Dynamic Analysis of a Dual Rotor-Bearing System in Support Of the TF-41 Seeded-Fault Testing

Jerzy T. Sawicki
Rotor-Bearing Dynamics & Diagnostics Laboratory, Fenn College of Engineering
Cleveland State University, Cleveland, OH 44115, U.S.A.

John P. Gyekenyesi
NASA Glenn Research Center, 21000 Brookpark Road, Cleveland, OH 44135, U.S.A.

George Y. Baaklini
NASA Glenn Research Center, 21000 Brookpark Road, Cleveland, OH 44135, U.S.A.

Andrew L. Gyekenyesi
NASA Glenn Research Center, 21000 Brookpark Road, Cleveland, OH 44135, U.S.A.

ABSTRACT

This paper presents the partial results of a dynamic analysis in combination with baseline experimental data of a two-spool TF-41, gas turbine aircraft engine. The engine was utilized for a government sponsored seeded fault test. By implementing a seeded fault in the form of a crack emulating from a notch into the fan stage disk, new sensor technologies were assessed in their ability to identify disk cracks in real time. The critical speed analysis of the complex engine conducted within this paper was in support of the vibration data captured during the full-scale fault tests. Comparisons were conducted between the critical speeds predicted by the model and the apparent critical speeds obtained from displacement sensors monitoring the fan blade tip clearance in the radial direction. Both the analysis and the experimental data indicated multiple critical speeds in the domains of operation, although, there were differences in the defined critical speeds. It is assumed that discrepancies were introduced by the fact that the sensors were monitoring the blades as opposed to the shaft. Therefore, the dynamics of the blades may have dominated the actual overall dynamic displacements of the system. In addition, disagreements may be due to the modeling assumptions concerning the bearing mounts and case rigidity.