XJTU-SY Bearing Datasets

1. Dataset overview

XJTU-SY bearing datasets are provided by the Institute of Design Science and Basic Component at Xi'an Jiaotong University (XJTU), Shaanxi, P.R. China (http://gr.xjtu.edu.cn/web/yaguolei) and the Changxing Sumyoung Technology Co., Ltd. (SY), Zhejiang, P.R. China (https://www.sumyoungtech.com.cn). The datasets contain complete run-to-failure data of 15 rolling element bearings that were acquired by conducting many accelerated degradation experiments. These datasets are publicly available and anyone can use them to validate prognostics algorithms of rolling element bearings. Publications making use of the XJTU-SY bearing datasets are requested to cite the following paper.

Biao Wang, Yaguo Lei, Naipeng Li, Ningbo Li, "A Hybrid Prognostics Approach for Estimating Remaining Useful Life of Rolling Element Bearings", *IEEE Transactions on Reliability*, pp. 1-12, 2018. DOI: 10.1109/TR.2018.2882682.

2. Brief introduction to experiments

2.1. Bearing testbed

As shown in Fig. 1, the bearing testbed is composed of an alternating current (AC) induction motor, a motor speed controller, a support shaft, two support bearings (heavy duty roller bearings), a hydraulic loading system and so on. This testbed is designed to conduct the accelerated degradation tests of rolling element bearings under different operating conditions (i.e., different radial force and rotating speed). The radial force is generated by the hydraulic loading system and applied to the housing of tested bearings, and the rotating speed is set and kept by the speed controller of the AC induction motor.

2.2. Tested bearing

The type of tested bearings is LDK UER204, and the detailed parameters are given in Table 1.

Table 1. Parameters of the tested bearings

Parameter	Value	Parameter	Value
Outer race diameter	39.80 mm	Inner race diameter	29.30 mm
Bearing mean diameter	34.55 mm	Ball diameter	7.92 mm
Number of balls	8	Contact angle	0°
Load rating (static)	6.65 kN	Load rating (dynamic)	12.82 kN

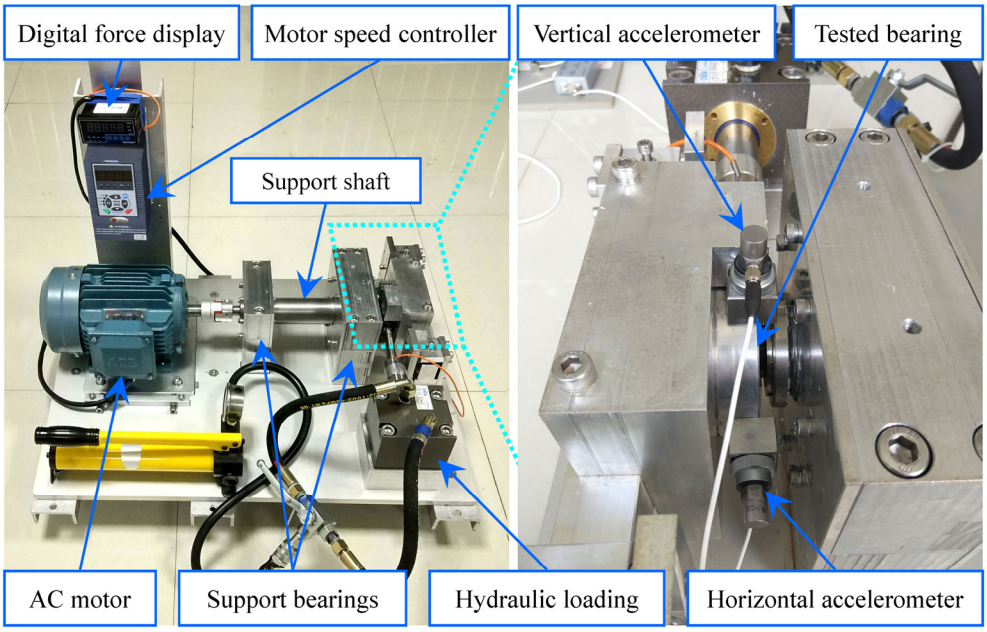


Fig. 1. Testbed of rolling element bearings.

2.3. Operating condition

A total of 3 different operating conditions were set in the accelerated degradation experiments, and 5 bearings were tested under each operating condition. The operating conditions include:

1) 2100 rpm (35 Hz) and 12 kN;
2) 2250 rpm (37.5 Hz) and 11 kN;
3) 2400 rpm (40 Hz) and 10 kN.

2.4. Sampling setting

To collect vibration signals of the tested bearings, as shown in Fig. 1, two accelerometers of type PCB 352C33 are positioned at 90° on the housing of the tested bearings, i.e., one is mounted on the horizontal axis and the other one is mounted on the vertical axis.

The sampling frequency is set to 25.6 kHz. As shown in Fig. 2, a total of 32768 data points (i.e. 1.28 s) are recorded for each sampling, and the sampling period is equal to 1 min.

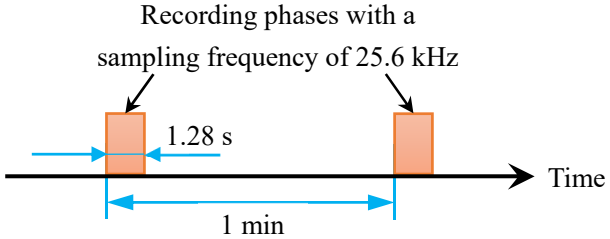


Fig. 2. Sampling setting for vibration signals.

3. Dataset details

The run-to-failure data of 15 rolling element bearings are included in the data packet (XJTU-SY_Bearing_Datasets.zip). For each sampling, the acquired data were saved as a CSV file, in which the first column is the horizontal vibration signals and the second column is the vertical vibration signals. Table 2 lists the detailed information of each tested bearing, including number of CSV files, bearing lifetime and fault element.

Table 2. XJTU-SY bearing datasets

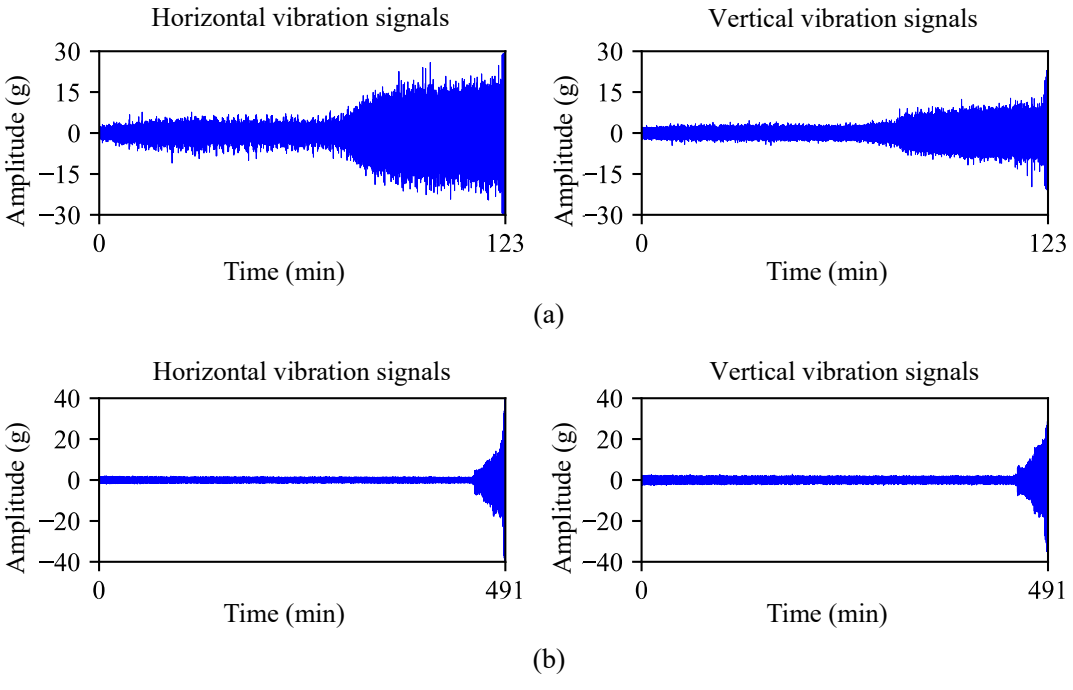
Operating condition	Bearing dataset	Number of files	Bearing lifetime	Fault element
Condition 1 (35 Hz/12 kN)	Bearing 1_1	123	2 h 3 min	Outer race
	Bearing 1_2	161	2 h 41 min	Outer race
	Bearing 1_3	158	2 h 38 min	Outer race
	Bearing 1_4	122	2 h 2 min	Cage
	Bearing 1_5	52	52 min	Inner race and outer race
Condition 2 (37.5 Hz/11 kN)	Bearing 2_1	491	8 h 11 min	Inner race
	Bearing 2_2	161	2 h 41 min	Outer race
	Bearing 2_3	533	8 h 53 min	Cage
	Bearing 2_4	42	42 min	Outer race
	Bearing 2_5	339	5 h 39 min	Outer race
Condition 3 (40 Hz/10 kN)	Bearing 3_1	2538	42 h 18 min	Outer race
	Bearing 3_2	2496	41 h 36 min	Inner race, ball, cage and outer race
	Bearing 3_3	371	6 h 11 min	Inner race
	Bearing 3_4	1515	25 h 15 min	Inner race
	Bearing 3_5	114	1 h 54 min	Outer race

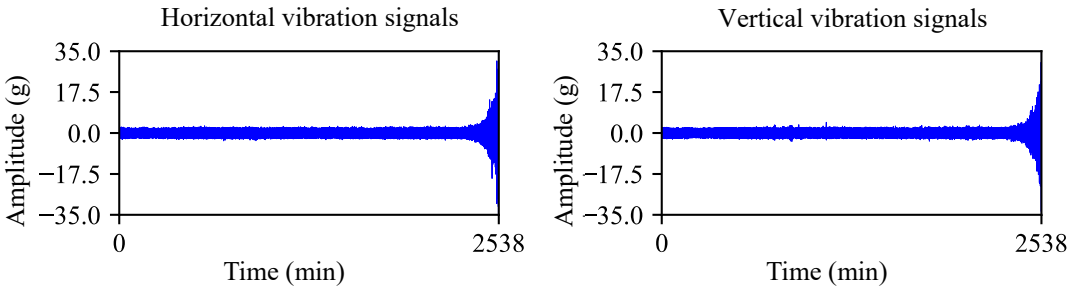
To observe the complete degradation processes of bearings (i.e., the tested bearings degrade from normal states to severe faults), each of the accelerated degradation tests was performed until the maximum amplitude of the horizontal or vertical vibration signals exceeded $10\times A_h$, where A_h is the maximum amplitude of the horizontal or vertical vibration signals in the normal operating stage.

Fig. 3 shows the photographs of the failure bearings. It can be observed that the failure of the tested bearings is caused by different types of faults, including inner race

wear, cage fracture, outer race wear, outer race fracture, etc. Fig. 4 shows the horizontal and vertical vibration signals of three tested bearings during the whole operating life.

Fig. 3. Photographs of the failure bearings. (a) Inner race wear. (b) Cage fracture. (c) Outer race wear. (d) Outer race fracture.





(c)

Fig. 4. Horizontal and vertical vibration signals of three tested bearings. (a) Bearing 1_1. (b) Bearing 2_1. (c) Bearing 3_1.

4. Contact

If you have any questions or suggestions, do not hesitate to contact:

✧ Mr. Biao Wang, wangbiaoxjtu@outlook.com

✧ Prof. Yaguo Lei, yaguolei@mail.xjtu.edu.cn