CNC retrofit helps mold shop succeed

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There comes a point in the life of every business when it has to choose between investing in an advanced technology and staying with the tried-and-true—the potential big payback versus the safe status quo. When that choice confronted the owners of Fidelity Machine & Mould Solutions, Calgary, Alberta, they opted out of the status quo and went for a CNC machine control solution from Miceli Technologies Inc. (MTI), Windsor, Ontario.

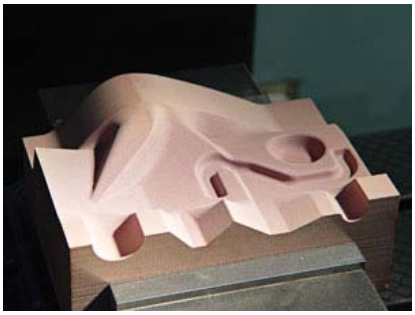
Mechanically, Fidelity's original machines were capable of moving at 300 to 400 inches per minute, but the outdated controllers weren't. MTI's constant velocity controller is built for speed and is appropriate for applications like this: machining strain relief inserts for cable overmolds. Source: Fidelity Machine

The decision brought together four entrepreneurial Canadians, two veteran moldmakers and two machine tool controls wizards. As often happens in business, sound creative decisions sprang from insufficient cash. Retrofitting used but well-cared-for mid-size vertical machining center (VMC) costs about $120,000. That's about one-sixth of the $750,000 installed price of an equivalent new machine, says Fidelity co-owner Jeff Litster, “and that was way beyond our budget. [With the retrofit,] we got a lower-cost machine that will perform better than high-end new machine tools.”

Fidelity chose the MTI retrofit in part because of MTI's “competitive price, [and] the value we saw in constant-velocity cutting,” says Litster. Once the MTI constant velocity controller (CVC) was added to the 10-year-old Fadal VMC, Litster and co-owner Ryan Arsenau almost immediately got the benefits they wanted in productivity, and more. In just a few hours after powering up, for example, everything was running flawlessly. The CVC learning curve also was half what other controllers had required in the past, Litster says.

Speed is the key

The whys and hows of this success have to do with the way a machine tool and its computer numerical control (CNC) work together. The MTI control, developed by entrepreneur Carlo Miceli, represents a third generation in machining's all-important look-ahead capability. Miceli's constant velocity controller can crank up the speed and accuracy of machine tools, even 20-year-old machines. That dramatically boosts the average speeds at which the machines' X-, Y- and Z-axis drives push cutters around workpieces to 300 - 500 inches per minute (or their metric equivalent).



The industry standard Mercedes-Benz test part was used to put the retrofitted machine through its paces. Source: Miceli Technologies

Other gains from the CVC technology include smoother movement, resulting in less wear & tear, better finishes, longer cutter life and faster cycle times; more processing power; and an increase in efficiency due to the ability to run computer-aided manufacturing (CAM) software directly on the controller terminal. Actual machine times approach 90% of the programmed time, as opposed to the previous controller, which may have had machine times as low as 30% of programmed time.

The technology that MTI builds into its CVCs include:

- 8 interpolated axes;
- 50,000 block-a-second program execution versus 2,000 to 3,000 blocks a second in even the best CNCs;
- 80 high-accuracy smart buffers for look-ahead algorithms versus the CNC norm of a few dozen lines of code (in effect, just one buffer);
- 4 million maximum (servomotor) encoder counts a second, a measure of maximized closed-loop feedback, and far more than what is offered in even the best CNCs, says Litster;
- 15-digit motion control accuracy and a minimum resolution of 0.001 micron. Very few industrial systems offer any accuracy and resolution below one micron, he says.

MTI's constant velocity controller (shown) retrofitted to a Fadal vertical machining center produced many benefits, including quicker cutting times. Gains vary widely, but some applications have been up to 70% faster. Source: Fidelity Machine

Needed: Maximum efficiency

Fidelity started with two OKK vertical machining centers, a 1990-model MCV820 and a smaller PCV55 from 1996. “We needed maximum efficiency from them, primarily to keep up with cable-over-molding demand,” Litster says. “Mechanically, these machines were capable of moving at 300 to 400 inches per minute [IPM], but the outdated controllers are incapable of pushing the machines accurately at anywhere near these speeds.”

Litster says cable-over-molding is intricate and challenging work that's always done on tight deadlines. “We found we could not afford to stop production on either OKK for a controller retrofit due to tight deadlines and backlog of work,” he says.

“The shortcoming of the original controllers is their inability to process data fast enough to push the machines to their physical limits,” Litster says. “Also, the controllers were unable to read in large amounts of data at high speeds, which led to data starvation. The machines literally did not know where to go.”

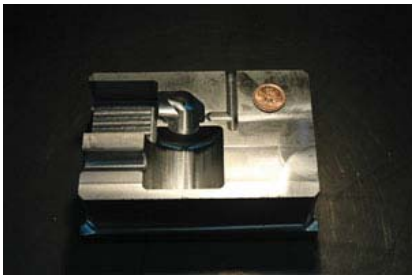
Those difficulties led directly to the retrofit decision. “Carlo [Miceli] said that was where the CVC would really shine, and it did,” says Litster. “MTI gives us unlimited processing and communicating capabilities. We can put any size program we want in there and don't have to worry about taxing the machine or not feeding it with data fast enough.”

Despite the hundreds-of-inches-per-minute speeds offered by CVC machining with look-ahead capabilities, high accuracy is even more important than speed at Fidelity.

“Removing material fast is not our main goal,” Litster says. “Most of our jobs are small. The injection-mold core and cavity for an over-mold are about the size of a paperback novel.” (In over-molding, segments of seismic cable and soldered connectors are fed into the mold tooling and a tough plastic shield is applied against moisture, dirt, shock, strain and stress.) This work is the mainstay of Fidelity's business.

These small blocks—often 6 by 8 by 3 inches—“actually present more of a problem than most machining,” Litster says, “because there is so little working area inside the core and cavity. Small cutters and tight radii often present more of a challenge and more difficult geometry, and smaller cutters are far less forgiving.” Fidelity uses ball-nosed cutters as small as 0.015 inch in diameter.

A larger mold with more open areas would be much simpler to program. “This is machining with almost no clearance for the cutter,” Litster pointed out, “so extremely precise control of all cutter movement is essential.”



Small blocks present more of a problem than most machining, because there is so little working area inside the core and cavity. Small cutters can be far less forgiving. Source: Fidelity Machine

Finishing vs. roughing

Fidelity also makes tooling for several other types of molds and surface finishes are always critical. Any imperfection in the molding surface will be picked up in the finished product—and rejected by customers. “In finish machining we need the smoothest possible motion,” he explained, even though they are taking small amounts of stock with each pass and shallow cuts.

"We usually feed much faster when finishing than when roughing," Litster added. "There are still CVC benefits when roughing, but for us those are not as large as in the finishing. Only about 10% of our cutting time is in roughing."

Perhaps the most important thing about the MTI controller is that it lets Fidelity program cutter paths with tighter tolerances, which provides more control over the cutter and better finishes. "On the other machines," Litster says, "we have to open up the tolerances and slow down so much to keep them from violating the surfaces."

Also a factor in Fidelity's decision to chose the MTI controller was the feeling of being gouged on price for a replacement circuit board for the larger of the two OKKs. "The control builder told us it was $9,000, take it or leave it," Litster recalls. "We had no choice but to pay. Everything in the MTI control is readily available hardware."

Litster says other benefits of the CVC include the following:

- Cut times are down by as much as a third. Some one-hour programs now run in 40 minutes, with better surface finish and longer cutter life;
- Gains in some cutting applications as high as 70%;
- The ability to install CAM software on the same CPU and interface as the controller. That not only cuts down on travel time between work centers and machines, but also eliminates any reason or excuse to run a program that is less than perfect.

"This increases efficiency, certainly, but it also helps the operator understand the cutting tool and program limitations better," Litster says. "That helps us program closer to target parameters the first time around." There is also an intangible result, he says: "I notice a rise in our confidence that we can meet customer demands for quality and appearance of our finished parts."

For more information, visit:

http://www.fidelitymachine.ca/