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HIGH-FREQUENCY MEASUREMENT OF BUSH BEARINGS USING SEISMIC MASS

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Technical task:
The high-frequency transmission behaviour of bush bearings (up to 3 kHz) is of particular importance for the development process, especially in the course of electromobility. The bush bearings are currently being measured internally and externally on high-frequency test rigs which operate according to the following principle:
The bearing core is excited via an electrodynamic shaker. The outside of the bearing is held by a device and this device with base plate is supported by force measuring elements on a decoupled foundation. The bearing core is now excited by a sliding or step sinus (usually 30m/s² peak), while the reaction forces of the force measuring elements are recorded. From the quotient of the reaction forces and the bearing travel, the so-called dynamic stiffness is obtained depending on the frequency, which is used as an evaluation variable for the bearing.

Initial situation:
The force measuring elements naturally have a certain flexibility. The structure mounted on the sensors therefore inevitably represents a vibrating system which, depending on its dimensions, has natural frequencies which fall more or less far into the measuring range. By force-to-force transmission functions (knock measurements) one tries to reduce the error. However, practice shows that this is only possible to a limited extent, since knock measurements also involve further inaccuracies.

Solution:
The force on the secondary side is no longer absorbed by force elements, but determined indirectly by the acceleration of a test mass.
The bearing is pressed into a solid ring which serves as seismic mass. The design of the ring is such that it only performs rigid body movements in the measuring range. The bearing is now excited with the same excitation signal as in the conventional design. Since the secondary side of the bearing is no longer held, the controlled variable is no longer the acceleration of the bearing core, but the differential acceleration of the bearing core and test mass. The bearing force is obtained from the product of mass and acceleration of the test mass. The bearing travel results from the double integration of the differential acceleration of the core and test mass. The dynamic stiffness can be inferred from the quotient of these two variables.

The test setup for measuring the axial direction is shown in the following sketch:

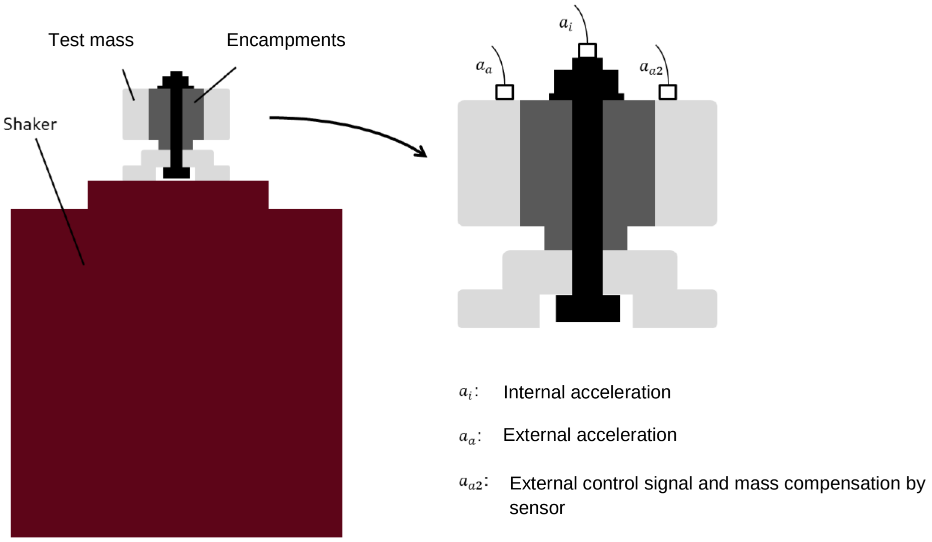

Figure 1

The second sensor on the test mass is primarily a mass balance, so that the center of gravity coincides with the axis of the force-parts line. At the same time, the signal can also be used for validation.

For a measurement in the radial direction, the core must be excited rotated using a corresponding fork. The inner sensor must be mounted as directly as possible on the bearing core so that the relative acceleration of the core and test mass can be detected with the greatest possible accuracy.

Advantages:

Due to the substitution of force measurement by acceleration measurement, a fixed secondary side is no longer required, which influences the measurement by its resonance behavior. As a result, measurement results of significantly higher quality can be achieved with a simpler and thus more cost-effective measurement setup. This has already been tested on the first exemplary measurements.

The limitation that no preload can be set for this test setup does not present itself as a disadvantage: With the typical preloads of the bush bearings in vehicle construction (up to max. 850 N), the dynamic rigidity remains unaffected by the preload.