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Reaction

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Reaction

News for the metalworking, metrology, toolmaking, automation and motion control industries

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Renishaw leads a measurement revolution

New five-axis scanning system measures at up to 500 mm/second

Renishaw is claiming the most significant advances in co-ordinate measuring machine (CMM) technology for 20 years with the recent introduction of revolutionary five-axis scanning techniques. Renscan5™, a new enabling technology that will allow highly accurate, ultra-high speed five-axis scanning measurement on CMMs, and REVO™, the first in a family of revolutionary measuring head and probe systems, will redefine the industry standard for scanning systems.

The introduction of Renscan5™ technology allows the development of a range of breakthrough five-axis scanning products that will measure at speeds of up to 500 mm/second, and virtually eliminate many of the measurement errors normally associated with existing three-axis scanning systems. A five-axis system achieves this by allowing the lighter measuring head to perform most of the motion during inspection routines, minimising the dynamic errors caused when moving the larger mass of a CMM's structure. Renscan5™ will be available with Renishaw's new UCC2 universal CMM controller that forms the foundation for Renishaw's future high speed scanning systems.

The first product to take advantage of the new Renscan5™ technology, is REVO™ which will maximise inspection throughput whilst maintaining a high-level of system accuracy. REVO™ uses synchronised motion when scanning to quickly follow changes in part geometry, without introducing its own dynamic errors. This allows the CMM to move at a constant velocity along a vector whilst measurements are being taken, removing the inertial errors that result from acceleration of the machine during conventional 3-axis feature scanning.

The REVO™ measuring head features ultra-stiff spherical air bearing technology in its two axes which are driven by state-of-the-art brushless motors, linked to 0.08 arc-second high-resolution encoders. A key benefit of this technology is easier access to features to be measured, due to infinite rotation and infinite positioning capability.

A highly innovative probe mounted on the REVO™ measuring head further minimises the errors caused by the dynamic effects of high-speed motion and allows the use of long styli without reducing accuracy. A laser light system is used to accurately measure the exact position of the probe tip, with a beam of light directed from within the probe's body down a hollow stylus to a reflector at the stylus tip. Unlike conventional styli that need to be very stiff, the new hollow stylus is designed to bend, thereby deflecting the return path of the laser beam which is monitored by a position sensing detector (PSD), also mounted in the probe's body.

Movement of the laser spot on the PSD is translated into a measurement output by combining it with information about the geometry of the measuring head and probe and each of the CMM axis scale outputs. Therefore, the exact stylus tip position can be calculated. With no inertial effects on the laser beam, measurement accuracy is maintained at high speeds.

New tool recognition technology for high-speed, reliable broken tool detection

Machine shops all over the world are regularly faced with the problem of broken tools during production.

Identifying where and why the tool was damaged can be problematic, whilst scrap, re-work, machine downtime and delay are all additional factors contributing to a reduction in productivity and an increase in cost. By using a tool breakage detection device, productivity and profitability can increase whilst scrap, rework and downtime become a thing of the past.

Conventional non-contact broken tool detection systems depend on the laser beam being blocked (tool OK) or not blocked (tool broken). The new TRS1 is different. It offers benefits beyond other tool breakage systems, as it does not merely look for a change in light levels.

The new tool recognition technology distinguishes between the tool and coolant or swarf, whilst it is also fast and reliable under real machining conditions.

Renishaw's new system projects a beam of laser light at the tool and monitors the scattered light that is reflected to determine if the tool has been broken. This recognition process ensures that individual tools can be rapidly checked at the beginning or end of a machining cycle.

The device comprises a single unit containing the laser source and detection electronics that enable the TRS1 to be mounted outside of the working envelope, safe from collision and saving valuable space on the table.

The TRS1 can be mounted on any rigid surface on the machine, as the positioning of the device relative to the tool is not critical. It is simple and quick to set up, as it does not require accurate alignment with the machine's axes.

Cost effective, fast and reliable, the single-sided device can detect tools as small as Ø0.5 mm, with the tool typically spending about 1 second in the laser beam. The TRS1 can detect a whole range of solid centre tools, including drills, taps, end mills, slot drills and ball nose end mills.

The compact unit can detect tools between 0.3 m and 2.0 m away, making it suitable for a wide range of machines.

Driving hard for quality and cost reduction

Nissan saves £250,000 and achieves zero scrap with Renishaw probe systems

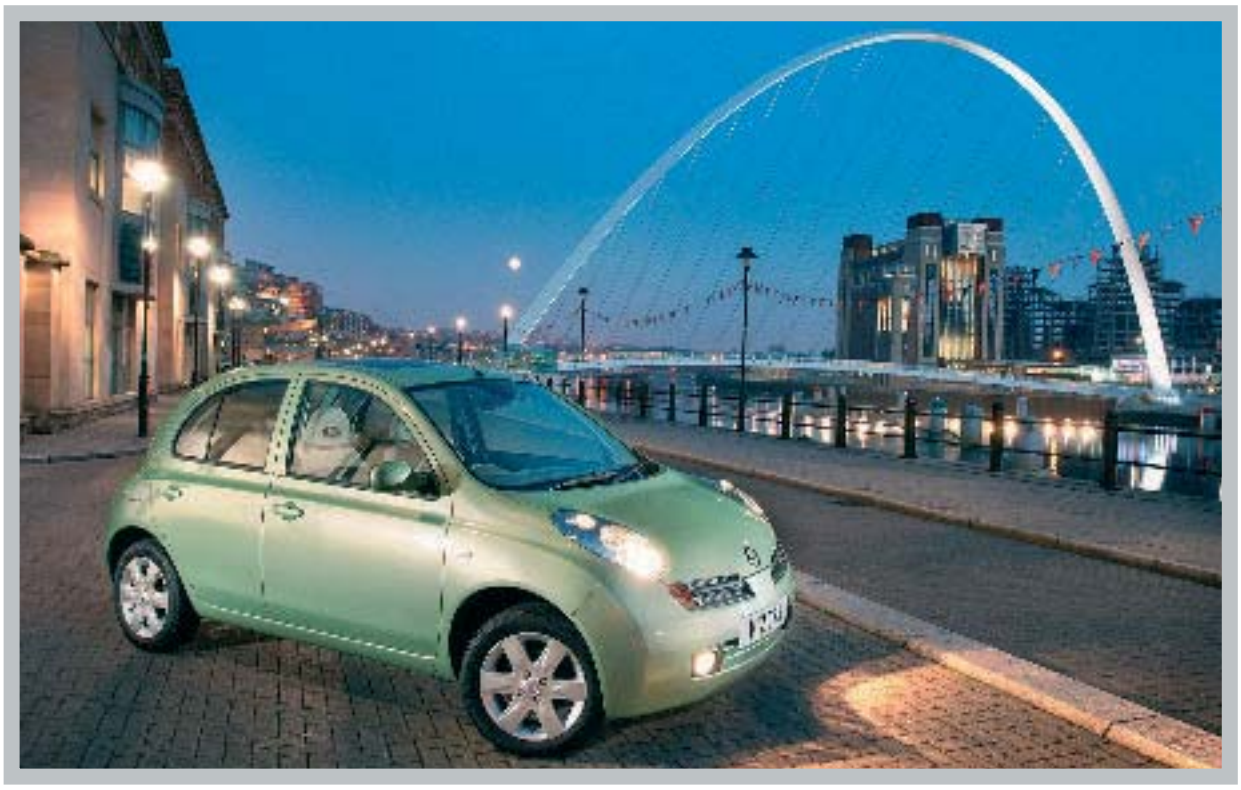
The Nissan plant in Sunderland, UK was established in 1986, with two dedicated camshaft production lines following in 1991. Nissan's continual development of new car models and wide variation in engines meant that a completely fresh approach had to be taken in 2001 to meet future production needs.

The current lines could not manage the complexity of the new generation of camshafts so a process was designed that replaced two dedicated camshaft lines to form one flexible line.

The new line occupies half the floor space of the two originals whilst maintaining the same output. In 2002 there were fourteen variants of camshaft through the new line, now there are six.

The initial quotation for a stand-alone flexible gauge to cope with the vast differences was £250,000, so an upgrade on their four existing Okuma lathes was considered as the dedicated machining techniques already produced good quality components. For each machine tool, a Renishaw LTO2S probe system turret mounted probe was proposed that would utilise the lathes' flexibility to manage the number of variants, and worked out at a total of only £20,000 for the four machines. These old machines have been given a new lease of life because they now have intelligence via the probe and can therefore react to issues as they arise.

The key areas of success are in part set-up and post-machining sample inspection, where new processes have had a dramatic impact on scrap levels. Nissan is quite happy to make a bold statement that there has never been a scrap component on these machines as a result of this process, out of 550,000 camshafts a year. The company is now nearing something of a milestone, anticipating that it will have produced some two million good parts.



Probe use becomes standard practice

Each CNC lathe has a permanently attached document that details the use of the measurement system within the manufacturing process, acting as a constant reference for every operator. The document lists the four key reasons to trigger post process measurement using the Renishaw probe:

1. Maintain general quality i.e. measure key features at a set frequency (20 parts).
2. Tool change. The tool management system on the lathe is interrogated every cycle to determine a full change or a single change. A full tool change will result in the measurement of all features whereas a single tool change will only measure the relative feature machined by that tool.
3. Variant change.
4. Start of shift or first off part. The part counters on the lathe are monitored every cycle. This is particularly important when the machine is started from cold on a Sunday night.

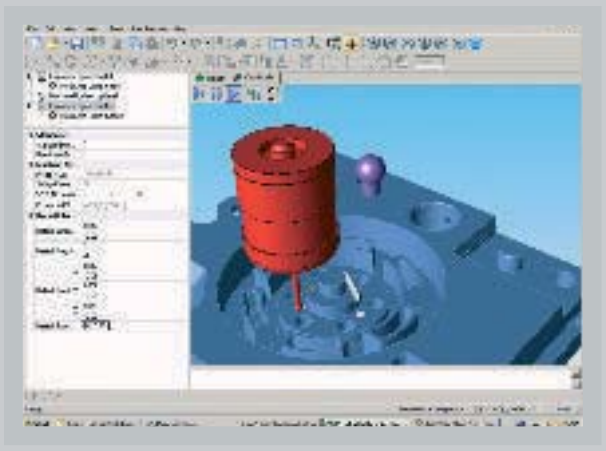
With the dramatic improvements in Nissan's manufacturing capability, and the integration of probing as standard practice, any initial resistance now seems a distant memory.

Nissan's Sunderland site and the camshaft line

The vast Sunderland site encompasses most of the manufacturing processes necessary to build and assemble all the piece parts for Nissan cars, whether within Nissan itself or through the multiple independent parts suppliers located around the perimeter.

NEW

Developing powerful probing routines via a CAD interface



Productivity+™ Active Editor Pro is part of Renishaw's new generation of easy-to-use probing and process control software which targets the entire spectrum of machine tool probe users. It can be used to develop powerful probing routines for both contact and non-contact laser probes, including tool setting, tool breakage detection, part set-up, part inspection and probe qualification.

The software is an all-in-one, independent solution for producing probing cycles remotely from the machine tool via a CAD interface that allows features to be identified with a single click, and a drag-and-drop interface that uses the measured data to update machine parameters. It removes the need for specialist knowledge of probing macro commands which vary by machine controller, a time-consuming way to produce probe routines.

Using Productivity+™ Active Editor Pro, existing machine programs for cutting cycles can be read and probing routines added at the correct point in the program, removing the need for cutting and pasting into text editors or on machine editing. Features can also be selected directly from an imported CAD model, making the generation of probing cycles even easier. For users without an existing CAD system, Productivity+™ Active Editor Pro allows the design of probing cycles using dialogue-based feature selection.

Once the programs are complete the routines may be fully simulated to identify errors and detect potential crashes, and then post processed for a wide variety of control systems. Productivity+™ Active Editor Pro operates with the popular Parasolid™ format. Postprocessors are available for Fanuc-type, Heidenhain, and Siemens controllers.

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New infinitely positioning probe head for DCC CMMs offers flexibility and future proofing

NEW AVAILABLE SOON

Gyro™ is an addition to Renishaw's Renscan5™ family of dynamic measuring heads, championed by the unique Revo™ head. Gyro™ is a unique and versatile measuring device available in three levels of functionality, providing measurement solutions from touch trigger probing to full 5-axis scanning, at speeds up to 500 mm/sec

Gyro™ with touch trigger probe functionality is a product with the ability to operate at 500 mm reach. Following a five-minute probe calibration, the head can be used at an infinite range of angles without the need for further qualification, saving users hours of set up times.

Using Gyro™ with an additional Renscan3™ software upgrade will allow users to access 3-axis CMM scanning functionality. This gives far faster data capture rates than single point measurements.

For ultimate accuracy and speed, a Renscan5™ software upgrade will gain access to full 5-axis scanning. The advantages provided by a 5-axis system using Renscan5™ technology are primarily the elimination of the dynamic errors caused by the mass of the moving CMM structure, and significantly faster scanning speeds by using the motion of the head.

Gyro™ Touch trigger

Gyro™ Renscan3™

Gyro™ Renscan5™

How to prosper as a UK machining sub-contractor

Castle Precision operates high-efficiency, high-productivity CNC machining

The directors of Castle Precision have embraced the latest technology in every discipline, but not for the sake of it – this is technology applied so effectively that in some cases 'wasteful' operations have been reduced by over 80%. As an example, Renishaw probe systems on Castle CNC lathes have reduced inspection times from about 35 minutes to less than six minutes.

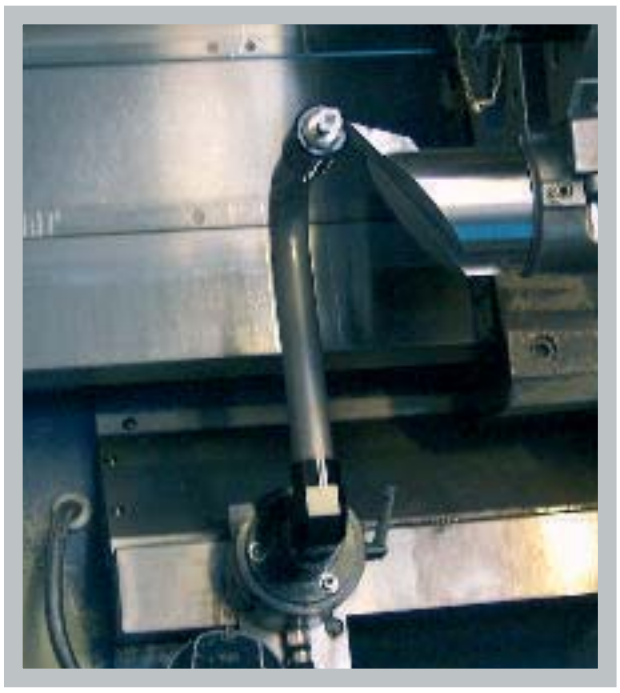
UK machining companies can learn a lot from Castle Precision – anyone who visits its plant is almost certain to feel inspired when they leave. It is difficult to cover every high-efficiency aspect of this company that also excels in areas such as production scheduling, machining operations, time recording, computer systems, invoicing and sales contact management.

Build quality in; don't inspect to achieve it

Renishaw has been involved with Castle, and has closely supported the company for over 20 years. Chairman, Marcus Tiefenbrun comments "I firmly believe in the principle of building quality in, not inspecting to achieve it. Renishaw probing is central to that manufacturing philosophy and throughout our use of CNC machines we have had a close relationship with Renishaw – the flexibility and willingness to assist has always been outstanding."

In 1984 a Mori Seiki 6-pallet machining centre was delivered fitted with Renishaw spindle probing. Although the software was limited at that point, the probe proved extremely useful for datuming all jobs – Castle had no doubts in fitting every new machine, from that point on, with probing retrofitted by Renishaw as standard.

Spindle probing is well accepted on machining centres but Castle have also demonstrated how effectively it can be used on CNC lathes for set-up and inspection tasks. Director of Engineering Alex Skinner, who, together with Marcus Tiefenbrun, has provided the inspiration behind the drive for technology, explains why this process in particular demonstrates how efficiency gains can be made.



"On one component we used to spend 35 minutes on in-process inspection – this had to be improved. It was manually loaded and had to stay in place, effectively part of the machining cycle, so the machine was stopped, not producing parts, for the whole of the in-cycle inspection. The inspectors would measure a particular thin-walled feature, decide whether or not it met specifications, pass or fail the part, and then not even record the measurements they had taken! We replaced this with a probe cycle, reducing the inspection cycle to about 6 minutes. The measurements taken are recorded in an SPC package and kept on record. We can tell instantly the measured dimensions of every part we have made over the last 5 years!"

Intelligent decisions with probing systems

That's not the end of the story. Alex Skinner continues, "We decided to use the probe to make intelligent decisions. The measurements are used to update offsets, these offset changes are downloaded and recorded to monitor and control the process. We have been able to significantly reduce human intervention, so now each operator often runs two machines instead of one."

Marcus Tiefenbrun has no doubts about the impact of the probe systems on his business. "The biggest benefit is the reduction… no, it would be more appropriate to say total elimination, of all offset problems. The second biggest is the de-skilling of the operations. We have also found that when our customers look closely at the processes we employ they are very impressed, going away with the confidence that the process is under control."

Passion for efficiency

It is very difficult to sum up a company like Castle, which has transformed itself from a 1960s company, dependant on production of low-cost parts for companies like Massey Ferguson, British Leyland and Singer (they even made parts for the Hillman Singer gearbox), to such a specialised high-tech company. It really comes down to three words – control, quality and efficiency.

Compact NC4 expands Renishaw's highly successful range of high performance non-contact tool setting systems

The NC4 laser based non-contact tool setter, is a part of Renishaw's growing range of non-contact solutions for a wide variety of machining centres. Now, Renishaw has added to the NC4 product range with a series of compact fixed systems.

The F95, F115 and F230 compact NC4 series, set new performance standards in a small package, with measuring gaps of 23 mm, 55 mm and 170 mm respectively. Tools as small as 0.03 mm diameter can be measured and detected at any selected point along the beam and repeatability can be as low as ±0.1 µm (2 σ).

Available as fixed or separate system variants, the NC4 incorporates the unique MicroHole™ protection system, as featured in all Renishaw non-contact products. Environmental protection is maintained 100% of the time, even during measuring routines, and with no complicated moving parts, risk of machine downtime is minimised.

In addition, the NC4 benefits from the innovative failsafe PassiveSeal™ which maintains IPX8 environmental protection rating, even if the air supply fails. In common with other models in the NC4 range, there is no focal point to identify, making installation quicker and easier.

Precision optics are supplied as standard, enabling this compact series to achieve un-surpassed performance, in a unit particularly suited for small machines and machines where space is at a premium. Custom made 'air blast' solutions are also available on request to ensure tools are clean before probing commences, thus providing outstanding performance and reducing manual intervention.

THE QUEEN'S AWARDS FOR ENTERPRISE 2002

NEW

New compact probing system for machining centres and mill-turn machines

NEW

Renishaw's new OMP60 probe is the first of a new generation of optical transmission products designed for compatibility with all current Renishaw optical receivers and next generation optical systems. It brings the benefits of probing to a wide range of machining centres and mill-turn machines, offering users set-up time reductions of up to 90%, reduced scrap, reduced fixture costs, and improved process control.

The OMP60 probe is compatible with existing OMM/MI12 and OMI receivers, enabling current MP7, MP8, MP9 and MP10 system users to benefit from some of its innovations. It uses miniaturised electronics, first seen in the highly successful OMP40 probe, allowing the development of a compact unit measuring just ø63 mm and 76 mm long, making it ideal for a wide range of machines.

The OMP60 probe can also be combined with the new OMI-2 integrated receiver and interface. Utilising state-of-the-art modulated optical transmission, the system offers the highest level of resistance to light interference.

The OMP60 features a 360˚ infra-red optical transmission system with a range of up to 6 metres, allowing probe operation in any spindle orientation. The result is simplified system installation and set-up on machine tools, making the OMP60 suitable for retrofitting to machines without existing probing.

User-programmable parameters for multiple turn-on/turn-off options, makes the OMP60 simple to optimise for specific machine applications. The probe is programmable through Renishaw's proven trigger-logic, a unique and simple programming method, allowing users to program probe options without accessing probe internals. This eliminates the risk of subsequent damage due to coolant and debris ingress.

Designed to withstand the harshest machine tool environments with IPX8 standard sealing, and also highly resistant to false triggering induced by shock and vibration, the OMP60 can be used with high-speed, single touch or double touch probing routines.

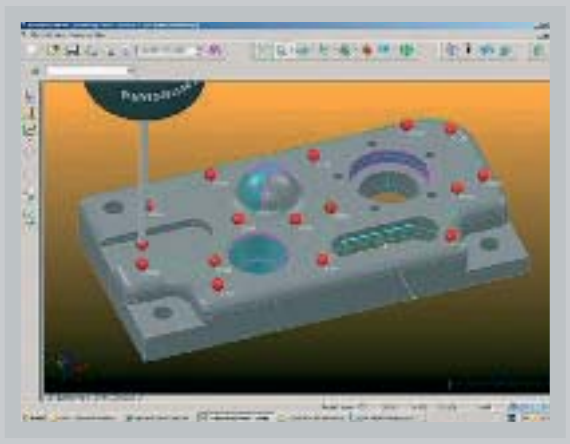
NEW

New software allows CMM style 3D inspection on CNC machine tools

Renishaw OMV (on machine verification) is a new software package for machine tool users, which gives powerful co-ordinate measuring machine (CMM) style 3D verification against a CAD model. The software is targeted at manufacturers of complex and large parts, such as mould tools, and combines freeform and geometric features. A straightforward point-and-click approach means that the user can see the inspection path as it is generated, and make changes if required.

Using Renishaw OMV for inspection allows manufacturers to detect errors earlier and correct them before the parts are removed from the machine tool. The ability to check that the part is reaching specification at various stages of the manufacturing process will save time, reduce the amount of scrapped components and increase confidence.

In combination with Renishaw's RENGAGE™ spindle touch probes, Renishaw OMV provides unrivalled accuracy of part verification on machine tools. Non-lobing, high accuracy RENGAGE™ probes, such as the MP700 and new OMP400 ultra-compact touch probe, are ideally suited to the 3D inspection routines made possible with Renishaw OMV. Surface data is measured and sent to a PC, where powerful CMM-style measurement algorithms process the data.



Features such as multi-point circles, cylinders, cones, spheres and planes, can now be measured to a high degree of accuracy, and powerful 'best fit' algorithms match groups of measured data to the model, reducing the deviations and errors, by removing alignment and datum constraints.

Renishaw OMV gives clear graphical displays of measured deviations and errors on the CAD model, indicating whether a measured point is in, above or below tolerance, and can produce a 'colour map' of the accuracy of the component. Powerful tolerance inspection reports provide formal documentation of the component's geometry, which can be combined with views of the CAD model.

Native CAD files that can be used with Renishaw OMV include Auto CAD's DXF and DWG formats, Catia, SDRC, Unigraphics and Pro/Engineer, as well as the standard formats of IGES, Parasolid, STEP and STL. The software runs on a wide range of machine tools, including those fitted with Fanuc, Mazak ISO, Pro3, Yasnac, Hitachi Seikos, Mitsubishi, Siemens and Heidenhain controllers.

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Renishaw retrofit greatly improves productivity and performance of an existing large CMM at John Deere

When faced with increased production at John Deere's construction and forestry products manufacturing facility in Davenport, Iowa, USA the company also had to address resultant capacity challenges to keep up with component verification. To meet these challenges, including the measurement of very large parts, an upgrade of its existing CMM by Renishaw has led to 'lights-out' inspection coupled with a major increase in productivity.

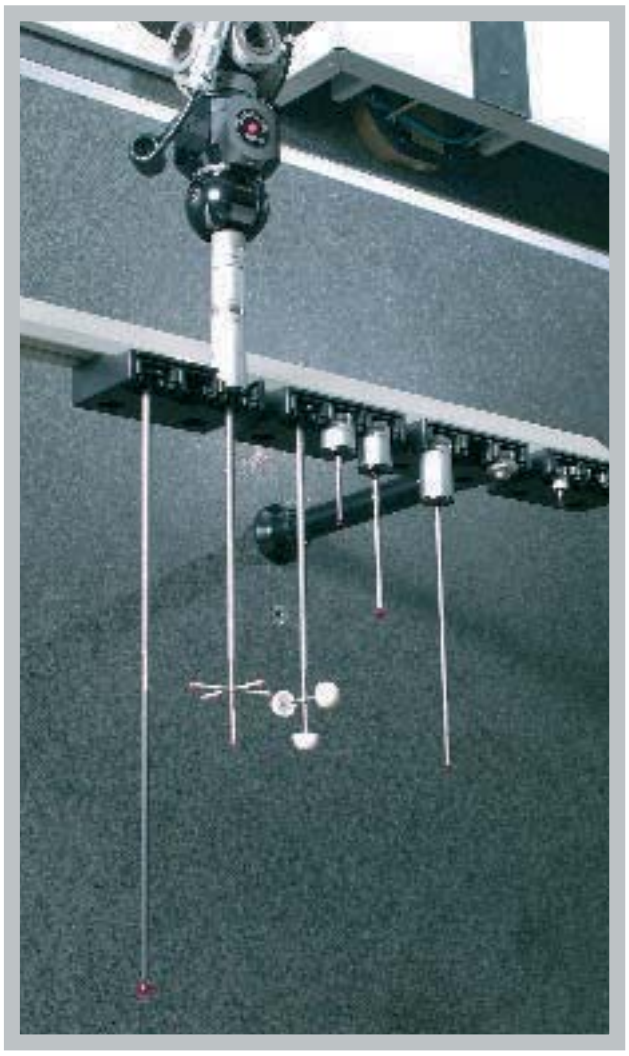
The company originally faced two choices: it could order a new CMM tailored to the job or, alternatively, it could attempt to greatly improve the productivity and performance of their existing 'large' CMM, a Leitz PMM 60 38 25 bridge machine. Affectionately nicknamed 'Christine', this machine has X=6000 mm, Y=3800 mm and Z=2500 mm axes. The 'new' route would take some ten months to come on-stream with substantial cost. By contrast, Renishaw was able to offer a complete retrofit solution based on its UCC controller that would breath new life into 'Christine' by updating to the very latest technologies at just a fraction of the 'new' cost and timescale.

Renishaw's retrofit solution for 'Christine' includes the powerful new UCC2 universal CMM controller and SPA2 multi-axis servo power amplifier, which together run the dual 'Y' axis drive system (four-axes under control).

Renishaw flexible tape scale and digital readheads were fitted to the axes, whilst a PH10M motorised indexing probe head, together with the SP25M compact scanning probe system, provide the necessary feature accessibility and sensor flexibility to measure a wide variety of part features in numerous orientations. The SM25-4 scanning module, with its 400 mm long styli reach, has proven to be particularly versatile for reaching deep features.

A notable benefit of the new probing package is that just six SP25M styli/module configurations, used with the simple, compact and automatic flexible change rack system (FCR25), has replaced some 30 bulky fixed-styli configurations that were previously required using the original probing system.

This has also freed up significant working volume allowing even larger parts to be measured than was previouslypossible. 'Christine' is now running efficiently on extended shifts and maintenance interruptions are also minimal, so 'up-time' is being maximised.



New range of advanced CMM controllers supports metrology revolution

Renishaw is leading a mini-revolution in the world of metrology with the introduction of a range of new controllers that will give unprecedented flexibility to users of co-ordinate measuring machines. The controllers are amongst the first to support the new industry standard I++DME protocol, which, in future, will allow CMM users to use their preferred measurement software with any machine control.

The new family of universal CMM controllers (UCC) and servo power amplifiers (SPA) provide cost effective solutions to every measurement requirement, from basic touch-trigger probing on manually operated machines to a fully automated multi-axis CMM with advanced scanning capability. The result is a configurable package that delivers unrivalled levels of probing flexibility and increased throughput, without compromising metrology excellence.

For sophisticated probing requirements, **UCC2** is a high power, multi-axis universal CMM controller, which offers greater measurement throughput by utilising powerful machine dynamic compensation techniques, innovative scanning routines and a higher data processing power than the earlier UCC1 system. Choosing the UCC2 controller also ensures a guaranteed upgrade path to the latest Renishaw technology.

Standard features of the UCC2 controller include an interface for Renishaw's market leading SP25M scanning probe, 4-axis control, advanced calibration routines for Renishaw probe technology and a comprehensive error map which compensates for the whole range of geometric, temperature and machine dynamic errors. For users choosing the optional scanning plug-in, there is the added benefit of **Renscan DC™**, a powerful aid to productivity which allows a CMM to perform high speed scanning with accuracy levels normally associated with slow speed operation.

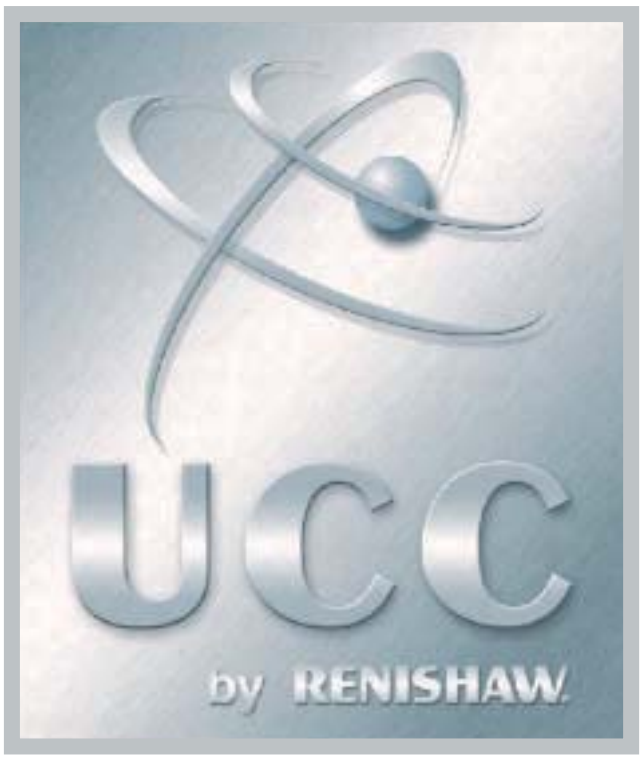
The new **SPA2** servo power amplifier offers full digital tuning in a '3+1 axes' or '6+1 axes' package. When combined with the UCC2, they form an excellent retrofit package allowing older touch-trigger only CMMs to be updated to full scanning capability.

For applications needing only a touch-trigger probing capability, Renishaw is also introducing **UCC*lite*™**, a lower specification controller configurable for use with manual or DCC CMMs, and **SPA*lite*™**, a lower powered servo power amplifier unit suitable for smaller DCC CMMs.

For all UCC family users, a major benefit will also be compatibility with the revolutionary new industry standard **I++DME** protocol which will give cross-platform controller compatibility with all major measurement software packages.

Within the new family of UCC controllers, Renishaw offers **UCC*server*™** software, which will handle all I++DME protocol communications.

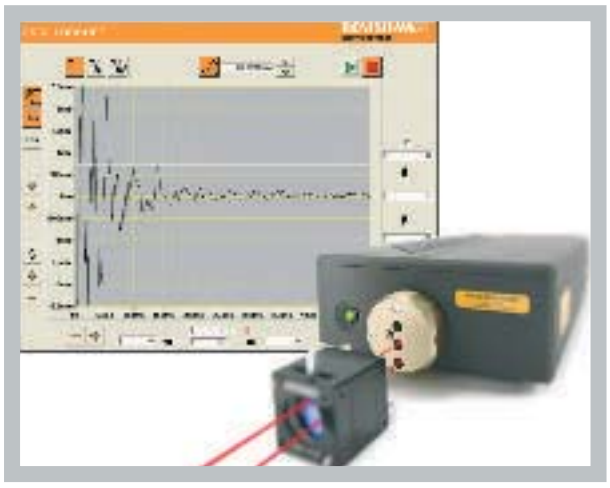
NEW



Precision motion analysis made simple

QuickView™ analysis and ML10 laser

NEW



QuickView™, a unique, new software package from Renishaw makes its ML10 laser an even more flexible and powerful analysis tool.

For years, electronic engineers have relied on oscilloscopes to study high-speed variations in voltage or current. Now, Renishaw's new QuickView™ software provides mechanical engineers with a similar capability, allowing them to study minute variations in linear or angular displacement, velocity or acceleration. With a simple graphical interface QuickView™ allows very flexible operation, avoiding the need for predefined measurement targets and sequences - just point and measure, ideal for ad-hoc system investigations.

Suitable for machine developers and machine builders, it will also appeal to engineering and research establishments as well as academic institutions.

The software's key feature is the ability to display continuous "streaming" data from the ML10 laser at 5 kHz, using a live oscilloscope type display (on a PC's screen) allowing real-time analysis of motion and positional characteristics. Typical applications include vibration analysis, servo tuning, identification of settle times, natural frequencies of resonance and mechanical damping factors etc.

The unique properties of Renishaw's ML10 laser interferometer measurement system ensure that the system provides a linear position reading resolution of just 1.24 nm, a range of up to 40 m and accuracy better than 1 ppm. This combination of resolution, accuracy and range makes the laser interferometer an ideal tool for characterising the performance of motion systems, both large and small.

Renishaw laser calibration reduces cost and improves accuracy, by a factor of four on CNC water-jet cutting machines

PTV spol s.r.o., based in Prague, Czech Republic, has experienced a very rapid increase in sales of its CNC water cutting machines. Precision water cutting has a huge number of applications, often in areas where traditional CNC machine tools have difficulties, perhaps with materials which are sensitive to heat, difficult to machine, or where users are cutting stone, ceramic, rubber, plastic, hard metals, foodstuffs and paper. PTV is able to vary the X and Y axis travels of its basic machine over a large range according to customers' needs so, in effect, every machine is customised.

The PTV machine was designed in 2002, originally with a magnetic linear encoder but had problems with maintaining the precise separation required between encoder and readhead, particularly over distances greater than 6 m. There were also dynamic problems in achieving the required accuracy from the lightweight structure of the X and Y axes so a laser interferometer was suggested to identify the causes of these effects. Following a demonstration of Renishaw's ML10 system, it was realised that it could be used to identify the dynamic errors, and to map errors during machine production.

PTV has removed the linear encoders from the original design instead, taking positional feedback from the rotary encoders integrated onto the drive motors. These had not been used before as they had been thought to provide inaccurate feedback, due to the variable distance and the resulting effects from the twisting of the ball-screw. The ML10 laser optics were mounted onto the finished machine and readings are taken at every 20 mm of axis movement and compared to the value provided by the machine's rotary encoder.

The ML10 software generates a repeatable compensation value for each position. The positioning uncertainty on the original design could be up to 0.2 mm per metre but PTV now knows that the accuracy is always better than 0.05 mm per metre and provides customers with a certificate from the ML10 software to prove it.

PTV also uses a Renishaw QC10 ballbar to undertake a ten-minute test on the machine, measuring a series of other characteristics that need to be checked and adjusted. Any variation from the normal test circle radius is picked up by the QC10's highly sensitive transducer and recorded on the PC. The ballbar's analysis software interprets this data and provides exact error values for 21 machine characteristics.

Scania – where machine tool maintenance is an investment, not a cost!

Dynamate AB, the plant maintenance company for world leading truck manufacturer Scania, has implemented one of the most comprehensive and well-structured maintenance strategies in its industry. At the heart of this programme is Renishaw's QC10 ballbar system, used to monitor the performance of over 500 large CNC machine tools.

The radical changes Dynamate has introduced at Scania's Södertälje manufacturing plant near Stockholm have proven their worth, with massive improvements in machine accuracy and considerable increases in the capability of machines to produce accurate parts. Central to this is recognition of the importance of regularly monitoring machine performance over time within a standardised test procedure.

"90% of new machines fail our tests"

Karl Orton, Dynamate's Production Service Manager, is happy to make some very blunt statements about new machines –

"We are a pain in the backside for machine manufacturers. Only 3 of 34 new machines purchased recently have passed ISO standards, as checked with our series of tests!

Regular 20-minute tests

At least once a year, in many cases more frequently, every one of the 500 CNC machine tools at Södertälje is subjected to a QC10 ballbar test. Results identify immediate improvements that can be made after the test, such as adjusting a machine's software settings, or indicate where more fundamental maintenance work should be scheduled, for example component replacement.

The results of every ballbar test are recorded on history charts so that changes in the machines' performance are recorded over time. This allows Dynamate to predict when maintenance tasks will be required, rather than just 'fire-fighting' when machine performance becomes so bad that scrap is produced.

Instant machine improvements

Kjell Norstedt, Maintenance Engineer, explains a typical example -

"One machine producing transmission parts had its program manually adjusted every few hours over the last few years, to keep component dimensions within tolerance. I ran a ballbar test in a matter of minutes and found a circularity error of 948 microns! Using values from the ballbar's analysis software I was able to immediately change the backlash compensation and reduce the circularity error to less than 400 microns. Once I change the motors most of the remaining error will be removed and they won't have to touch the program values again."

He continues, "Historically, a measurement of quality has been done after production, very few measure before, to analyse machine performance. At last somebody understands what we are saying – I have waited 20 years for someone to listen."

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SiGNUM™ RESM - high operating temperature, ultra-low cyclic error, *IN-TRAC*™ optical reference mark and now, even faster...

Offering high speed, non-contact performance, combined with advanced features including dynamic signal processing and the *IN-TRAC*™ auto-phase optical reference mark, the SiGNUM™ range is redefining encoder performance.

The RESM optical angle encoder comprises the RESM ring, the SR readhead and Si interface. The RESM is a one-piece stainless steel ring with 20 µm graduations marked axially on the periphery. It features the ***IN-TRAC***™ optical reference mark, which is repeatable in both directions up to 85 °C, and now, at speeds over 4,500 rev/min.

Precision rotary axes on machine tools require reliable and accurate encoders for angular position feedback. The dynamically responsive RESM provides a system repeatability that cannot be matched by any sealed encoder. With accuracy to ±0.5 arc second and resolution and repeatability to 0.02 arc second, it suits the most demanding precision applications. Furthermore, as part of the SiGNUM™ range, the RESM encoder system offers exceptional signal purity to give the lowest sub-divisional error of any encoder in its class.

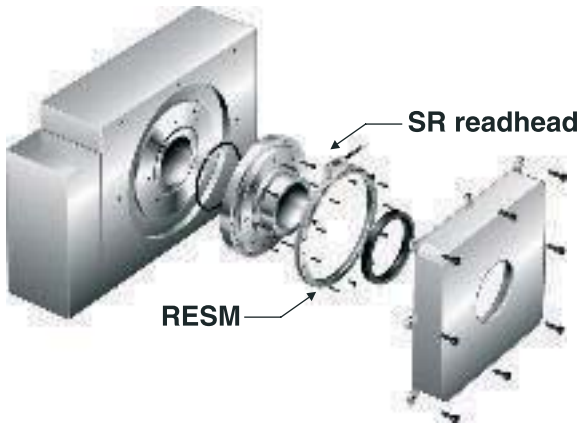
The RESM offers outstanding accuracy and is extremely compact and easy to install. The low profile ring is available in a wide range of sizes (Ø52 mm to Ø417 mm) and line counts, all of which feature a large internal diameter for flexible integration. While the large internal diameter simplifies the routing of cables and pneumatic supplies through the machine, Renishaw's patented taper mount provides active adjustment to minimise installation errors and simplify integration. Coupling losses, oscillation, shaft torsion and other hysteresis errors that plague sealed encoders are eliminated by 'taper-locking' the non-contact, modular RESM to the machine's rotor.

The SR readhead is sealed to IP64, enabling a quick recovery from coolant splashes or brief immersions. Like all Renishaw encoders, it benefits from unique filtering optics, which provide exceptional immunity to dirt, oil, dust and grease. In addition, RESM uses SiGNUM™ intelligent signal processing to ensure excellent reliability and ultra-low cyclic error (<±40 nm), whilst comprehensive SiGNUM™ software enables optimum set-up and real-time system diagnostics via a PC's USB port.

Adding real value to a rotary table has never been easier!

Direct encoder feedback on a rotary table significantly improves performance but it has always been an expensive custom modification – until now.

The total axial length of SiGNUM™ is only 16.5 mm, so it can easily be bolted directly to the rear of the table's rotor. Direct encoder feedback can become a simple modular option and you won't even lose the table's through hole.



New SiGNUM™ RELM high accuracy linear encoders

NEW

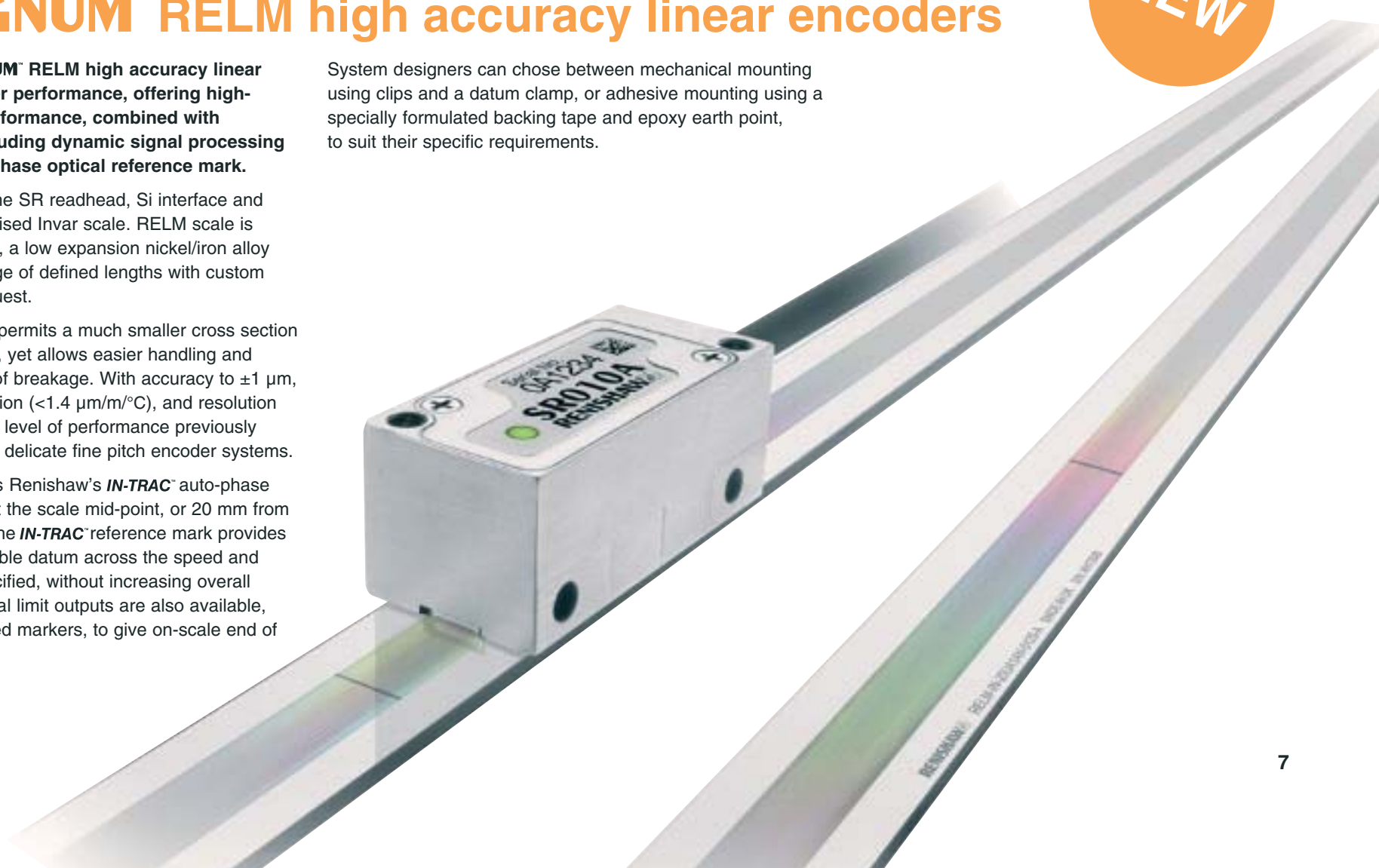
Renishaw's new SiGNUM™ RELM high accuracy linear scale redefines encoder performance, offering high-speed, non-contact performance, combined with advanced features including dynamic signal processing and the *IN-TRAC*™ auto-phase optical reference mark.

The system comprises the SR readhead, Si interface and RELM 20 µm pitch stabilised Invar scale. RELM scale is manufactured from Invar, a low expansion nickel/iron alloy and is available in a range of defined lengths with custom lengths available on request.

The robustness of Invar permits a much smaller cross section than typical glass scales, yet allows easier handling and installation, without risk of breakage. With accuracy to ±1 µm, low coefficient of expansion (<1.4 µm/m/°C), and resolution to 20 nm, RELM offers a level of performance previously available only from more delicate fine pitch encoder systems.

RELM scale incorporates Renishaw's ***IN-TRAC***™ auto-phase optical reference mark at the scale mid-point, or 20 mm from the scale end (RELE). The ***IN-TRAC***™ reference mark provides a bi-directionally repeatable datum across the speed and temperature ranges specified, without increasing overall system width. Dual optical limit outputs are also available, using customer positioned markers, to give on-scale end of travel indication.

System designers can chose between mechanical mounting using clips and a datum clamp, or adhesive mounting using a specially formulated backing tape and epoxy earth point, to suit their specific requirements.



Volume **12** Issue **1**
Reaction

RENISHAW
apply innovation™

HS10 laser head and RLE laser encoder – homodyne interferometer systems for precision position feedback applications

Continuously proven in harsh machine shop environments, an HS10 based system provides user selectable resolutions to 79 nm, and when used in conjunction with an RCU10 compensation system provides part per million (1 µm/m) accuracy on axis lengths to 60 m. For shorter axis applications (to 4 m) the RLE system can provide resolutions to 10 nm and, similar to the HS10, when used with the RCU10 compensation system can provide part per million accuracy.

The RLE system is available with three different integral interferometer configurations that enable planar (X-Y), linear and differential measurements to be made.

A significant benefit of the RLE system is the fibre optic launch mechanism that delivers laser light directly to the point of axis measurement without additional beam bending or splitting optics. This enables RLE integration to be non-intrusive (on machine design) and reduces installation complexity to a level associated with traditional linear encoders.

The Renishaw RCU10 quadrature compensation system provides significant improvements in process accuracy and repeatability by addressing environmental error sources associated with the feedback system, the workpiece and the machine structure; all in real time. To achieve this, the RCU10 compensator is located directly within the position feedback loop. Taking readings from the encoder and environmental sensors, the position feedback is then modified to remove associated errors before the signals are supplied to the motion control.

The system can be used with any linear encoder that produces differential digital quadrature and can implement user selectable combinations of the following algorithms:

- Refractive index compensation (for laser interferometer based encoder systems)
- Scale compensation (for tape or glass based encoder systems)
- Workpiece compensation
- Machine structure compensation

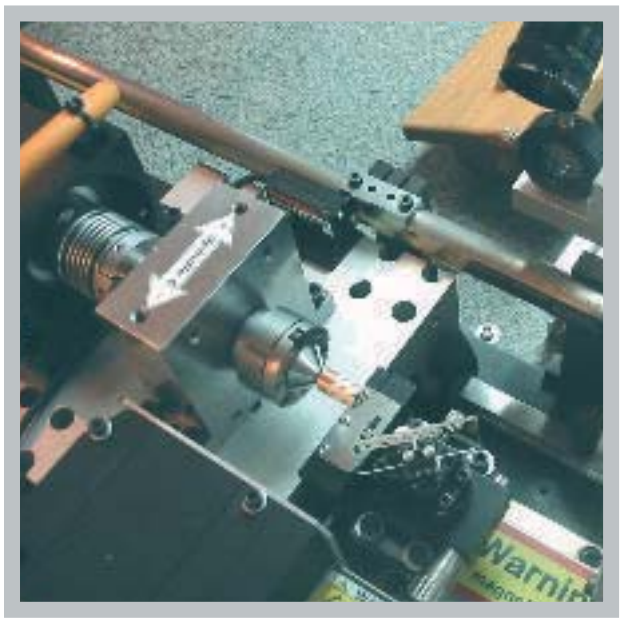
Breakthrough mobile technology relies on Renishaw encoders

A revolutionary mobile phone antenna has been developed by UK company Sarantel, based on its patented PowerHelix™ technology. When other conductors or the user's hand or head are next to the antenna, performance is completely unaffected, unlike conventional antennas. The unique manufacturing process uses a special purpose machine from Finnish company Citam Assembly Automatics Oy, fitted with Renishaw linear encoders to give very high accuracy.

The antenna creates very low 'Near Field' energy in use, meaning that the critical radiation does not extend more than a few millimetres.

Dr Oliver Leisten, Sarantel's Technical Director, comments, "This style of antenna breaks new ground in the requirement for an unprecedented level of three-dimensional imaging technology during manufacture. Renishaw encoder systems are a vital part of this process." The key to the functional performance of these antennas is the very high accuracy of the PowerHelix™ pattern, which, in turn, relies on the high positioning accuracy of the Citam laser-marking machine, prior to etching away unmarked areas.

Citam Managing Director, Mika Harju explains, "The pattern must be accurate to within 5 µm, which is achieved with a combination of rotary and linear movement. The Renishaw scale and readhead on the linear axis is ideal at providing the feedback for this application. The scale is true 'cut-to-suit' – we buy it and use it at the length we want, which is very important on customised machines. We have also used Renishaw's end limits and reference marks, which are essential to control the linear motor used to drive that axis."



High accuracy positioning

The Renishaw graduated tape scale has been applied to an Invar bar, chosen for its zero-expansion properties. The RGH22 optical readhead travels with the spindle stage. Like the Invar bar, it has been mounted very close to the working volume to maximise the machine's metrology performance. In this way, the encoder system achieves an accuracy of better than 1 µm over the 400 mm axis length. Mr Harju adds, "Another factor in choosing the Renishaw scale is the quick and easy installation. It is cut to the length required and stuck down with the self-adhesive backing mounted on the moving stage, using the applicator supplied."

Control and feedback during laser marking

Machine control is implemented from an industrial PC which stores and displays the helix patterns taken from a CAD generated drawing. Prior to the laser marking process, the machine uses optical sensors to measure the actual diameter and length of the dielectric "puck", so the PC can adjust the CAD file and achieve the correct linear and rotary motion to suit the chosen pattern.

Breakthrough antennas for mobile applications

Sarantel's PowerHelix™ antennas are the result of over 20 years of research and development, and are the subject of over 100 patents world-wide. These balanced antennae offer the benefits of small size, exceptional beam-width and low Near Field. When, for example, they are used with portable GPS (Global Positioning System) receivers, more satellites are acquired, no bulky ground plane is needed, and a predictable response is obtained regardless of proximity to conductors, other antennas or human tissue.

Citam's specialised service

Sarantel approached Citam to develop this process due to its experience in producing specialised machines, which include advanced servo control systems from top-tier manufacturers, vision systems for inspection applications, high spec linear and rotary motors and lasers.

Citam has a wide network of highly skilled partners and subcontractors providing manufacturing capacity, special technologies and skills for a broad range of applications. It has worked closely with Renishaw in the integration of their encoders into a number of Citam machines. There are really no limits to the size or complexity of customer design requests that can be solved and delivered.

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