TEXAS A&M ENGINEERING
EXPERIMENT STATION

Turbomachinery Laboratory
Turbomachinery Research Consortium

Title: Multiple Steady State Response Prediction for Nonlinear Rotordynamic Systems

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Unlike linear systems which exhibits a single steady state response, nonlinear systems may have multiple steady-state orbits (e.g., multiple synchronous, multiple harmonic orbits, multiple whirl or whip) which coexist at the identical location, rpm and unbalance. It is impractical and unreliable to utilize the common approach “Transient Numerical Integration to Steady State TNISS” to identify all coexisting responses. In contrast, the method being developed Multiple Response States Prediction MRSP employs an algorithm directed search to determine all steady state response. MRSP nonlinear vibration analysis insures that a high vibration state was not missed.

The project objective is to develop a general, finite element shaft rotordynamic software based on MRSP algorithms such as Shooting, Deflation, Continuation, Genetic Algorithm, etc. so that the solver has a capability to determine (a) all coexistent solutions CS, (b) condition for sudden, unexpected jump between CS, and (c) chaotic motion of various nonlinear force models with rub, partial arc bearings and floating ring bearings.

For the current term, the MRSP solver has the capability to perform Thermo-hydrodynamic (THD) solutions for bearings, and Component Mode Synthesis (CMS) technique is applied to analyze more realistic rotor-bearing models with large numbers of degrees of freedom. The solver will also include other nonlinear bearing applications such as pressure dam, squeeze film damper, seal and etc.

The deliverables are MATLAB stand-alone executable with user friendly EXCEL based input interface, detailed worked examples, and user’s manual.

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