

Coming: Stable Milling Speeds Determined In The Office

A utility available online may be the starting point toward software that can predict optimal spindle speeds outside the shop, without the user having to test or measure every tooling combination.

By PETER ZELINSKI

You don't have to hear chatter in order to avoid it. The article on page 66 focuses on taking *test cuts*—listening and looking in order to find the chatter-free milling speeds that make it possible to take heavy depths of cut. While this test cutting works fine in moderation, plants using many tools on many different machines will need a more direct approach, or else the requirement to test every combination of machine, tool and toolholder could quickly add up to a lot of test cutting.

Researchers who study chatter in machining do have a more direct approach, which they use routinely. Their "tap test" involves sensors that are affixed to the tool while it is held in the spindle. A light blow from a sensitive hammer rings this setup like a bell, with electronic equipment interpreting the sensors' measurements to graph the frequency response. This graph indicates all of the stable spindle speed values. No machining is required.

Even this approach has drawbacks, though. A shop has to acquire the testing equipment and become proficient in its use, or else the shop has to rely on an outside source for the testing—calling upon that source whenever a new tool or machine is added.

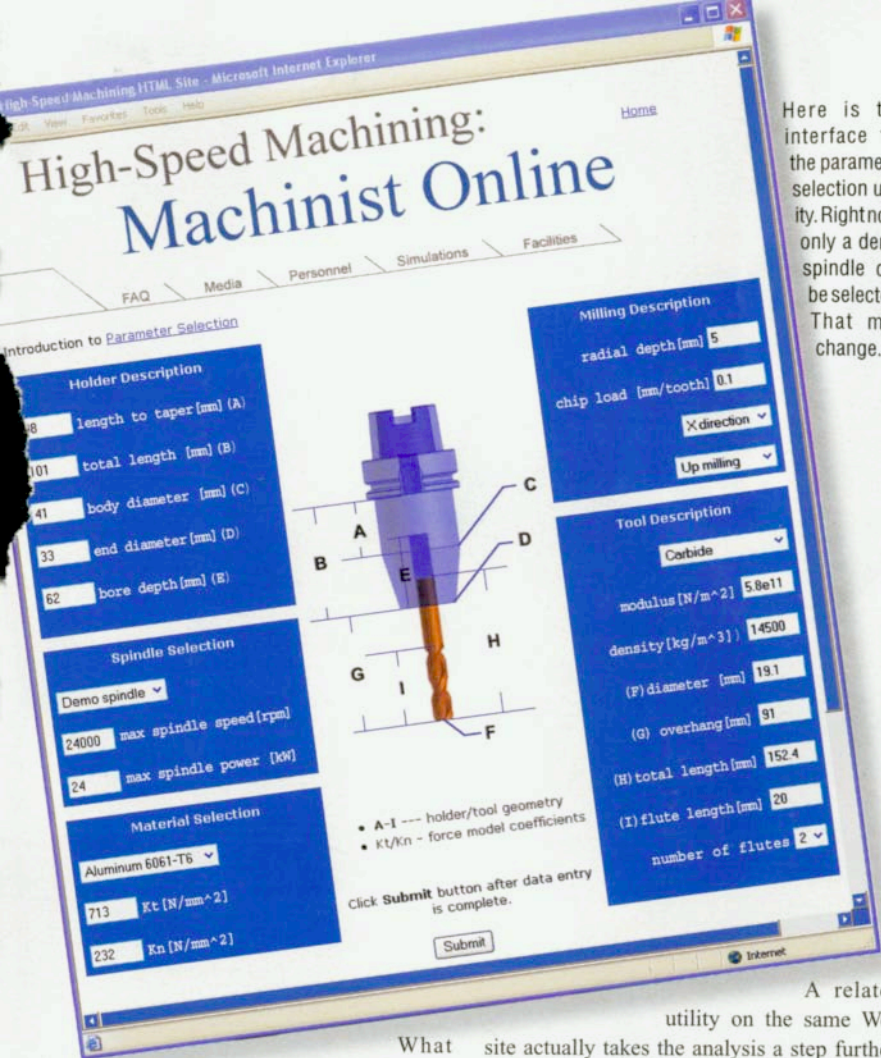
There is also the need to keep track of the results. The shop has to maintain a library of optimal parameters for all of the shop's machine-and-tooling combinations, multiplied by all of the materials the shop wants to mill.

The effort may look daunting.

Tony Schmitz, an assistant professor with the University of Florida's Machine Tool Research Center, thinks he knows a better way. The frequency response of a cutting tool by itself can be mathematically modeled, he says. So can the frequency response of a toolholder by itself. Reasonable assumptions can be made about the connections that hold this tool and holder in place. All that remains is the spindle.

From a practical standpoint, this cannot be modeled mathematically. The spindle is a complex system with significant variations from one design to another. But that's OK, he says. If the spindle by itself can be tap tested just one time—that is, not once for every tooling combination, but just one time—then the frequency response of this spindle can be added to the modeled elements. A software utility could perform the addition. As a result, a CNC programmer could simply select a tool and holder from pre-existing menus in order to obtain the optimal speeds for the machining center that the programmer wants to use.

A utility that works like this now exists. It can be accessed through the University of Florida's Web site at highspeedmachining.mae.ufl.edu. The utility not only recommends spindle speeds, but also asks for information about the workpiece material so it can recommend depths of cut as well. Visitors to the site can try different tool characteristics to see how they affect a spindle's stable machining parameters.



Here is the interface for the parameter selection utility. Right now, only a demo spindle can be selected. That may change.

What the utility cannot do is what you really want it to do. It cannot tell you what speeds to use in your own particular process. That's because the data for your spindles are not in the system.

Dr. Schmitz hopes to see this utility commercialized. If use of the utility is one day sold for practical use, then providing the initial tap test that captures the user's spindle data would somehow be part of the package, he says.

A related utility on the same Web site actually takes the analysis a step further. Even among those shops that know how to realize chatter-free speeds in milling, many fail to appreciate that a tool that is milling quietly may still be vibrating in a significant way. Machining accuracy might be compromised even if the cut is highly productive. Therefore, a companion utility called "GatorMill" (after the University of Florida mascot) predicts the force and vibration that the tool will experience during a particular milling operation. ■