

## **EXPERIMENTS AND ANALYSIS FOR A COMMON CASE OF CRACKED ROTORS INSTABILITY AIDING ITS DETECTION**

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### **ABSTRACT**

A case of vibration instability, not previously reported in the literature, controlled by parameters interacting with the cracked shaft can aid to detect faulty shafts while operating. Lack to detect damaged shafts might cause a catastrophe should the cracked rotors suddenly fails in operation. For simple rotor-bearing systems having a mid-span transverse crack, the modeling approach while deriving the equations of motion is crucial to simulate effectively their qualitative behavior. Here an improved mathematical model capable of reproducing unstable vibration situations which might stem by common field problems is presented and test validated. By varying key system parameters numerical stability analyses based on Floquet Theory, are performed and studied. Then by varying parameters controlling the instability and through laboratory experiments using *WinADRE* and a modified *Bently Nevada* rotor-kit the model is validated and successfully corroborated. Test data show occurrence of the predicted crack-related instability and its sensitivity to the controlling parameters. Finally, based on the previous analysis a method for detecting mid-span cracked shafts is proposed and discussed. In spite that the method requires reaching rotating velocity near the speed threshold, it can be a useful diagnostic tool and it is ease to implement in field practice.

**Keywords:** Instability, cracked rotor, imbalance, nontrivial equilibrium, local resonances