ABSTRACT

Prenger, Nicholas Joseph, M.S.M.E., Purdue University, December, 2003. Modeling the Dynamics of Rolling Element Bearings Using ADAMS. Major Professor: Dr. Farshid Sadeghi, School of Mechanical Engineering.

Six-degree-of-freedom dynamic models were developed using the multi-body dynamics software ADAMS to study the dynamics of deep groove ball bearings, angular contact ball bearings, and spherical roller bearings. Existing 3-D bearing part geometry from CAD is imported into ADAMS. Custom user-defined contact subroutines determine the contact point between simple shapes that represent bearing part surfaces and calculate the appropriate forces and moments to apply to the bearing parts in contact. Radial preload, radial, axial, moment, and gravitational loading can be applied in any combination to all ADAMS bearing models. Lubricated elastohydrodynamic (EHD), piezoviscous- rigid (PVR), and isoviscous-rigid normal force calculations can be included in the bearing analysis on an optional basis. Cage motion is fully dynamic for all models. The ADAMS/PostProcessor graphical user interface can be used to examine graphical results and to view animations of the bearing during operation. Results from the ADAMS bearing models are generally in good agreement with published analytical and experimental results. Parametric studies were carried out to examine the effects of bearing speed, axial loading, roller – cage pocket clearance, cage – inner race clearance, roller phase shift, and traction coefficient on bearing performance for spherical roller bearings with one-piece and two-piece cages. For the bearing studied, the roller skew angle initially became more negative with increasing axial load due to roller – raceway contacts and then became less negative past a critical axial load because of the roller – raceway spin-resisting moments and increased roller end – inner race inner flange contact. Bearing

torque was shown to increases with increasing cage – inner race clearance in cases with cage whirl about the inner race because of centrifugal force effects. All studies showed that there is a correlation between skew angle stability and cage whirl about the inner race in spherical roller bearings. As skew angle changes rapidly, the inner race center of mass location also changes rapidly causing a loss of contact with the inner race and a disruption of cage whirl.