STUDY OF THE CHARACTERISTICS OF A ROLLING BEARING WITH AN OUTER RING INSTALLATION DEFECT

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The characteristics of the non-stationarity of vibration signals of a radial rolling bearing with a deviation in the installation of the outer ring of the bearing have been investigated. The high sensitivity of the degree of non-stationarity of the vibration signal to the error in the installation of the bearing has been shown.

Keywords: periodically non-stationary random process; rolling bearing; vibro-mechanical stand; outer race rotation period

In the department of methods and facilities for acquisition and processing diagnostic signals of the Karpenko physico-mechanical institute of the NAS of Ukraine a specialized vibro-mechanical stand VMS-1 to study vibration signals from rotating mechanism elements and assemblies has been developed. The stand is mounted on a rigid welded metal chassis of rectangular shape. An asynchronous motor with a power of 2.2 kW controlled by a LENZE ESMD222X2SFA driver is mounted on it. The motor through flexible coupling rotates a shaft with a length of 720 mm, mounted in two bearings pressed onto the shaft by the cold method, which are inserted into the holders.

The bearing holder on the motor side is rigidly attached to the chassis, and the bearing holder on the opposite side of the shaft is fixed on a movable platform that can move along the longitudinal and transverse axes of the shaft and deflect in two planes – radial and perpendicular to it. The selected position of this holder is adjusted and fixed using the appropriate adjusting screws. Vibration sensors can be attached either using magnets or screwed directly into the bearing holder at angles multiples of 45°. The LENZE ESMD222X2SFA driver with a remote control provides settings for the drive motor speed, direction of rotation, V/f frequency control law (linear or quadratic), DC braking, shaft slip compensation, time to enter the set mode and other necessary parameters. To suppress its own possible mechanical vibrations, a ballast weighing 70 kg is installed in the stand, and vibration isolation from the floor of the room is achieved using rubber pads 60 mm thick.

An experiment was conducted to investigate the vibration characteristics of the signal from a radial single-row bearing type BBC-R 6205 2RS/P6. Vibration signals were sampled in the vertical direction at 6 different angles of deviation of the bearing holder plane along the plane of the shaft axis: 0°, 0.5°, 1.0°, 1.5°, 2.0° and 3.0°. The pass-band of the analog signal filter was set 10 kHz, the signal sampling frequency was 25 kHz. The duration of signal recording for each test was 4 seconds. At 0° deviation of the bearing holder, the bearing has a standard setting, the balls roll evenly with minimal friction. At holder deviations of 0.5°–1.0°, a small lateral shift appears, and the balls begin to slip along the outer ring. With holder deviations in the range of 1° to 2° the rolling of the balls becomes significantly uneven, partial sliding, creating local wear zones on the outer ring. With a deviation of 3°, the balls go beyond the optimal track, which leads to rapid wear of the outer ring and loss of accuracy of the bearing.

Based on the calculated characteristic frequency of rotation of the ball on the outer ring (≈180 Hz) based on the bearing parameters [1], the vibration signals were analyzed using the methods of periodically non-stationary random process [2–4] in the vicinity of this frequency. The period of signal non-stationarity was determined, and the total power of the components at this frequency (Table 1) was calculated.

Table 1. Total power of basic harmonics for holder deviation angle

Holder deviation angle	Total power of basic harmonics
0.5°	0.263949
1.0°	1.382962
1.5°	6.653281
2.0°	8.405771
3.0°	19.283532

It is shown that the proposed signal processing methods of periodically non-stationary random process have high sensitivity to deviations in the bearing holder orientation from the standard one.

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