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New Cutting Technology Provides Improved Workpiece Finish and Increased Tool Life

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An innovative cutting tool holder has been developed in Sweden by a team of experts from Blekinge Institute of Technology. Performance results show a marked improvement over traditional tooling currently used for external and internal turning operations. The Acticut® system consists of a sensor that responds to cutting tool vibration and a digital signal processor that calculates feedback signals driving actuators embedded in the tool holder.

Vibration and noise in manufacturing have a degrading impact on productivity, costs, and the working environment. The usable life for a tool used in metal turning operations is often less than 15 minutes before a change must be made. Costs for tool bits and holders are often 5% of a company's overhead.

New Cutting Technology. Acticut represents unique research that can potentially improve metal cutting operations. The method provides the following advantages:

- Faster and more reliable production
- Improved surface finish (see Figure 1)
- Substantial cutting noise reduction (see Figure 2)
- Reduction in tool holder and tool bit consumption
- Effective and robust monitoring
- Rapid return on investment

How does it work? When a tool holder begins to vibrate, the machining process is degraded and results in increased surface roughness, increased noise levels, production interruptions, and increased supply needs. An actuator is embedded in the tool holder for counteracting cutting tool vibration. The actuator(s) and sensor(s) are connected to an adaptive digital controller. Active control of tool vibration is carried out in real-time via the controller using a DSP (Digital Signal Processor).[1,2]

The Control Unit and Active Tool Holder. The brain of an Acticut system is the unit that monitors tool vibration together with a digital signal processor that calculates the proper 'anti-vibration' in real time. The mathematical implementation of this process is a dedicated algorithm that has been developed specially for this application. Figure 3 illustrates the system's basic principle. All elements to counteract and sense the vibrations are embedded in the tool holder so the dimensions of the tool holder have not been altered. The amplifier and on-line control

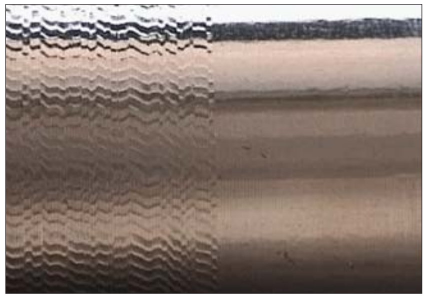

Figure 1. Machined surface with (right) and without (left) Acticut.

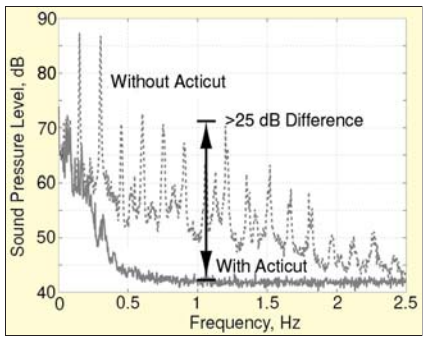

Figure 2. Sound levels before and after the deployment of the Acticut system.

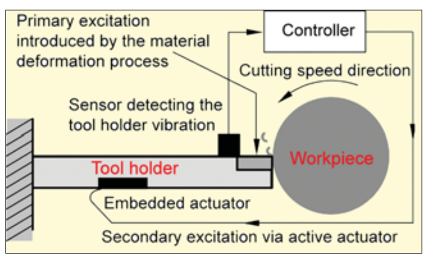

Figure 3. The fundamental principle behind the Acticut system.

system are included in an external unit (shown in Figure 4) that is connected to the active tool holder.[3]

A series of different tool holders such as the one shown in Figure 5 are currently available. Given a specific customer application and using a different tool holder than those available at this time, it is possible to custom design a system for most applications. The Acticut controller is designed with flexible power driving capabilities, and the controller can be easily programmed.

It has been challenging to explain active vibration control in real-time when carrying out metal-cutting operations. The classical approach is to refer to "self-excited chatter due to the regenerative effect or mode-coupling effect." Most text

Figure 4. Acticut controller.

Figure 5. An Acticut tool holder with embedded sensors and actuators.

books covering machine tool vibration are focused on this as the basis for understanding the phenomenon. The development of the Acticut system has proven that a new understanding of cutting tool vibration is needed.[4,5]

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More information on the Acticut® system can be obtained from: thomas.lago@acticut.com or visit their web site www.acticut.com.