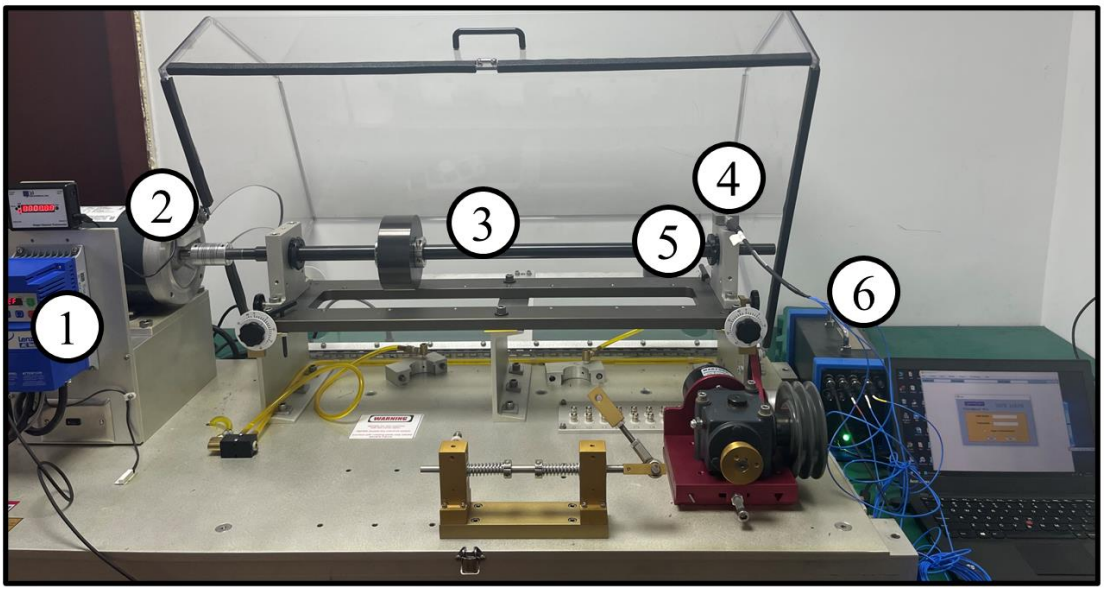
HUSTbearin dataset

1. Dataset overview

This dataset comprises vibration signals from bearings in ***9*** different health states under ***11*** distinct operating conditions (*include steady speed and time-varying speed*). These datasets are publicly available, and anyone can use them to validate diagnosis algorithms for rolling element bearings. Publications making use of the HUSTbearing datasets are requested to cite the following paper.

Chao Zhao, Enrico Zio, Weiming Shen, Domain Generalization for Cross-Domain Fault Diagnosis: an Application-oriented Perspective and a Benchmark Study, Reliability Engineering and System Safety (2024), doi: https://doi.org/10.1016/j.ress.2024.109964.



1: Speed control, 2:Motor, 3: Shaft, 4: Acceleration sensor, 5: Bearing, 6: Data acquisition board

Fig. 1. (a) Test rig of HUSTbearing dataset.

2. Brief introduction to experiments

2.1 Bearing testbed

The bearing fault tests were conducted using a Spectra-Quest Mechanical Fault Simulator, as depicted in **Fig. 1**. From left to right on the test rig are speed control, motor, shaft, acceleration sensor, bearing, and data acquisition board. The bearings in

nine health states are illustrated in **Fig. 2**, representing (1) normal, (2) medium inner race fault, (3) severe inner race fault, (4) medium outer race fault, (5) severe outer race fault, (6) medium ball fault, (7) severe ball fault, (8) medium combination fault, and (9) severe combination fault. It's important to note that combination fault denotes a fault in both the inner race and outer race. All faults are artificially preset.

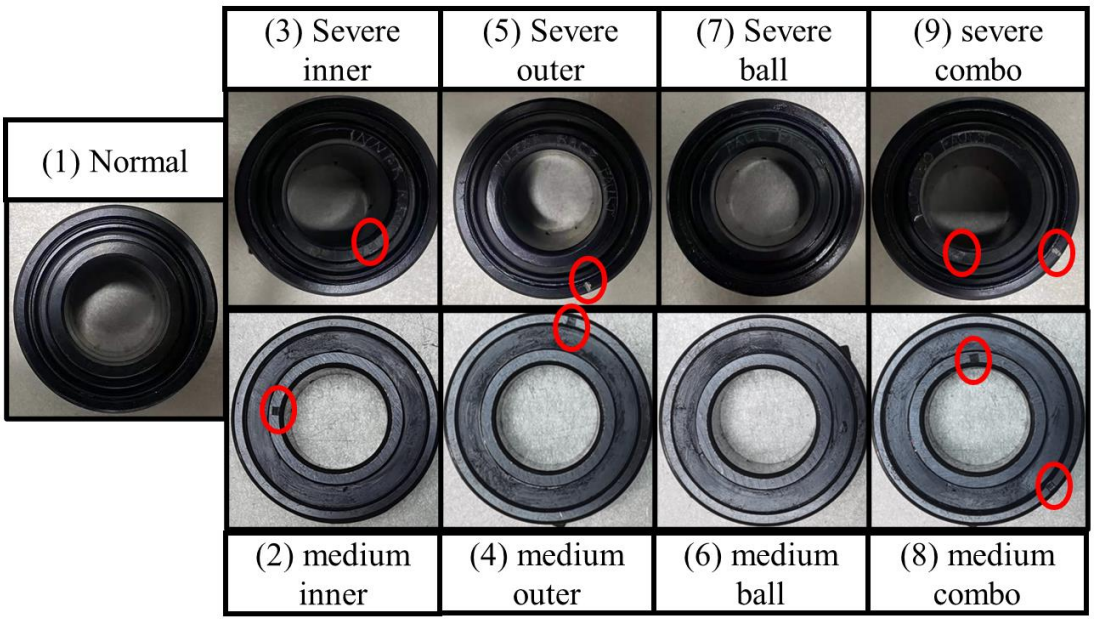


Fig. 2. Photographs of the failure bearings.

2.2 Tested bearing

The type of tested bearings is ER-16K, and the detailed parameters are given in **Table 1**.

Table 1. Parameters of the tested bearings

Parameter	**Value**
Shaft Diameter	38.52 mm
Ball Diameter	7.94 mm
Number of Balls	9

2.3 Sensor and related setting

Acceleration sensor for data collection is shown in **Fig.3**, and the sensor model is indicated in **Fig.4**. Specific signal acquisition settings are detailed in **Fig.5**.

Fig. 3. Photographs of the three-way acceleration sensor.

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LOW COST MINIATURE INDUSTRIAL TRIAXIAL ACCELEROMETER, SIDE EXIT 4 PIN MINI-MIL CONNECTOR, FOLLOWS CARTESIAN PHASE COORDINATE SYSTEM, 100 MV/G, ±15%

- ☑ 30-600,000 CPM Frequency Response (±3dB)
- ☑ -65 to 250°F (-54 to 121°C) Temperature Range
- ☑ Welded, Hermetic Sealing
- ☑ Collect 3 Channels of Data Simultaneously for Faster Data Collection
- ☑ Follows Cartesian Coordinate Phase Configuration (Right Hand Rule)

Fig. 4. Sensor type.

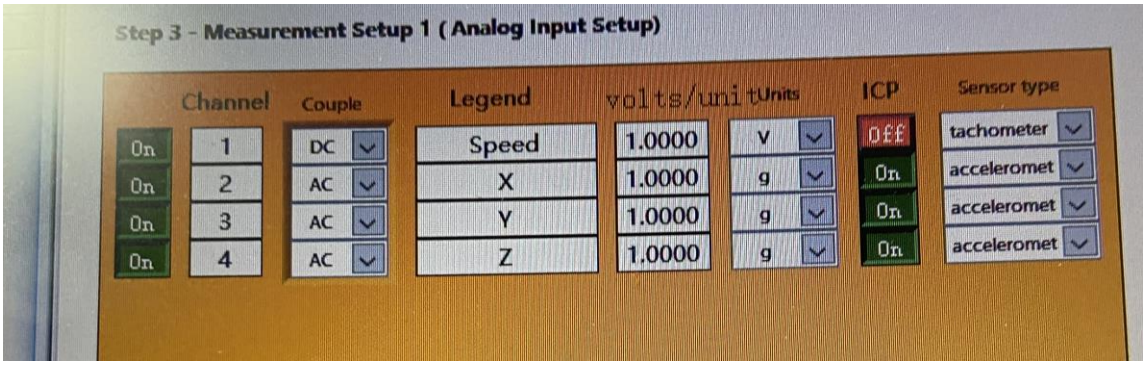


Fig. 5. Signal acquisition setting.

2.4 Operating Condition

A total of 11 different operating conditions were set in experiments. The operating

conditions include:

1) 20 Hz

2) 25 Hz

3) 30 Hz

4) 35 Hz

5) 40 Hz

6) 60 Hz

7) 65 Hz

8) 70 Hz

9) 75 Hz

10) 80 Hz

11) 0-40-0 Hz, see Fig. 6.

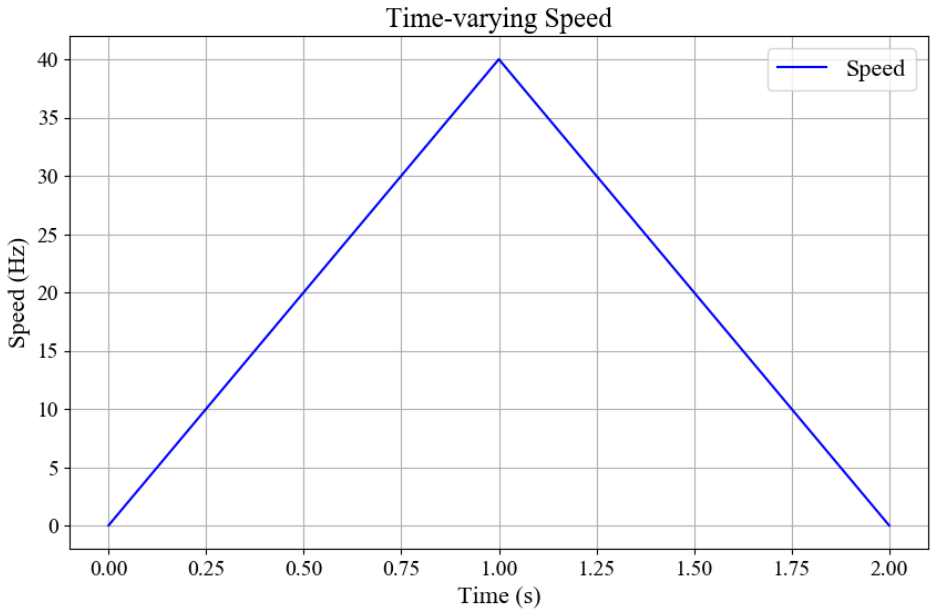


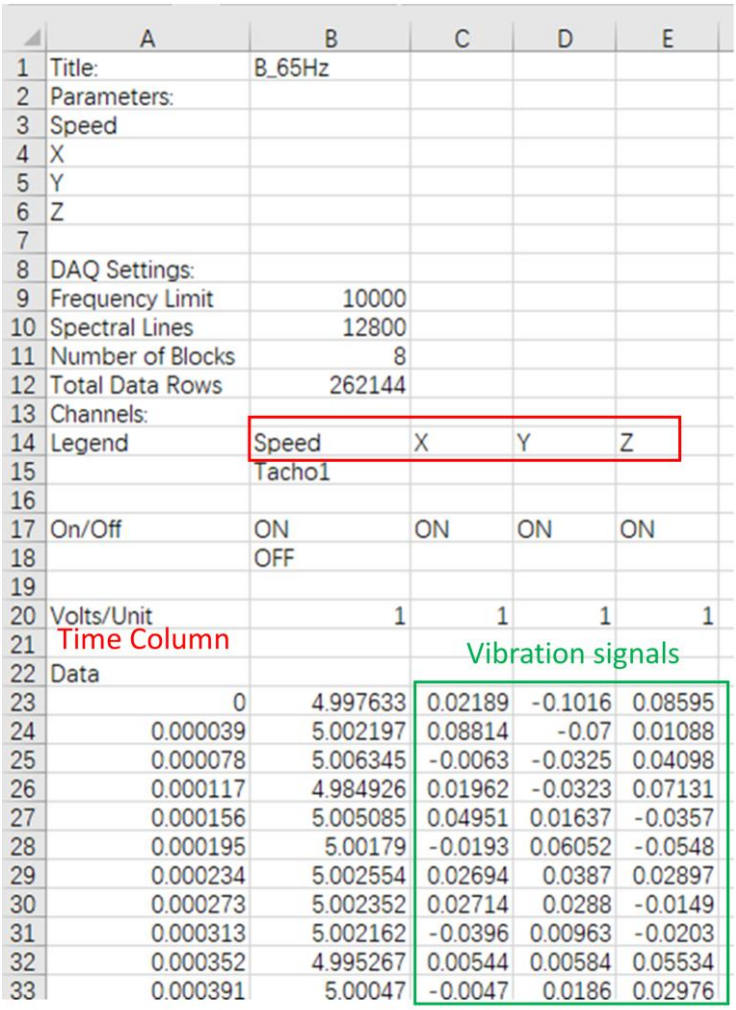
Fig. 6. Time-varying speed.

2.5 Sampling setting

The sampling frequency is set to 25.6 kHz. As shown in **Fig. 7**, a total of 262144 data points (i.e. 10.2s) are recorded for each sampling.

The second column of the dataset represents speed. However, since we collected the data at a constant speed, this column is redundant and holds no meaningful value.

You can ignore it. The correct speed is indicated in the filename.



	A	B	C	D	E
1	Title:	B_65Hz			
2	Parameters:				
3	Speed				
4	X				
5	Y				
6	Z				
7					
8	DAQ Settings:				
9	Frequency Limit	10000			
10	Spectral Lines	12800			
11	Number of Blocks	8			
12	Total Data Rows	262144			
13	Channels:				
14	Legend	Speed	X	Y	Z
15		Tacho1			
16					
17	On/Off	ON	ON	ON	ON
18		OFF			
19					
20	Volts/Unit	1	1	1	1
21	Time Column			Vibration signals	
22	Data				
23	0	4.997633	0.02189	-0.1016	0.08595
24	0.000039	5.002197	0.08814	-0.07	0.01088
25	0.000078	5.006345	-0.0063	-0.0325	0.04098
26	0.000117	4.984926	0.01962	-0.0323	0.07131
27	0.000156	5.005085	0.04951	0.01637	-0.0357
28	0.000195	5.00179	-0.0193	0.06052	-0.0548
29	0.000234	5.002554	0.02694	0.0387	0.02897
30	0.000273	5.002352	0.02714	0.0288	-0.0149
31	0.000313	5.002162	-0.0396	0.00963	-0.0203
32	0.000352	4.995267	0.00544	0.00584	0.05534
33	0.000391	5.00047	-0.0047	0.0186	0.02976

Fig. 7. Illustration of file. The second column of the file represents speed. However, since we collected the data at a constant speed, this column is redundant and holds no meaningful value. You can ignore it. The correct speed is indicated in the filename.

3. Dataset details

The raw data file comprises 99 files (9 health states multiplied by 11 working conditions), each in Excel format. For instance, the filename "0.5X_B_65Hz" indicates a medium ball fault under the 65 Hz working condition, where 0.5X denotes medium damage.

The health states are represented by the following codes:

H: healthy

I: inner race fault

O: outer race fault

B: ball fault

C: combination fault

For example, "O_80Hz" signifies a severe ball fault under the 80 Hz working condition.

4. Contact

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

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