

FAGOR AUTOMATION

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Aerospá

High-flying machining solutions



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Editorial

Fagor Automation is a company with more than 30 years of experience in the development and manufacturing of products for machine automation including controls and related software developments. Loyal to our values for cooperation, participation, social responsibility and innovation, we have always excelled by forming mutual partnerships with our customers offering them specific solutions, tailored and flexible according to their needs.

Our main goal, besides providing innovative products with higher performance and better features, is to offer anywhere in the worldbetter global support and generate business opportunities for our partners.

Our commercial network consisting of highly qualified staff, is present in all five continents, in more than 50 countries with direct presence thru 30 branch offices and more than 40 distributors. Their job is to collaborate and offer immediate and efficient solutions to the needs and demands of our customers.

At Fagor Automation, we make it a daily effort to achieve the maximum quality from all aspects of our work. To communicate various aspects of our development we launch this newsletter to further strengthen our relationship with our customers.

With every issue following the values of our brand we would like to present the company news comprising of our advancements, innovative global solutions and provide update on various business sectors where we are present, showcase our services and share information on upcoming R&D projects.





FAGOR AUTOMATION SOLUTIONS FOR LARGE MACHINING

The Answers the AEROSPACE Sector Demands

The aerospace industry demands advance, reliable and accurate technology solutions. Fagor Automation, a leading supplier to the companies of the aerospace sector has reinforced its position with two products especially designed for high speed and high surface accuracy large machine machining: The CNC 8065 and the L model linear encoder

Fagor Automation has developed many products for the aerospace industry such as the CNC 8065 and the L model linear encoders. These two products offer competitive advantages to manufacturers because they obtain higher speed and high surface accuracy when machining large parts.

CNC 8065, a leading solution for 5 axis machining

The CNC 8065 has been designed to easily adapt to a broad range of machine structures, manages standard kinematics (parallel kinematics, spherical spindles, rotary tables, etc.) and allows integrating those created by the machine manufacturers adapting to the new innovative machine designs of today.

In 5-axis machining, managing these kinematics combined with RTCP (Rotation Tool Center Point) interpolation results in a high quality part finish. The user simply has to enter the part program he has created and the CNC adapts the movement of the articulations of the kinematics to continuously compensate the tool position while machining. Besides 5-axis machining, the 8065 CNC also permits machining in inclined planes without having to loosen and wedge the part. Once the tool has been manually or automatically oriented, simply define the inclined plane and thus carry out all kinds of machining operations, pockets, rotations, etc.

One of Fagor Automation's hallmarks is the flexibility and numerous possibilities it offers the customer when they must intervene during the machining process. For example, machining zones may be avoided (irregular surfaces) or re-machine portions of the part that were not machined properly due to a damaged tool.

Another exclusive Fagor Automation feature is the ability of the user to dynamically control the behavior of the machine while machining. If the machine behavior is jerky, they may improve the smoothness with higher surface quality and if the program is running slowly, you may speed up the process to reduce machining time.

The independent movement of the tool regardless of the position of the spindles and rotary tables is another feature of the CNC 8065 worth mentioning.





With CNC systems, the rotational translation in space requires positioning the tool perpendicular to the work plane. Fagor Automation offers greater flexibility by allowing the tool axes to move freely without limiting it to the work plane and to the rotation of the spindles or articulated tables. This way, with the CNC 8065, the work plane may be rototranslated in space on machine-tools of only 3 axes without having the RTCP function active.

Therefore, when programming in a plane rotating the tool path in space, the tool path will not be affected by the position of the rotary axes and vice versa: The roto-translation in space and the RTCP function can also be programmed to work in inclined planes with 4-axis or 5-axis machines and work easily either with RTCP active or only with roto-translation active.

The CNC 8065 allows adapting the behavior of the machine dynamically to the machining operation

Likewise, the instruction #KIN ID may be used to activate any kinematics configured on the machine at the operator's choice. It allows changing from lathe mode to milling mode on the fly on multi-function machines or adapting the kinematics to the new spindle on multispindle machines.

L model linear encoders, more advantages for large part machining

Fagor Automation's L model linear encoders are the perfect answer for machines with long measuring lengths.

Throughout the entire life of the product, from installation and mounting to maintenance, L model linear encoders offer significant competitive advantages to the customers thanks to outstanding improvements implemented with them.

The product consists of a single engraved measuring steel part that may be installed very easily. The aluminum modules have a tongue and groove system for easy initial positioning and set mounting points that make it extremely easy to mount consecutive modules. The tensor that ensures it is very easy to secure and tension the tape.

The new tensor, unique on the market, is the result of an extraordinary development that allows extracting the reader head at either end without having to remove the measuring tape, which avoids having to recalibrate the machine. For example, on axes with two reader heads, quite common on large machines (lathes, gantry machines, etc), accessing the reader heads from either end of the scale is quick and easy.

The L model is available in either incremental and absolute protocols. Absolute feedback, in which Fagor is a world reference with installation of encoders exceeding 42 meters and now available for even longer lengths, provides the position upon machine power-up eliminating the need to home the machine

The "virtual axis" allows extracting the tool from the part easily

Interrupting the execution of a 5-axis program is no longer a problem. Fagor Automation has launched a new application on the market that allows extracting the tool from the part very easy, just by turning the "Virtual Axis" feature on and moving the tool in the desired direction.

A "virtual axis" is a fictitious axis that always movement in the direction in which the tool is oriented. When the operator wishes to withdraw or advance the tool, the CNC moves the axes of the machine so the tool moves in that direction.

The great advantage of this feature is that it may be used on-line during the execution of a program. As easy as setting the program running, getting the handwheel, selecting the virtual axis and moving it without affecting the current program in execution. When machining foundry parts with an irregular surface, this feature allows the operator to adapt the penetration pass on the fly to the roughness of the irregular surface immediately and without interrupting the execution of the program, therefore simplifying programming and the operator's job.

It may be especially useful when drilling holes at an angle since it is possible to approach and withdraw the tool in the direction of the plane it is currently in. It does not require defining an inclined plane, or RTCP, just have the tool inclined and activate the instruction #VIRTAX.

The virtual axis works with any type of kinematics, be it table-table, spindle-spindle or spindle-table, and since it is just like any other axis of the system, travel limits may be set for it and avoid undesired collisions.

which can be a very important improvement for large machines.

In addition, Fagor Automation offers the mirror model that allows installing two encoders in parallel on an axis with the origin at the same end without having to change anything at the CNC control. All this translates into considerable savings in costs and mounting time savings of up to 10% in comparison with the previous model and up to 50% in routine maintenance operation savings.

Fagor Automation consolidates its leadership on large machines for the aerospace sector with the CNC 8065 and the L model linear encoders. All of these features and more offer an improved value and many advantages to its customers. ■

L model linear encoders are very easy to install even on extremely long measuring lengths





Fagor Automation has successfully installed its automation systems in the following aerospace industry leaders' manufacturing facilities:

- Lockheed Martin
- Cessna Aircraft
- Alenia –Aermacchi
- Bell Helicopter
- Airbus
- ATK-Alliance Tech
- Boeing
- Messier-Dowty
- Bal Seal Eng.
- Raytheon
- Bombardier
- Pratt & Whitney
- L3 Communications
- Rolls Royce Turbine
- Northrup Grumman



DMS strengthens its position in the AEROSPACE SECTOR

This company from Colorado (U.S.A) equips its machines with Fagor CNCs to obtain the speeds, accuracy and performance their customers demand

There is something in the air in Colorado Springs... Or better put, there is something in Colorado Springs that helps put planes in the air. Diversified Machine Systems (DMS) is a U.S.-based designer &

"The Fagor CNC is rich in features like RTCP, Volumetric Compensation and High Accuracy Surface Speed that provide our customers the speed and accuracy they demand" manufacturer of 3 Axis CNC & 5 Axis CNC Routers and large format CNC machine centers. With more than 30 years of innovation, custom engineering and industry experience as an Original Equipment Manufacturer (OEM), DMS serves virtually every industry, with a special emphasis within the Aerospace, Automotive and the Consumer Goods Industries. DMS CNC Routers are designed as cutting solutions for a variety of materials such as composites, aluminum, steel, plastics, wood and foam cutting.

DMS products have had a natural attraction to the Aerospace market considering companies such as Cessna, Zodiac, Kaman Composites & Boeing have all found the DMS machines to be their manufacturing solution. Last year, DMS installed their sixth machine at Cessna, a custom 5 Axis Overhead Gantry CNC Machine Center integrated into a 10' x 35' fixture table built into a concrete reenforced pit. This machine is equipped with the Fagor CNC 8065.

How did they do it?

As stated by DMS CEO, Patrick Bollar, "To be a successful CNC machine brand in the 21st century, you need your employees to possess considerable agility and focus, combined with a strong engineering background. Our CNC machine solutions improve our customer's production capability, addressing of any special needs they may have had. We pay attention to the basics and this is with a strong focus of employee training, and even includes an expansion of our Internship program to include an Engineering Internship. This commitment goes hand in hand with our goals and is a real benefit to the students."

It starts with the sales staff - at DMS the sales staff has an average of 25+ years experience in the field. This first contact with the customer is vitally important in helping to identify and understand the client's needs. Solutions can be complex, but if you have the staff that recognizes the problem immediately and can easily identify tangible solutions, the process gets off to the right start. A thorough review of the needs of all clients are compiled on-site and then presented to the Engineering Department back at the Headquarters, where they begin the design process. The entire DMS process is a collaborative effort that is designed to cater to the specific needs of their customers.

Ed Hilligrass, DMS Executive Vice President states, "Equally important is the Technology you choose to reach your goals. Here at DMS, we have partnered up with Fagor Automation. The Fagor control is a very feature-rich control with capabilities such as RTCP, Volumetric Compensation and a High Speed Surface Accuracy (HSSA) feature that helps our customers achieve the speeds and accuracy they demand.

DMS utilizes a Fagor Automation tiered CNC Control line-up. The Fagor CNC 8037 is utilized for simple 3 axis machines, and then we move upward to the Fagor CNC 8055 and CNC 8065 Controls for high performance 5+ axis application solutions. "The Aerospace market is constantly evolving with new performance demands. It is nice to have an automation partner who understands this, and is committed to providing the very best CNC technology available."

It isn't just about the people and technology, you also need the building tools to properly present your company and provide a work environment that allows for constant growth and expansion of ideas. Hence, DMS has recently moved into their new 70,000 square foot Colorado Springs Headquarters. According to Patrick Bollar, the CEO of Diversified Machine Systems, "2012 was a record year for DMS, and to keep pace with customer demand, we felt that the



DMS Founder and CEO, Patrick Bollar

move was critical. In order to stay on track and meet our production goals, we needed a space that would allow us to streamline our process and improve efficiency. This facility is an investment in our future, and it reinforces our strong commitment to U.S. manufacturing."

It is more than just the Aerospace market DMS is excelling within - multiple markets have found the DMS machine to be the perfect solution. The Medical, Cabinet, Countertops, Furniture, Automotive and Plastic markets have all been a big part of Diversified Machine Systems' growth over the years. Much of this can be attributed to several factors, including further expansion into international markets, such as Europe, India and China, as well as a wide-ranging customer base that has increased custom application needs, but fewer companies willing to provide their application specific solutions that DMS is built for from the inside up.

The Future Looks Bright

A new state-of-the-art world headquarters, highly-skilled employees at every turn, well-chosen technology partners and an ever-steady eye on the future, coupled with a broad customer base expanding across a dozen different markets, DMS looks poised to continue the impressive growth they have seen in recent years. It appears the Colorado community has recognized this as well. In June, DMS was named in 2014 the Colorado Company to watch and follow and DMS was also recognized with the 2013 Regional Business Alliance Excellence in Manufacturing Award by the Colorado Springs Regional Business Alliance.

As stated by DMS, "Aerospace is demanding ... good thing that even their strictest tolerances come standard [on our machines]." At the end of the day, DMS helps put planes in the air and we know they are pretty proud of that, as they should be ■

Co-Founder of the company "Officina Zucchinali" and expert programmer and Machining Expert

TARCISIO ZUCCHINALI

"With CNC 8065 we are at the FOREFRONT"

The company Officina Zucchinali, located in (Bergamo, Italy) has been working in the machining sector for more than fifty years. Founded by Mr. Zucchinali Agostino in 1960, their permanent development has led them to focusing on mid-large size machining

Officina Zucchinali has a number of machine tools capable of meeting the needs of the different machining stages: horizontal and vertical turning, milling, drilling and boring. In order to keep innovating and potentiating their own machines, the company has acquired a Lazzati boring mill, with a D'Andrea spindle and equipped with the Fagor CNC 8065.

Tarcisio Zucchinali, co-owner of the company, expert programmer and miller, explain the needs and demands of their company.

Was choosing the CNC one of the main factors for purchasing the Lazzati machine tool?

Indeed, it was crucial. For us, purchasing a large machine, like the Lazzati millingboring machine that allows to make large parts was a very thoughtful and important decision that could leave nothing to chance. The CNC is the heart of the machine tool and, as such, it must get the best performance, ensure efficiency, obtain maximum machine performance and be the engine that never stops. It is without a doubt, the key component of the work activity. That's why we chose the CNC 8065; we had no doubt from that point of view...

Which were the characteristics of the CNC 8065 that called your attention the most?

Above all, its operating power, easy operation, machine-level programming features and a crucial characteristic, that it is very intuitive. This is key when facing typical machining issues on large milling-boring machines such as 5-axis machining, RTCP function with articulated spindles and rotary tables. Plus, 3D graphics are very useful for simulating the machining of a solid before executing it on the machine and be able to resume the interrupted machining operation very easily. And last, but not least, the possibility of interrupting the program, do a tool inspection, resume the execution at the same interruption block even inside the macro instructions, which is something that not all CNC can do.

Is machine-level programming still important to you when it comes to CAD/ CAM programming assisted by external systems?

I believe that machine-level programming still has great value and it is a deciding factor when choosing a CNC. Not only are essential high-speed machining in CAM programs, the capability of handling 5-axis machining or the great capability of storing data; it is also key to have powerful features and the programming language that must allow describing profiles quickly and easily without trigonometric calculation, it must have efficient milling strategies depending on the cycle being used (2D and 3D grooves, rotation in space to create revolving solids, inclined plane machining, etc.).



Which functions do you find crucial at machine level?

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I'd like to emphasize profile programming using the ProGTL3 language: this is the evolution we were waiting for. It is a geometrical language already used in Italy in the past, Selca's Proget2, which Fagor Automation has known to remake and even improve on it by combining Selca's geometrical language with the standard ISO. Make profiles, even complex ones, at machine level without using a calculator, without trigonometry, simply using the technical design tools, with 4 simple G codes, is the most important feature that could be implemented.

Plus the possibility of using spiral milling macros, function G8735, excellent for profile finishing operations or to drill holes as well as the great functionality of programming 3D surfaces defined by a top-view profile and one or more section profiles (function G8736), are in my opinion, and that of my collaborators, the most important aspects of machine-level programming.

All the simpler cycles like grooving, rectangular and circular pockets with islands, even to be able to change the machining strategy are also very important. All this that seems trivial, is supported by a very easy graphic interface, based on help screens, that makes data entry extremely easy reducing programming time, optimizing costs and increasing the productivity of the machine.

What's your opinion about the opening of the technological center, specifically linked to the milling world, in Ivrea and the support they provide?

For us as an end user, it is important to know that Fagor Automation has made a strong bet in the milling sector. Knowing that the CNC that we have acquired will keep integrating new features strengthens us on the market and allows us to respond to the needs that keep coming up.

Also, the support from qualified technicians with a large experience in the sector of milling CNCs ensures us continuity with the past and an immediate response to any kind of problems, from CNC customizing to assistance in training and programming as well as technical support when needed ■

The easiest <mark>3D</mark>

programming

The Profile-Section feature allows programming complex 3D shapes without the need for an external CAD-CAM

Fagor Automation, within its strategies, is strengthening its position on the milling market. That's why it has created its own R&D center in Italy specialized in that sector. Since Italy is the main producer and consumer of this type of machines, this center helps Fagor Automation be closer to the users, identify their needs and work on developments tailored to them.

The last feature developed by this R&D is a simple programming of a 3D surface defined by a plane profile and one or several section profiles.

This important feature, called "Profile-Section" allows programming solid or 3D surfaces without the need for external CAD-CAM applications, using function G8736, in ProGTL3 language or ISO language, to define plane profiles and section profiles as well as machining conditions.

A typical application of this feature is simple mold and die machining with different tapered walls, spherical or semi-spherical sections with plane passes or section passes as well as machining of open profiles where the section is to be applied (pipes, chamfers, on 3D corners, etc.).

This feature may be used to machine holes, grooves, bosses in taper sections or of other types without complex trigonometric calculations.



Section profile finished in semicircular plant, diemaking



Flat profile with tapered section, tooling



Flat profile with circular section, diemaking

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Finishing pass

As a result, the programming time for these parts has been minimized without having to use external CAD-CAM systems, with the possibility to change the machining conditions at machine level, like pass depth, tolerances, machining strategy, etc.

Modifying the machining conditions at machine level makes getting excellent part finish possible: Reducing the pass depth eliminates the need for manual finishing; the fact that the operator can choose the machining strategy makes it possible to reduce the load on the tool, increase its useful life and prevent breaking it and damaging the part. All these incidences are often caused by the machining conditions set in programs that have been created externally by CAM systems that are not always optimized for the machine and operator's experience.

Likewise, the possibility of spiral machining or ramp penetration in any programmed profile eliminates drilling time and results in optimum surface finish, with continuous machining without leaving the part and in considerably less machining time.

Even the tool, that will always work as specified and with constant material removal, will suffer less wear and have better chip removal, consequently increasing its useful life.

When machining surfaces defined by a flat profile (in the plane) and one or more profile sections, it is very impor-



Ramp penetration, spiral milling strategy Parallel pass in the plane (top) Profile following pass (bottom) Roughing pass

tant to use the right machining strategy. The pass may be either unidirectional or bidirectional and for open profiles, they may be parallel in the plane or following the profile. On each occasion, the right one, or at least the least damaging one, must be chosen for the tool or that allowing shorter machining operations.

Fagor Automation manages the machining process in all its stages: roughing, semi-finishing and finishing. Quite often, high speed machining methods are used in all these stages by programming #HSC ON. In order to obtain maximum precision and productivity, it is recommended to do the roughing and finishing operations with a specific cutting tool for each operation. The tool table of the Fagor CNC has simple and intuitive graphics to set the geometric parameters and the useful life of the tools.

It is always up to the operator to choose the size and shape of the tool according to the size of the part and the operations to carry out as well as the value of the finishing stock and the value of the cutting depth in roughing, semi-finishing and finishing operations

Fagor Automation: CNC 8060 AND DRIVE-CLiQ®

More possibilities in AUTOMATION

The ideal solution for precision mold machining

The CNC 8060 is equipped with advanced Fagor features for mold making, achieving maximum precision with a surface finish and similar machining cycle times to those of the CNC 8065.

Thanks to the HSSA machining system (High Speed Surface Accuracy), the user receives two benefits: A high quality part finish, plus a reduction in mechanical stress on the machine, therefore increasing its useful life. The HSSA feature incorporates 3 machining modes: FAST, which provides best performance in high speed machining giving priority to machining time. ACCURACY, for accurate machining that is designed to closely follow the defined paths. And the SURFACE mode, that offers the perfect balance between speed and surface finish quality while optimizing the programmed cutting speeds.

The Bode diagram tool that the CNC 8060 offers as a standard feature measures the frequency response of the machine and offers the possibility to apply filters for the machine vibrations caused by the various operating conditions and environment.

Using the Dynamic Override feature, the user can adjust the dynamics of the machine at any time, even while executing the part program. The feature is accessed through a toggle key and the adjustment is made using the mouse or the right/left arrow keys.

Dynamic Override allows the operator to adapt the dynamics of the machine in real time to obtain the best behavior possible. If the machine behavior is jerky, it allows smoothing its behavior in order to obtain a part with higher surface quality. If machining is slow, you can "perk it up" by reducing machining time.



Three machining modes: FAST, ACCURACY and SURFACE

Within the aerospace market, CAD/CAM generated programs for designing complex parts are large and require a specific processing of the CNC system to achieve the maximum speed with the desired precision. The solution implemented in the CNC 8060 system to process CAD/ CAM generated programs consists in combining splines and polynomial transitions as well as interpreting the NURB format used by CAD/CAM programs. This process helps achieve high machining speeds while maintaining exceptional accuracy required by all the geometries to be machined and reducing part execution time considerably.

Thanks to Ethernet communication capability, it is possible to easily and quickly integrate the CNC 8060 as another node in the computer network of the company for fast and easy data exchange. With the CNC 8060, it is also possible to execute a program located in another PC through the Ethernet port, therefore increasing the productivity of the shop.

All of this technology is combined with Fagor Automation's exclusive IIP programming by allowing the operator to choose the operation by simply pressing the associated icon. All the operator then does, is enter the data directly from the blueprint. This method does not require any prior CNC programming experience. Like with previous Fagor CNC systems, icon-based programming offers the customer a graphic screen will all the necessary variables for the operation, including data for the finishing pass, therefore eliminating the need to define multiple pages in order to enter the machining data.

The method to operate with the CNC 8060 is even easier due to CNC navigation based upon pop-up-menus. This navigation can also be customized as needed to by filtering the information that the operators require and hiding other information that is not required, therefore simplifying what the Operator see's on the CNC screen. In addition, a free CNC 8060 simulator for PC is available from the Fagor Automation corporate website that allows for the creation of part programs at any PC work station.

The CNC 8060 offers Solid Graphics as a standard feature, and as an option, high definition graphics. Graphics are available both in simulation and execution modes and allows for the visual rotation of Part Graphic, zoom in and out and display multiple views at the same time including the display of cross sections of the part through several parallel or perpendicular planes. The graphic representation of the part is defined quickly and easily as well as the selection of viewpoints.

Another advanced feature is the remote control of machining utilizing Fagor Automation's own application "Process Informer" that notifies automatically of a program stop or an error during unmanned machining by sending a message to a phone or to a PC.

Besides automatically converting DXF files, the CNC 8060 can automatically convert programs generated in older Fagor CNC models, therefore allowing to keep using program that have already been tested. It is also possible to edit those old format programs before converting them into the CNC 8060 language. The CNC also incorporates the operating and programming manuals directly integrated within the CNC. By simply pressing the HELP key, all pertinent information to the current operation is automatically displayed to the user. ■

DRIVE-CLiQ[®], a single product to connect linear and angular encoders

In linear and angular encoders, Fagor Automation offers connection to Siemens [®] (Sinamics, etc.) systems through the DRIVE-CliQ[®] interface. This connection is made through a universal type external cable which means that a single product may be used to connect linear and angular encoders.

This connection has been awarded the Siemens® certificate for the linear encoders series L, G, S/SV, and angular encoders with an outside diameter of 90, 170 & 200 mm. With these models, Fagor Automation, expands their available products for the machine tool market and are now the first company that offers absolute linear encoders of up to 42 meters with the DRIVE-CliQ® interface.

The implemented solution consists of an external cable with the electronics integrated into the circular connector that is good for the entire range of Fagor Automation encoders. The solution utilizes IP67 protection, and maintains a small size utilizing the 8-pin M 12 thus allowing the connection to the Siemens® DRIVE to be installed in tight space limited applications.

Among the primary characteristics, we should mention a resolution of 10nm on



G encoder and DRIVE-CLiQ

linear encoders and up to 27 bits on angular encoders, with special mention that this resolution is offered in a measuring travel length of up to 42 meters and it is even available for longer lengths.

The connection through DRIVE-CliQ[®] is an alternative to the SSI protocol connection (more 1 Vpp A and B signals). The DRIVE-CliQ[®] connection offers many advantages: Full digital interface without analog signals between the encoder and the drive; easier parameter setting, easier installation because data is sent from the encoder to the drive via the digital interface; speed of the linear encoder up to 180 m/min; and resolution of the linear encoder up to 10 nanometers ■ 15



One of the two companies that participate in the european project JRP SIB58 Angles – Angle metrology is Fagor Automation

Technology partner for European Metrology ANGLE project

Fagor Automation contributes to the 'JRP SIB58 Angles– Angle metrology' project of the European Metrology Research Project (EMRP), with its very high accuracy measuring technology

Fagor Automation has participated in the second meeting of the project JRP SIB58 Angles – Angle Metrology held in Warsaw the 4th and 5th of June. The main objective of this project is the progress of angle metrology in R&D and industry by improving the realization and dissemination of the radian (angular unit of the international system). It will be carried out using new angular measurement devices and innovative calibration techniques. Metrology, measurement science, is the backbone of the high technology world. What cannot be measured, cannot properly be understood and neither can be controlled nor manufactured reliably.

This project tries, through research and experimental work, to develop devices for the realization of 'radian' with an expanded uncertainty of less than 0.01 arc seconds (50 nrad). This work ensures reliability and traceability with respect of the

Example showing the importance of measuring the geometrical shape of the mirrors used in synchrotrons and a procedure to measure it





International System (IS) of angular measurement in industrial and scientific applications.

The Joint Research Projects are financed by the European Union and are the landmark of basic research for future technological developments. This project has been designed and developed by the main European Metrology Centers with the cooperation of the Japanese center (NMIJ) and the Korean center (KRISS). Only two companies participate in the consortium of the project: Möller-Wedel and Fagor Automation.

Möller-Wedel is a well known manufacturer of autocollimators; the devices for measuring small angles that are mainly used in calibration applications (together with an optical polygon) of angular tables.

Fagor Automation is known worldwide as manufacturer of high precision angular encoders. These devices are used for measuring angles within 2π radians; i.e. within a complete revolution. As may be understood by the definition of its functionality, these devices are essential to define angular measurements. At this time, due to their precision and resolution, they rival with higher-end autocollimators with the added advantage that the encoders are not limited to small angles.

Source

Angle metrology is key for the following scientific and industrial applications:

Accurate measurement of the geometric shape: for example of the beamforming optics in synchrotrons and free-electron lasers. Applications in precision engineering: for example, measurement of geometrical errors.

Industrial applications: for example in cars, air planes, industrial robots, accurate length measurement for great distances, large volume metrology, manufacturing processes (machine tool), etc.

Angle metrology is key for scientific and industrial applications

Scientific applications: for example angular stabilization of optical components for X ray equipment.

The scientific and technical excellence of the measurement systems expected to achieve as a result of the project will in turn translate into significant advances in the application fields mentioned here.

Potential impact

The research using synchrotrons and free-electron lasers have a strong impact on medicine, material science and in the energy sector. Likewise, developing more accurate angular encoders directly affects the quality of manufactured products, since the machines are more accurate as well as the measurements taken afterwards. Here are some examples of impact.

Environmental impact: Research done in high energy physics (synchrotrons and free-electron lasers) will make it possible to obtain sustainable energy sources and a better environment.

Financial impact: Angle metrology is an enabling technology for a wide range of manufacturing and measuring equipment in practically all industrial sectors. Among them, we could point out two of them: the Machine Tool sector and the Optics sector. The latter is probably the one that is going to grow most in this century. Therefore, Angle metrology is becoming an important engine of the economic growth.

Social impact: Medicine is a field of application with great social importance. In this sector, the new high energy physics plays an important role. At this time, it is the main means of development for new pharmaceuticals and treatments.

A road to technical and scientific excellence

The starting point of this project is the definition of the angular unit of the Internal System of Units: the radian. According to that definition, there are two realizations of radian:

Realization by sub-dividing the full circle (2π radians).

Realization by using the ratios between two lengths.

The first one is done using angular encoders. The second one using angle generators. Autocollimators are used to transfer between them. These three kinds of devices are, therefore, the main pillars of angle metrology.

For further information: <u>http://www.anglemetrology.com/</u>

Productivity and Data collection SOLUTIONS

Fagor Automation's CNCs may be connected fast, easily and automatically via "MT Connect" communications protocols. This is a manufacturing industry standard to facilitate the organized retrieval of process information from CNC controlled machine tools.

"MT Connect" maintains a lightweight, open, and extensible protocol designed for the exchange of data between shop floor equipment and software applications used for monitoring and data analysis. Thanks to a Fagor developed "MT Connect" adaptor, delivering this Machine Tool Data to Manufacturing Management is fast, easy and automatic.

Manufacturers in the past could Network their Fagor CNC for the primary purposes of uploading/downloading part-programs and other general use production data, but now Fagor Automation CNC customers can Network their machinery control systems, providing process information that could be retrieved from any web-enabled client connected to the network.

With this "MT Connect" capability, this new possibility to network all manufacturers control platforms together allows them to utilize a host of software platforms that enable them to Monitor CNC machine efficiency in a professional and organized way with real-time data.

Advances in reducing production scrap and calculating the overall Machine Tool Efficiency as well as identifying lean manufacturing strategies become a reality through the capturing of all Machine Tool data. Third-party platforms such as Predator ™ support automatic, error-free and unattended machine monitoring for events such as job start and end, setup start and end, cycle start/stop and program end and many more.

All this type of data is collected automatically using software, hardware, custom macros and other methods without requiring operator training or input. Fagor Automation CNCs adopt "MT Connect" protocol facilitating data exchange to improve shop floor productivity and efficiency



3rd party software solutions also support manual monitoring of events that are initiated by machine operators machine logon/offs, downtimes, and scrap accumulation. All of this data can be automatically organized in concise layouts that help identify inefficiency quickly and easily. This new MT Connect ability combined with the Advanced Technological resources of the Fagor CNC 8060 and CNC 8065 Controls ensures of CNC's ensures the customer has the most advanced and accessible CNC technology available today and also quantify this capability as well as improve upon it from an efficiency aspect ■

Renishaw adapts their INSPECTION PLUS software for Fagor CNCs

Fagor Automation has announced the ability to interface with Renishaw software. While the capability to interface and operate with Renishaw Probing Systems has always been a standard feature of Fagor CNC Systems, the Fagor CNC now work with Renishaw software programs for a broad host of applications.

Of principle note is the Renishaw Inspection Plus Software for Machining Centers. Inspection Plus is a totally integrated package of software that includes vector and angle measure options, print options and an extended range of cycles. This includes an SPC cycle, 1 or 2 touch probing option, tool offset compensation by percentage of error and output data stored in an accessible variable stack.

Cycles included comprise of:

- X or Y or Z single surface measure.
- web/pocket measure.
- 4 point web / boss measure.
- Internal/external corner (3 point measure for corners). (4 point measure for intersection of angled surfaces).
- 3 point bore / vector measure. (approach angles are specified for each point).
- Angled web/pocket measure.
- Hole/web in PCD.
- 4th axis measure. (component, fixture or machine table can be compensated for alignment).
- Stock allowance (it measures a surface at several points to adapt the irregularities of the material).
- Multi-stylus calibration. (several stylus ball configurations can be calibrated and stored).
- Measurement of distance between elements.
- Angular XY surface.
- Statistical process control (SPC) macro for tool offset updates.

Capability also includes a "Inspection" software for Machining Centers.

Renishaw adds probing and inspection solutions for Fagor CNCs

This Basic inspection/job set-up software contains the ability to set work offsets, update tool offsets and print inspection results. Due to the ease of use, this software is suitable for use by an operator or part programmer alike.

In addition, Fagor CNCs can work with Renishaw's CNC Reporter software. This is a simple yet powerful tool for analyzing data and creating printable reports from data generated by the Fagor CNC and Renishaw's inspection probing operation. The program provides measured feature dimensions, indicates whether these features are in or out of tolerance, and applies a 'GO/NO-GO' decision. The software allows the ability to collect data from over 250 parts within the same file and offers the possibility to customize the report template to suit your application needs. In addition, the reports are easily configurable in a Microsoft[®] Excel environment.

This new capability combined with the existing Fagor CNC 8060 and CNC 8065 Probing Canned cycle capability ensures customers have available to them a universal probing solution that provides the most advanced technological probing inspection capability available today ■



Fagor Automation designs and manufactures innovative products that are technologically advanced and absolutely reliable

Creates, develops and patents systems and components that offer maximum quality and advance automation features

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