Case Study: Machine tool with retrofitted AVR system

Scope

Each manufacturing process is driven by the demand for high-quality goods at minimum costs. When it comes to production equipment, like milling, turning, drilling or grinding machines, the inevitable vibrations originating from the cutting process are one important factor which could limit the above-mentioned goals. The common approach to counteract chatter vibrations is to adapt the production parameters often resulting in reduced material removal rates.

Approach

From a structural dynamics point of view, the conventional (passive) approach to keep vibration levels low is to build a rigid machine with as much damping as possible. Alternatively, active vibration reduction (AVR) systems can be used. Such systems offer an additional degree of freedom in vibration reduction by actively generating motion or forces with a positive influence on structural dynamics. Depending on the implemented control algorithm, e.g. additional damping or counter-vibrations can be generated resulting in the requested vibration reduction.

Active vibration reduction (AVR) system

Such an AVR system consists of at least a sensor, a controller and an amplifier with actuator. The sensor picks up the vibration of the machine, the controller determines the appropriate counteracting signal, which is amplified and fed to the actuator that induces the counter-vibration into the machine.

Machine tool with retrofitted active damping device (ADD)

One concept of AVR is to use an inertial mass actuator. These devices can easily be attached to existing machine tools (retrofitting). For optimum performance, the location has to be carefully selected. A manufacturer of big milling machines wanted to improve their performance with respect to vibrations during machining (chatter). A biaxial 250 N actuator was used for the retrofit. The effect of the controller can easily be seen in Figure 2.
Annotation

How far the limits in a milling, turning, drilling or grinding process can be pushed by integrating an AVR in a structure or by retrofitting an ADD strongly depends on the individual vibration problem (e.g. process, workpiece, material, tool, machine configuration, actuator location). Please contact us for support in selecting, engineering and implementing the right AVR system for your application.