■ Micropulse Incorporated, Columbia City, Indiana

Surgical Precision

Orthopedic implant supplier uses Sinumerik CNC and Simodrive linear motors to automate surgeons' spare parts production.

The manufacture of orthopedic implants and the tools used by surgeons is a specialist field calling for high grade materials and high manufacturing standards. Examples of these products are replacement knee joints, hip and shoulder components and the reamers, rasps, broaches and other metal cutting instruments used in surgical operations. They have transformed many people's lives in the modern world who would otherwise have suffered continuous pain and disability. Orthopedic implants are made from various special materials including titanium, stainless, cobalt chromium, zirconium and now Nitinol, a nickel-titanium derivative that possesses 'shaped memory' and behaves in a manner similar to human muscles.

The highly complex surface of this hip broach was traditionally machined and inspected on separate machine tools at every step. Micropulse now produces the finished part in a single set-up on the Schütte cutter grinder

Many companies in the orthopedic field in the United States are located around Warsaw, Indiana, one of which is Micropulse Inc. One of the problems faced by Micropulse and its competitors is the short production runs required for many products despite requiring a highly rigorous R&D and prototyping process. To manufacture products such as a knee joint or hip broach, a precision textured surface surgical tool used to prepare a hip joint for an implant procedure, Micropulse performed five-axis milling, grinding, belt sanding and polishing operations. These processes were carried out on individual machine tools, which was slow and costly. The key was to introduce more automation into the process by the use of a new complex multifunction machine with Sinumerik 840D. The Sinumerik CNC provides a complete digital system for complex machining with fine dynamics and precision, offering a wide range of specialized functions for drilling, turning, milling, grinding and handling technologies. It also supports nibbling, punching or laser machining technologies.

Universal machine

The machine selected by Micropulse was a Schütte WU 305 Linear universal tool and cutter grinder. The Schütte WU 305 combines milling, grinding, belt sanding and polishing on one pendulum slide with true rotary five-axis capability and sophisticated Sinumerik CNC. The Sinumerik system provides the flexibility and open architecture to support all functions of the machine together with the various proprietary part design and machining programs used by Micropulse and its customers. A ball-screw version of the WU 305 had been on the market for several years, but Micropulse selected a new version of the Schütte cutter grinder with Simodrive 1FN3 linear motors on all five axes. The availability of the linear motors was a key factor for Micropulse.

Linear power

The linear motors are part of the Simodrive series of drives designed to interact with Sinumerik controls to achieve high contour precision and fast operation. The drives have a low moment of inertia and there-

Pictures: Siemens Energy & Automation, Inc.

The Schütte WU 305 Linear universal CNC cutter grinder performs milling, grinding, belt sanding and polishing all in one operation

fore operate with enhanced dynamic response and always produce maximum torque, even at zero speed. The use of powerful rare-earth magnetic materials enables operation at high power densities. As a result, velocities of up to 300 m/min and accelerations of up to 45 g are theoretically possible.

The five-position wheel changer and five-axis pendulum slide enable the Schütte machine to produce in one operation the sophisticated surface profiling Micropulse needs. This results in a major saving in set-up time versus going from machine to machine. Micropulse has found the Sinumerik 840D is the only CNC control fully capable of processing the software for the cylindrical grinding on their cutter grinder.

Custom programs

A typical job run by Micropulse on the Schütte machine might involve a Pro-E, Mastercam, Unigrafix or SolidWorks program. Usually, a working model is supplied by the customer, which is then analyzed by the production engineering team at Micropulse. Changes might be recommended, based on the machinability of the material, the particular configuration of the part or the process flow aspects of the job. The program is modeled for the SIGS (Schütte Integrated Grinding Software) program onboard the machine, which utilizes CGTech's Vericut machine optimization and part verification process. These programs accommodate the machine's kinematics to ensure high quality tool paths and avoid errors. The lockout keys on the Siemens control, limit access to machine functions. This prevents any changes to the machine functions or the software on the cutting program, except by the dedicated operator and other authorized individuals. This is important for Micropulse because of the very expensive materials used and the highly proprietary nature of many customer parts. The Siemens control and drive packages work in concert to maintain superior speed and accuracy. The large look-ahead feature keeps the speeds optimized, while both the hard and soft set-up times are reduced because of the integration software and the plain language inputs. The acceleration-dependent feed-forward control eliminates contour deviations which can be caused by following errors, for example. This results in the utmost precision even at a high tool path velocity.

Introducing the CNC controlled Schütte machine and automating its production processes has enabled Micropulse to enter the knee joint, hip broach and other end product market areas where previously it had not been competitive. Consequently, Micropulse has enjoyed substantial business gains both from old and new customers. Micropulse already runs three shifts at its 60,000 sq. ft. facility and further expansion is planned for the near future. ■

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