

SOUND SHAKES UP MACHINING

By Bill Leventon

With an assist from sound that humans can't hear, machining can be a cooler and faster process—and yield more accurate results to boot.

So say fans of ultrasonic-assisted (UA) machining, the application of intense acoustic waves to conventional metalcutting operations. While the frequencies of these waves can vary, 20kHz is commonly used to stay above the audible range of most adults, according to Matt Short, technology leader for ultrasonics for EWI, Columbus, Ohio, which develops technologies aimed at helping companies bridge the gap between R&D and commercial implementation.

Acoustic waves create an oscillatory motion along the tool axis, which Short described as an expansion



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Acoustech Systems' NRT module drills stainless steel.

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and contraction that displaces the tool tip about 30µm (0.0012"). Like conventional ultrasonic machining, UA machining relies on an ultrasonic transducer to create acoustic waves. But unlike ultrasonic machining, which uses the oscillatory motion of a tool to essentially peck away material, UA machining techniques attempt to keep the oscillating tools—in this case, conventional cutting tools such as drills—engaged with the material during the cutting process, Short explained.

Ultrasonic energy introduced into machining processes changes the physics of these processes in a way that significantly reduces the cutting force, said Short. The lower cutting force reduces the amount of heat and plastic deformation produced during machining, making a tool more effective as it shears material.

"Every year, companies spend millions of dollars on ways to extract heat from the process," Short said. "But ... it is possible to leverage [UA machining] to not create heat in the first place." He added that advantages related to reduced cutting force and heat include longer tool life, finer surface finishes, increased feed rates, tighter tolerances and fewer burrs.

Short believes UA machining is particularly well-suited for aerospace and nuclear applications, which often involve materials such as titanium, stainless steel and nickel-base superalloys. Why? The

heat created by conventional machining produces a grain structure that makes these challenging materials even more difficult to cut, he explained.

For UA machining to work, however, the cutting tool must be resonant within the bandwidth of the transducer and power supply. So tool length and geometry, which

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Machine Technology

impact operating frequency, must be considered when planning a UA machining process, Short noted.

A significant development in UA machining technology, according to Short, is EWI's "ultrasonic machining module." Designed in the form of a conventional toolholder, the module can be attached to new and old machines. EWI's module technology is the basis for the NFP and NRT units from Acoustech Systems, also of Columbus, for multiple-spindle machines and lathes that perform centerline work.

Another option for UA machining is the iVU-5 from Taiwan-based Tongtai Machine & Tool Co. Ltd. The dual-function iVU-5 can operate as a vertical machining center



Absolute Machine Tools

The new iVU-5 from Tongtai can operate with or without ultrasonic-assist.

and perform rotary UA machining.

Rotary UA machining combines high-speed spindle rotation with high-frequency vertical vibration of the cutting tool to reduce the cut-

ting force, boost productivity (in its UA mode, the iVU-5 cuts three to five times faster than conventional machine tools) and impart ultrafine finishes, according to Absolute Machine Tools Inc., Lorain, Ohio, which sells the machine in the U.S.

Applications for the iVU-5 include microdrilling and machining of hardened steel, aluminum and high-nickel alloys. Before the introduction of the iVU-5, "manufacturers would have to use a slower EDM approach for microhole production," said Courtney Ortner, Absolute's chief marketing officer.

On the downside, the iVU-5 costs more than a wire EDM. Then again, Ortner noted, buyers "are getting two machines in one."

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