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Air Bearing noise analysis

Porous Media Air Bearings offer proven advantages in applications where precision motion or positioning is required. From coordinate measuring machines and precision machine tools to high-speed, precision positioning applications, Air Bearings provide an outstanding solution. In many of these applications, air bearings exhibit a disturbance attenuation effect by eliminating the physical connection between machinery and the world, replacing it with a thin layer of air. The isolating property of air bearings is, therefore, of great interest. In this regard, the vibration and noise-producing characteristics of air bearings are investigated.

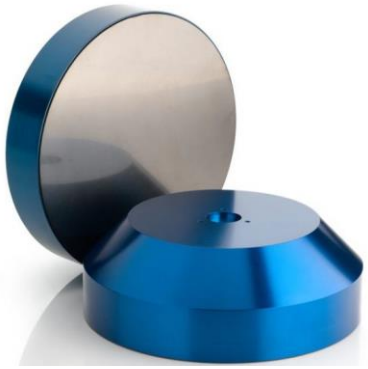

Figure 1 New Way Air Bearings

In this study, we examine the noise characteristics of a 65 mm New Way air bearing. The measurement conditions include a 570N payload and 5 bar operating air pressure, resulting in a 4µm air gap and an air flow of 1.3 SLM.

Test setup

The Air Bearing is placed on a smooth granite surface with a maximum peak height of 1µm within a range of 7cm, supporting an approximate load of 570N. A Lion Precision high precision capacitive sensor is used to measure the displacement of the air gap as shown in Figure 2. The measurement is conducted in two instances, one without pressurized air flowing into the Air Bearing and the other with an input air pressure of 5 bar, controlled by Piezo regulators PRE1-U08 from Aircom. The measurement without air shows the sensor's noise level, while the measurement with air reveals a combination of the sensor noise and air bearing noise. The capacitive sensor was sampled at 10 kHz.

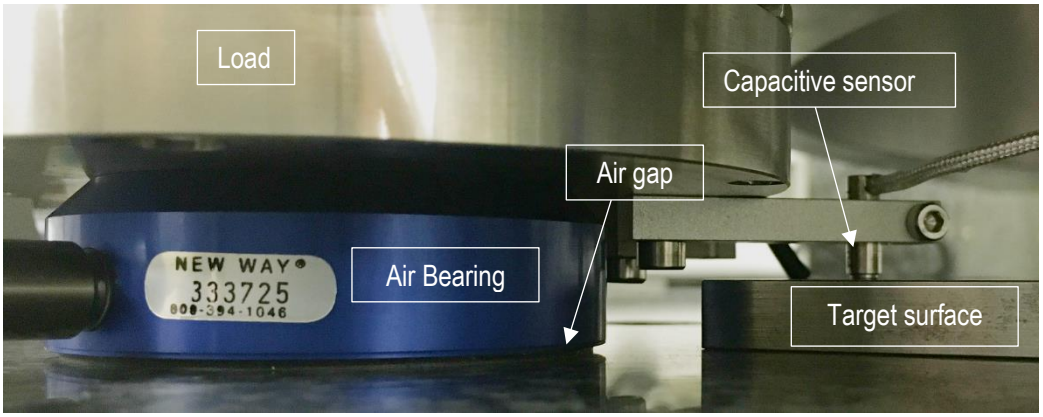

Figure 2 Test setup for noise measurement of New Way 65 mm air bearing

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Test Results

Figure 3 illustrates the results of the experiments over a 2 second time interval. The left hand plot depicts the sensor noise when the air bearing is not activated (no air), while the right hand side plot shows the displacement after applying an air pressure of 5 bar to the air bearing (with air). As observed, the filtered sensor noise displays a peak to peak variation of around 1nm and an RMS value of 0.17nm. In contrast, the air gap demonstrates a peak-to-peak value of 2.5nm with an RMS value of 0.32nm.

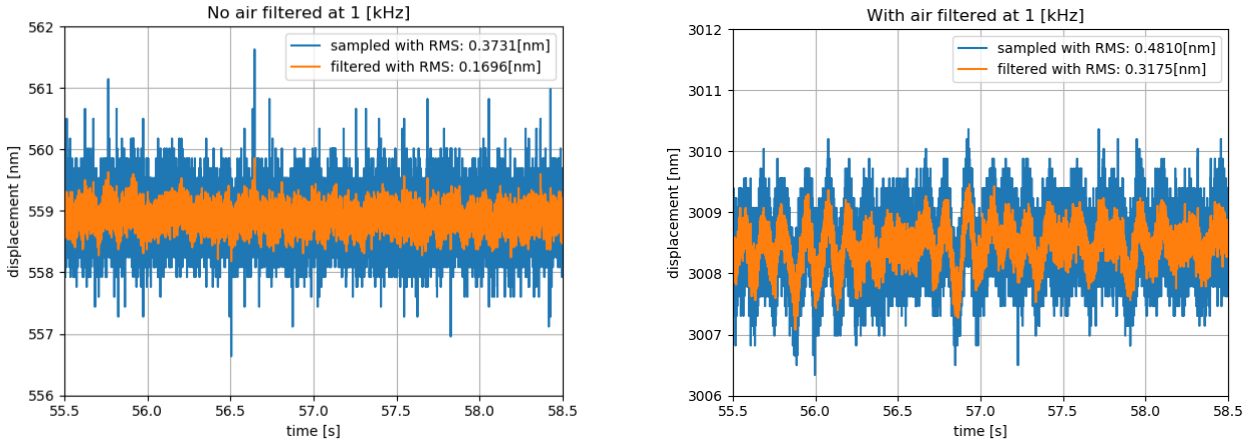

Figure 3 On the left, the measurement without any pressurized air is depicted and on the right, the measurement with 5 bar pressure is shown. The blue plot represents the raw measurement, while the orange plot displays the filtered data using a moving average filter with a 1 kHz cut-off frequency.

Conclusion

In this study, we examined the noise characteristic of a 65 mm New Way Air Bearing under a 570 N payload and 5 bar operating air pressure. The results demonstrated that this Air Bearing achieves outstanding noise characteristics, with a peak-to-peak value of less than 2.5 nm and an RMS value of less than 0.32 nm.