CIRO PRODUCTS LTD

Caring Beyond Our Products

Structure-Borne Sound Control

1. Why using structure-borne sound?

As soon as the grinding wheel touches the part a structure-borne sound (noise) is generated. This signal for example can be used to monitor grinding processes. The intensity and the frequency of this structure-borne sound depends on many factors, such as the grinding power, type and material of the grinding wheel, the grinding wheel speed (rpm), the part, and the material the part is made of.

2. Applications

The recording, processing, and evaluation of the structure-borne sound may be used for the following applications:

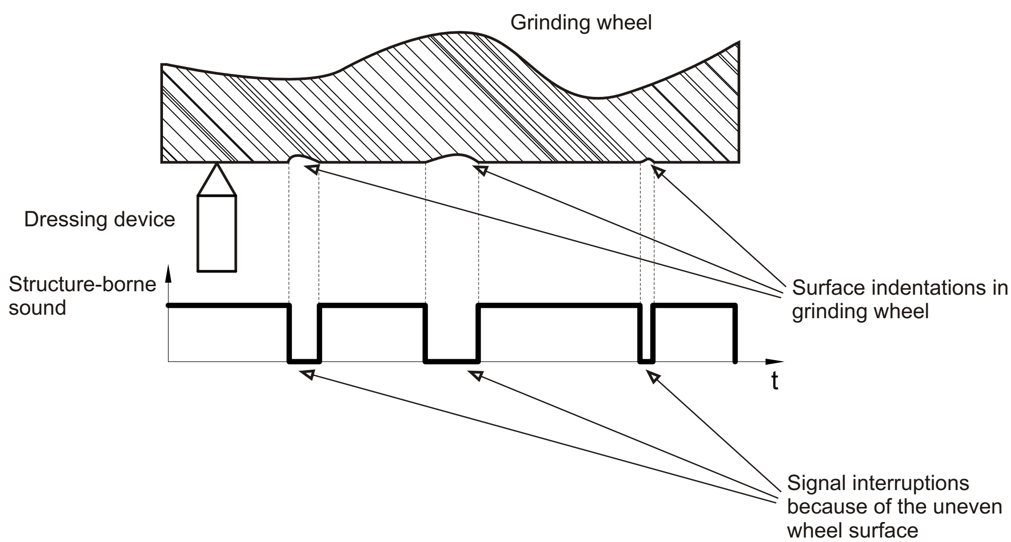
- GAP control (air gap monitoring)
- Wheel dressing control (monitoring during wheel dressing)
- Crash control (crash monitoring)

2.1 GAP control

The main focus is the moment the wheel contacts the part. The objective is to reduce the air grinding time, i.e., to reduce the time the wheel needs to approach the part and makes its first contact. The contact between grinding wheel and part needs to be recorded precisely and within micrometers for the grinding process to start.

2.2 Wheel dressing control

While dressing the grinding wheel a similar structure-borne noise is created like in the grinding process. If during dressing the structure-borne sound is recorded with interruptions, it is obvious that the grinding wheel surface is not completely dressed, i.e., some indentations are still present. Another dressing cycle is therefore needed.



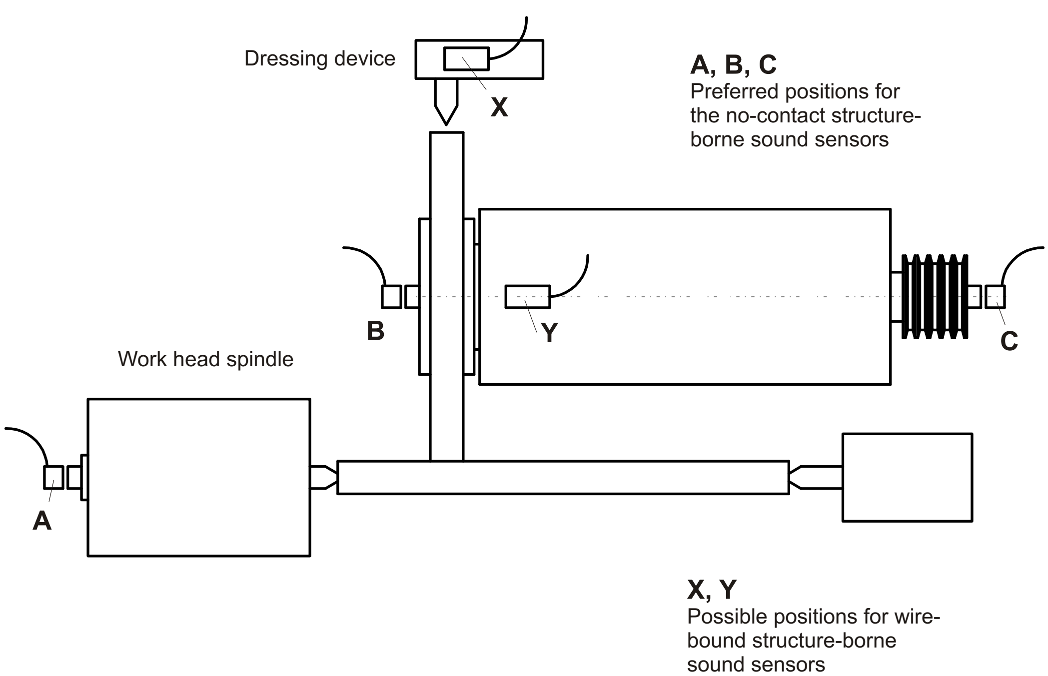
2.3 Crash control (crash monitoring)

It is of course a desire to foresee crashes and to be able to react in time to prevent or at least minimize machine damages.
Structure-borne sound monitoring is a way to meet this desire with certain conditions. The basic assumption is that a crash produces a high structure-borne sound. If the amplification of the signal is set so that during normal grinding the crash level is not reached then the respective level output can be used for crash detection. The corresponding machine input needs to be very fast in order to stop dead all feed functions. Thus the worst can probably be prevented.

Another way of thinking about crash protection:
If a structure-borne sound is recorded during machine operations where dressing or air gap control is **not** in use, then a crash is evident. This scenario is probably a better way for crash protection, since the sensitivity can be set high. Please bear in mind that the reaction time of the machine controller needs to be very quick. It is therefore essential to utilize the fastest input available. Inputs depending on process cycles sometimes have varied and longer reaction times.

3. Positioning of the structure-borne sound sensor

The structure-borne sound is generated when the grinding wheel makes contact with the part. To record a good signal the sensor is placed as close as possible to the origin of the structure-borne sound. To facilitate this, sensors were developed who can transmit the signals over an air gap (1-3mm) to a receiver. This is necessary if the sound sensor needs to be mounted on the rotating grinding spindle. A wire-bound sensor may only be mounted to stationary parts like to the spindle housing for example. In this case, the structure-borne sound has to travel from the rotating spindle via the bearings to the housing and eventually to the sensor. Every transition, especially the bearings, influence the sound like a filter, which is detrimental to our application. Also the bearings generate a certain level of background noise. The structure-borne sound needs to be stronger then the bearing noise to be detectable. The higher the spindle rpm goes the higher the level of the background noise. This illustrates that recording of structure-borne sound becomes problematic with higher rpms and depends much on the spindle bearings.
The selection and position of a sensor and the desired application have to be matched and may need empirical trials.



If a wire-bound sensor is used at the non rotating dressing device, usually a very good signal is available for wheel dressing control. The same sensor at this position however could not be used to monitor for GAP or monitor for crash.

4. System components

A structure-borne sound system consists of a structure-borne sound sensor (wire-bound or no-contact) and a structure-borne sound amplifier or processor with the ability to communicate with the machine controller.

5. Balancing and structure-borne sound combined

The combination of balancing and structure-borne sound processing may be useful in many cases. For instance minimizing connecting cabling or if not enough space for two displays is available at the operators panel. Elaso delivers all balancing heads, if required, with built-in structure-borne sound sensors. A no-contact collector however is essential since the sound signals are not well transmitted by brush-type collector. Accordingly, there are controllers available for balancing only, for balancing and structure-borne sound monitoring, or structure-borne sound monitoring only.

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