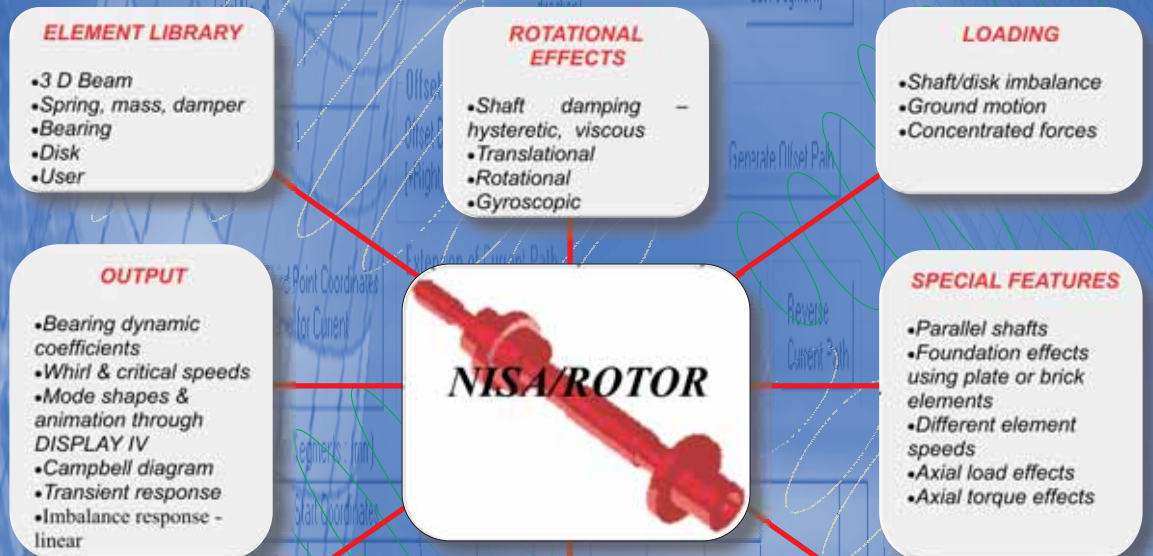
# NISA - ROTOR




***NISA/ROTOR**, a new member of NISA family of Finite Element programs, offers CAE based solutions to a wide variety of problems encountered in the Dynamic Analysis of Rotor-Bearing systems. Equipped with an extremely user friendly GUI, Graphic displays and efficient solvers to handle the system skew-symmetric and unsymmetric matrices, **NISA/ROTOR** presents an elegant platform for analyzing different rotor bearing systems frequently encountered in practice.*

# NISA - Rotor Analysis Input

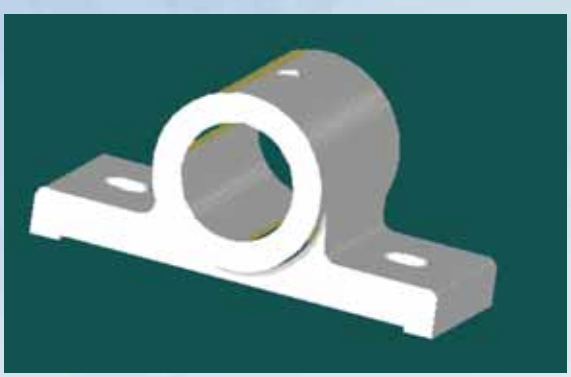
## Bearing Analysis

Bearings influence the dynamic behavior of the rotor in a significant way. User has been given the facility to input bearing dynamic coefficients using three different options. First one is defining the bearing coefficients directly. Second option is to provide a table of non-dimensional bearing dynamic coefficients vs. Sommerfeld number. From this table, the bearing coefficients at a particular speed are obtained by linear interpolation. Finally, there is a third option to compute bearing coefficients for a specified bearing geometry.

### THE INPUT INCLUDES

- Direct input of bearing dynamic damping and stiffness coefficients including cross-coupling terms (isotropic or orthotropic) for different speed ranges, if necessary.
- Table of non-dimensional bearing dynamic coefficients with respect to Sommerfeld number for interpolation at any other speed.
- Computation of bearing dynamic coefficients for a given bearing specification data such as load on bearing, shaft diameter, length to diameter ratio, bearing clearance and viscosity of the lubricant.

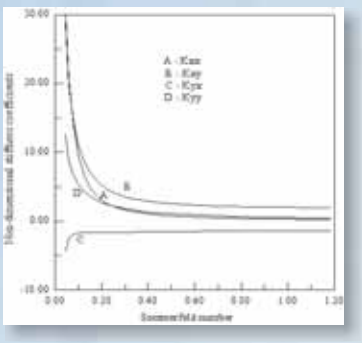
*An independent program is incorporated into NISA/ROTOR module to compute the bearing dynamic coefficients. The program utilizes linearized Reynold's equation about a steady state position. The equation is solved to arrive at the stiffness and damping coefficients using FEM with 2D discretization of the fluid film surface, for plain cylindrical journal bearing and 2 and 4 tilting pad journal bearings. Closed form expressions are used to compute Dynamic coefficients for Rolling element, Squeeze film damper and seals**



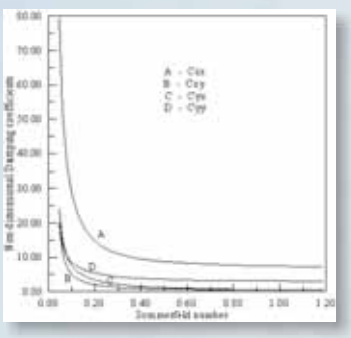
*Journal Bearing*

### THE OUTPUT INFORMATION INCLUDES

- Bearing dynamic coefficients stiffness and damping
- Sommerfield vs non dimensional coefficients output to an ascii file



Bearing dynamic stiffness coefficients



Bearing dynamic damping coefficients

## Eigenvalue Analysis

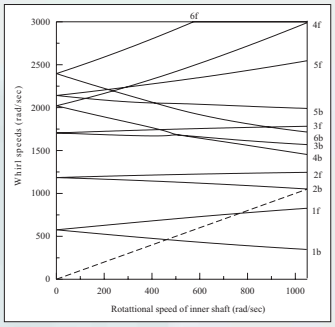
The eigenvalue analysis provides the dynamic characteristics of the rotor bearing system in terms of its damped / undamped whirl frequencies and mode shapes. The program utilizes a two-sided Lanczos block assembly and block solver algorithm specifically developed to handle unsymmetric matrices. The block solver is based on Crout decomposition procedure. The size of the original problem can be reduced using conventional Guyan reduction procedure.

### THE INPUT INCLUDES

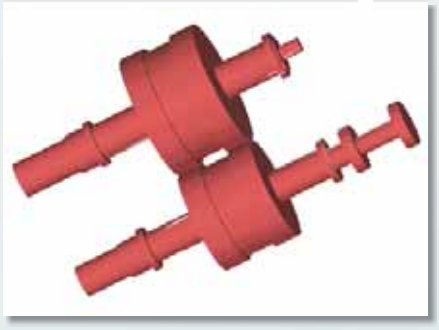
- User defined rotational effects
- Element speeds
- Disk data and bearing coefficients
- User element matrices
- Master DOF for Guyan reduction

### THE OUTPUT INFORMATION INCLUDES:

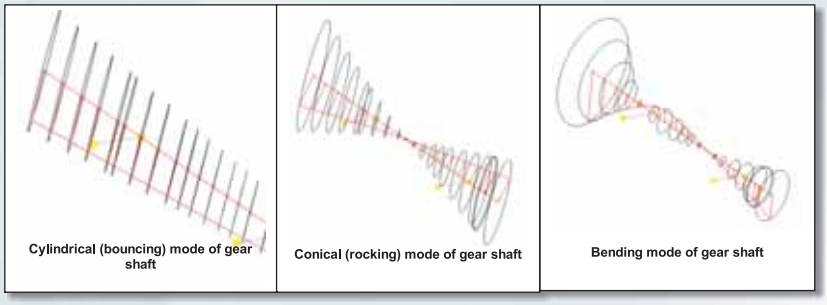
- Damped / undamped whirl frequencies
- Selective printout of mode shapes
- Campbell diagram, critical speeds and forward / backward whirl frequencies
- Stability via damping exponents/ Logarithmic decrements
- Plotting and animation of mode shapes
- Modal stresses




Campbell diagram Critical speed map



Gear and pinion shaft



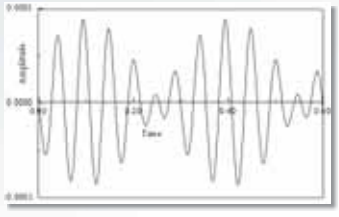

## Linear Transient Dynamic Analysis

Transient dynamic analysis determines the response of rotor bearing systems to arbitrary time-varying loads. The program utilizes Newmark-beta method for implicit direct time integration using block assembly and block solver based on Crout decomposition procedure.

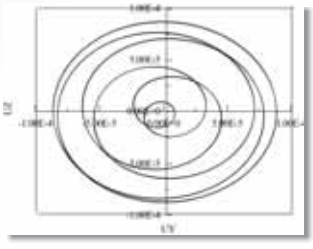
Dual Rotor system

### THE INPUT INCLUDES:

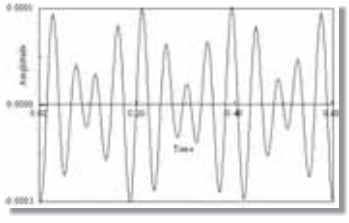
- Damped / undamped whirl frequencies
- Selective printout of mode shapes
- Nonzero initial conditions
- Time dependent concentrated loading
- Imbalance forces due to shaft or disc eccentricity or combination of both
- Ground motion



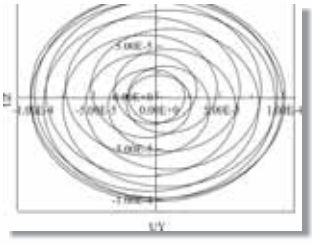
Time history at inner rotor in one full period. Speed ratio = 1.2



Whirl Orbit at inner rotor in one full period. Speed ratio = 1.2



Time history at inner rotor in one full period. Speed ratio = 1.3



Whirl Orbit at inner rotor in one full period. Speed ratio = 1.3

### THE OUTPUT INFORMATION INCLUDES:

- Time histories for displacements, velocities, accelerations
- Shaft orbit time histories at user-defined locations

# NISA - Rotor

## Direct Frequency Response Analysis

Frequency response analysis is an efficient method for determining the steady state response of rotor bearing system subjected to harmonic loading. The program utilizes unsymmetric solver in complex frequency domain using block assembly and block solver based on Crout decomposition procedure.

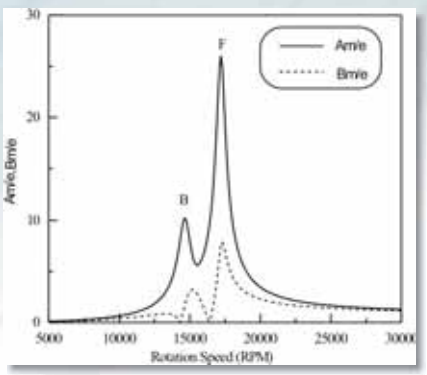
Nelson-Mcvaugh rotor

### THE INPUT INCLUDES:

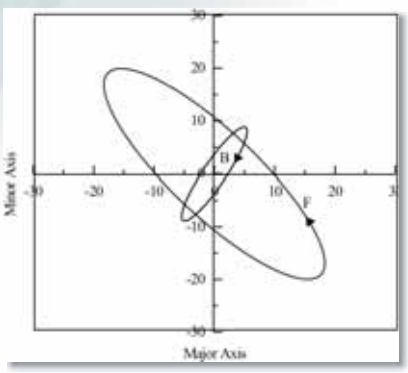
- Frequency dependent harmonic imbalance forces due to shaft or disc eccentricity or combination of both

### THE OUTPUT INFORMATION INCLUDES:

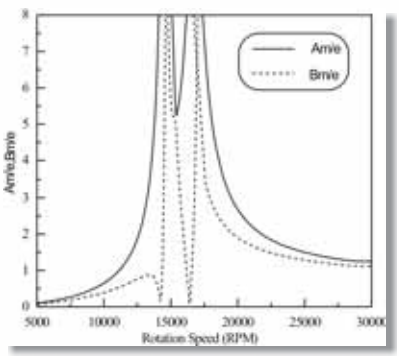
- Amplitude output for displacements, velocities, and accelerations.
- Orbits at user-defined locations for one excitation period
- Phase spectra output for displacement, velocities, accelerations



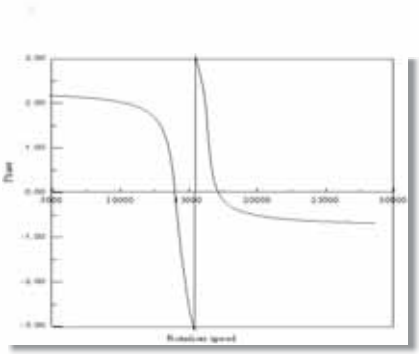

Damped unbalance response
F - Forward whirl, B - Backward whirl




Whirl orbits at first two critical speeds




Undamped Unbalance response



Phase plot

## About us

*Starcom Information Technology Limited is a leading provider of Computer Aided Engineering (CAE) services to the Automotive, Aerospace, Energy & Power, Civil, Electronics and Sporting Goods industries. Over 70 dedicated scientists, technology architects and software engineers providing NISA based solutions have helped major engineering companies reduce analysis turnaround time, improve user productivity, and ensure faster return on investments.*

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