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Boosting automation and reducing lead times of complex parts on Citizen lathes

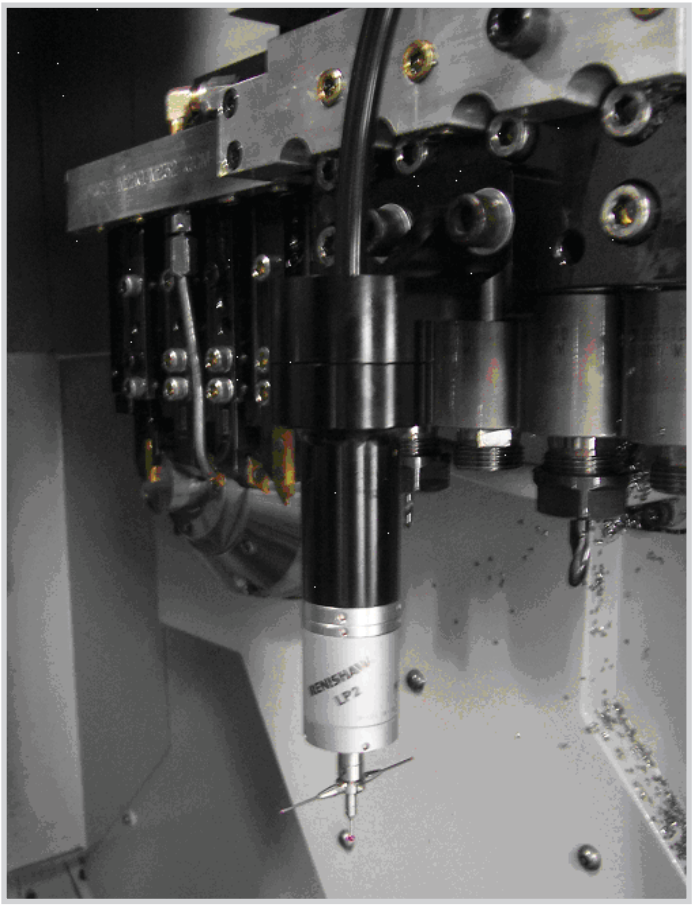
At MACH 2008, Renishaw (stand 5140) and Citizen Machinery (stand 5260) are showcasing a revolutionary new approach to setting and controlling complex machining processes on sliding head lathes. Currently, on trial in its own machine shop, a new approach to on-machine probing is helping Renishaw benefit from dramatically reduced set times and the confidence to run 'lights out' on even the most sophisticated parts.

Renishaw has used Citizen sliding head lathes for over 20 years and has nearly 30 such machines in its state-of-the-art machining facility at Stonehouse in Gloucestershire. These include ten Citizen M32 machines, which feature powered tooling on both a turret and a platen, enabling cross working on both main and opposed spindles. This capability is used to produce the increasingly complex parts that comprise the company's world-leading metrology systems. With its designers specifying more milled profiles and aiming for fewer, smaller, more elaborate parts in its latest products, Renishaw intends to overcome the challenge of achieving its efficiency and cost targets by employing this new in-cycle gauging system on this class of machine tool.

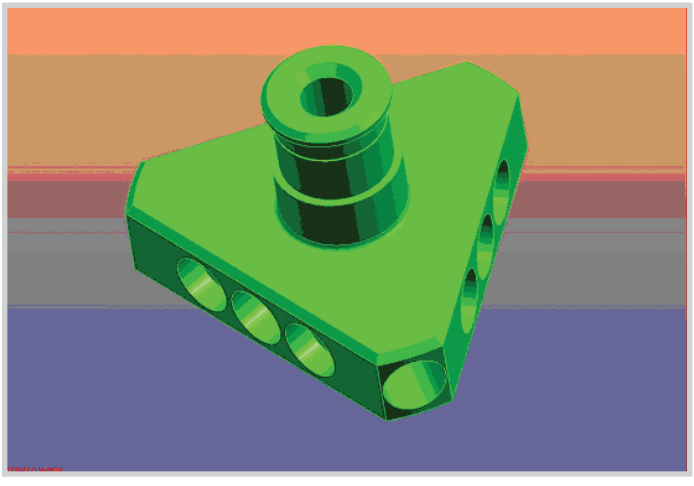
Paul Maxted, Principal Manufacturing Engineer, explains the problem. "As the feature count and level of milled features has risen, we've experienced longer set times as our setter-operators have tried to optimise the process. Although we have automated set-up and process control on our machining centres, on the Citizens we have traditionally made a complete part, checked it on a co-ordinate measuring machine (CMM), interpreted the results and then updated process parameters. This is obviously manually intensive and can be prone to human error. It's not unusual for us to take five to ten attempts before we get all the features in tolerance. Set times are typically several hours, with the worst examples taking even more than an entire shift to complete. These long set times impacted on our productivity and caused us in some cases to run larger than ideal economical batch quantities."

Automated tool offset updates

With tooling stations on these machines at a premium, Paul Maxted developed a mounting bracket on top of the platen for a probe with a special 'T' stylus. Unlike probes mounted to a fixed headstock, the platen mounted probe can move in all three linear directions, allowing routines to be carried out that check part position and verify part size, including cross and axial features.



Platen-mounted probe with a 'T' stylus can access all features on complex parts.



A typical complex part with milled profiles and cross-working features.

The specially designed probe and stylus configuration also allows comprehensive measurement of all drilled, milled and turned features on main and secondary spindles.

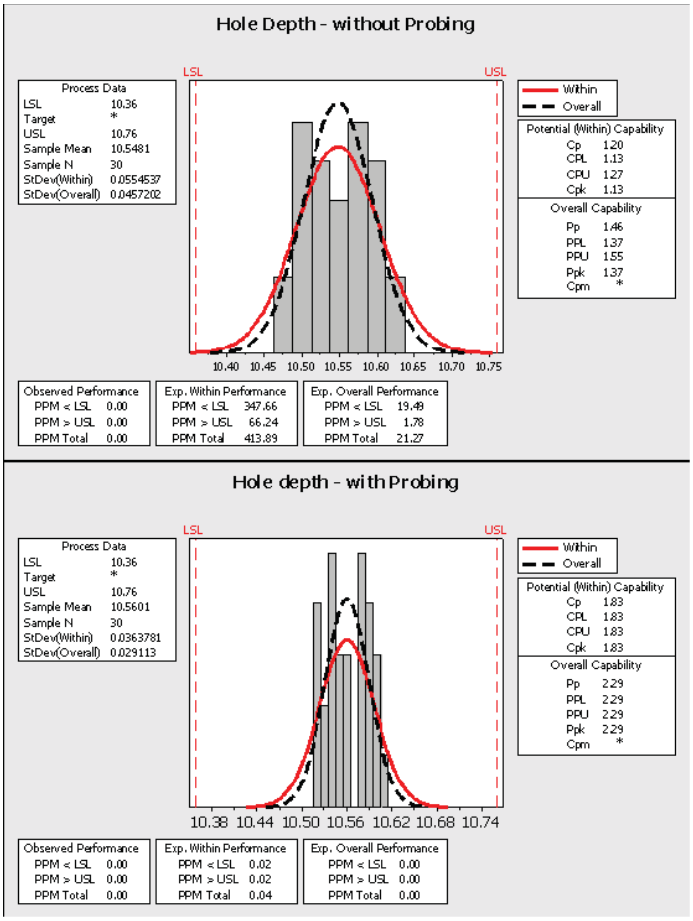
Instead of machining the first part complete, each tool is brought out and performs its work, followed by a rapid probing routine that directly measures the tool's performance and updates the tool offsets without operator intervention. Roughing and finishing tools are measured and individually updated so that each is optimised.

Paul Maxted explains some of the other benefits of probing on sliding head machines. "It's invaluable to measure each tool's performance there and then, on the machine. Firstly it's automatic, but just as importantly, we get a better understanding of the cause of process variation and can therefore better control its effects. Roughing and finishing tool performance is inter-related, so it's vital to control each to get the optimum process precision. When you measure offline, you immediately lose the association of the part with the machine tool as you measure everything from a part datum – if that's wrong then the other feature positions will appear wrong too. In contrast, on-machine probing gives you full traceability and the means to address problems at source."

Although the cycle time to make the first part is longer with probing, what happens next makes all the difference. A second part is made using the new process parameters to prove that the process is set correctly, and then production can start. This compares to numerous manually intensive 'measure, interpret, update, re-machine' loops using traditional methods. Probing has given set-up reductions of several hours in some cases, reducing setting costs and boosting productivity.

In-process control

The other major benefit is realised once production starts. The probe is used to measure each tool on a sample basis, with the frequency determined by the tolerance that must be achieved. With each source of variation under independent control, and with fully automated checking and immediate feedback, genuine 'lights out' production can be achieved. What's more, the in-process control reduces the level of part-to-part variation and keeps processes on centre in the face of tool wear or thermal drift, resulting in improved process capability.



Significant improvements in process capability resulting from automated in-process control.

"Early indications from production testing have confirmed that the anticipated improvements in process capability will be achieved on turned and milled features, with Ppk figures up to 2.00," declares Paul Maxted. "Such figures have traditionally given us the confidence to run unmanned, matching the high level of automation that probing has given us on our other classes of machines."

The technology demonstrator can be seen on a M32 machine on the Citizen Machinery stand (5260) at MACH 2008, which is being held at the NEC from 21st to 25th April 2008. Manufacturers making complex parts on sliding head machines who need improved process performance and traceability shouldn't let this new technology slip by!