Quod Erat Meliorandum

To introduce innovations simplifying and rationalizing, an interesting new proposal DESINA-compatible from QEM

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"Quod Erat Demonstrandum" - Q.E.D. – is a well-known abbreviation used in mathematics and physics to end a proof.

Looking always to the best, an Italian company studied a new approach to improve ("meliorandum" in latin language) positioning systems. Here we are not discussing about specific products or system, but about a new philosophy, arising from the consideration that – statistically – in many applications there are drives in standstill during working cycle.

This philosophy is very useful in complex machines, where the number of auxiliary movements, as set-up positioning before working cycle, is considerable. Due to possible cost reductions using this philosophy, it would be a well-founded conjecture to drive each mechanical load with single motor, avoiding multiple loads driven from the same motor and related mechanical transmissions. Machines could be designed with better elegance in rational way, improving overall efficiency and reducing maintenance needs. In addition, general safety and noise level could take benefits from this innovative approach. Easiness of future modifications is another "plus" offered by this philosophy.

We asked to Dario Zatton, Marketing Director of QEM S.r.l., a well-established Italian manufacturer specialized in positioning systems, to explain to Motion Control Italia magazine readers some highlights of this Company.

What kinds of technologies are in your background and in your actual offer?

Relating to axis movement, we developed a technique using epicyclical curves to accelerate and decelerate motion. Mathematically it is possible to demonstrate that this technique greatly reduces jerk to the motor and consequently through kinematics devices to the load. Many applications will take advantage by using epicyclical curves, mainly all that need to reach high speed loading and unloading gradually kinetic energy, as – for example – cutters for cut-on-the-fly, feeders for plastic films or metal sheets, movements for hanged loads, powders or liquids handling, movements of vehicles with people aboard.

In QEM we reached interesting results like our operating system "real time multitasking", specific for motion control applications, called QMOS (Qem Multitasking Operative System). This operating system is very appreciated for his architecture and flexibility, performances and portability, and enable us to design a wide product range called Qmove. These Qmove are manufactured in three main series: a cheap "Integrato" system, that manages HMI and motion control in a single-processor architecture; a user-friendly and powerful "Compatto", to control many axis with a limited I/O number; a flexible and expansible "Modulare" to control with a single CPU up to 22 axis and 256 I/Os.

All products of this family are compatible between them as development tools

QMOS: proprietary QEM Operating System
PTQ: QEM's Technological Partner
ISYAX™: Integrated System for Axis multipleXing - architecture for axis management
AMU: Universal MultiAxis Drives
SYNCHROMOVE™: proprietary technology for motion controllers
DESINA: decentralised and standardised installation technique for machine tools and production systems
DMA: standard device to switch motors, brakes, feedback transducers, etc. in a multiplexed system.
Qmove™: motion controllers in modular, compact and integrated versions.

QEM factory
in Montebello Vicentino
(Italy)

and application software; it is very easy and simple to migrate from hardware to another in few minutes, without the need to modify programs related to specific works. QMOS takes under control available hardware operating under different deterministic levels. "Devices" are firmware objects pre-programmed to make specific operations in sampling times programmable between 1 and 250 ms. Such "devices" have the maximum priority in operating system levels. Devices could be replicated, with different names, but they could share hardware resources and they could be set on or off from application program. Between devices, we can mention analogue point-to-point positioning, on/off positioning for size changes, two-directional counters having real-time comparison on digital outputs, recorder to get and to display on monitors dynamic axis behaviour, and many other useful devices.

Recently QEM patented an original technology for axis motion control, named Synchromove, useful to realize simply and effectively all applications that need synchronization between two or more axis. Thanks to this technology, our motion controllers can manage effectively and in a cheap way many complex applications, like linear and circular cutting-at-the-fly, winding, flexographic printing, silk screen processes, stratification, vertical and horizontal packaging.

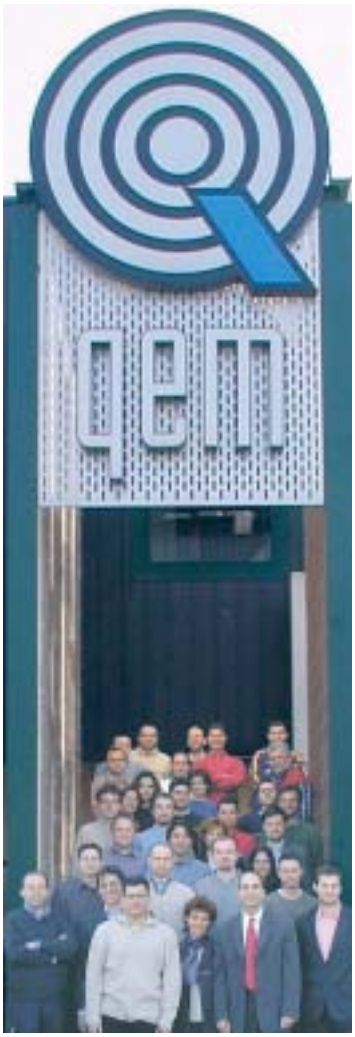
We have also experienced applications to SCARA, anthropomorphic robots having five freedom degrees, for painting, palletising, pick, and place, material handling, and we are evaluating more complex applications, like continue welding and metal sheet folding.

What are main advantages of Synchromove technology?

First, Synchromove is very user friend, simple to be programmed. This technology is in practice a programmable path generator using usual motion laws (acceleration, deceleration, constant speed) to associate Master distance to Slave one. This is a big simplification in calculation to define Slave trajectory v/s Master path; all calculations are simple, being simple as additions or subtractions. All spaces are considered as incremental units, and all necessary calculations could be executed during movement. Therefore, also sophisticated applications could run on cheap hardware using less memory than requested by other technologies (i.e.: "cam profiling") for the same performances.

Practically to realize any position profile master/slave it is enough to divide the trajectory in different sectors, and to compile a spreadsheet writing at least three data for each sector: master space to define the sector width, slave space related to master sector, and the motion law applicable to slave if master was running at constant speed. Keystone for superiority of Synchromove technology is this third data related to motion law. Using this technology it is possible to manage functions also not strictly related to slave axis motion, i.e.: to state a loop between specified sectors, disconnect and reconnect slave from master axis, thus encourages new powerful and flexible applications with low memory needs.

People working in QEM



It seems that Synchromove is an interesting technology especially for easiness of use and cheapness. Has this technology some "plus" to realize applications not easily feasible?

Synchromove was conceived to be implemented in devices useful to associate a real or virtual master to an extended axis array, the number or which is limited only by available hardware resources. This architecture allows synchronizing between them many axis that are working like "mechanically" connected to one main master. If master axis is a virtual axis, it could be imposed to execute whatever trajectory with motion law that could vary dynamically to optimise results. After describing space relations between master axis and all slave axis, attention could be paid only to drive in the proper way the master axis, without any worry for dynamic behaviour of all slave axis.

To understand better

Synchromove power we consider a case of an anthropomorphic robot having five freedom degrees. With standard techniques, matrix calculations are necessary to get angular position of each axis in each point of trajectory, thus requiring a very fast motion controller. We can reach the same results using Synchromove, simply applying trigonometric formulas resulting from a reverse cinematic calculation. In practice the desired trajectory is virtually divided in many small linear movements, translated in angular position variations of robot arms between beginning and final position of each segment; length sum of all trajectory's segments has the same value of distance that virtual master will run across. In this mode it is possible to manage robot as single-axis that could be accelerated, moved at constant speed, decelerated, stopped, jogged, etc. as requested by application program.

Synchromove technology offers the possibility to mitigate effects of quick changes in angular position, therefore virtual master, and consequently the whole robot, could be accelerated and decelerated with epicyclical law to smooth hard motion in all operating volume.

The characteristic offered by Synchromove to synchronize all axis in space rather than in time, give the possibility to record in auto-learning mode a certain trajectory executed at any speed, to have the possibility to repeat it with great accuracy also at different speed.

Your Company's maxim is "To innovate, simplifying and rationalising". You were able to be true to your motto.

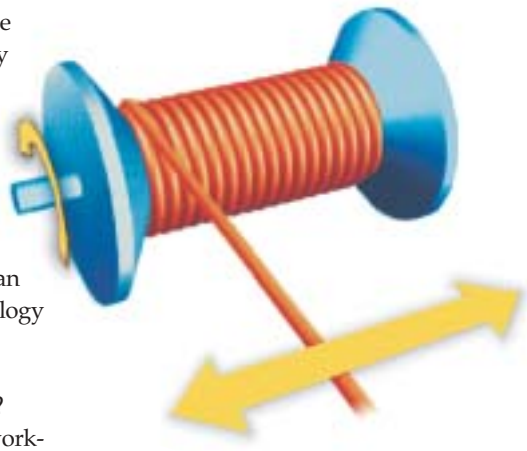
We demonstrated with Synchromove our constant wish to abide to our maxim, and in other occasions like during design of Qview and Qpaint,

our two development environments to develop applications with our products Qmove. Such environments are modular and flexible, to allow quick and sure integration of all improvements realized by our technicians, mainly finalized to simplify realization and debugging of application programs. We created specific functions to solve automatically main technical problems in complex applications for a programmer not so expert in motion control. As example, we could mention shaping, linear and circular printing and cutting-in-the-fly, winding, circular interpolations, robot motion and many other applications. During realizing such type of automation, having such functions available is a great benefit for programmers, because they have simply to add parameters and to study proper interface with more simple tasks to get final application running after a short developing time.

On which products is Synchromove technology employed?

A) This technology offer best performances when is implemented as "device", and for this reason we have embedded it on all Qmove motion controllers, where the original operating system QMOS uses hardware resources mainly as devices. We are evaluating the possibility to implement Synchromove on motion controller cards devoted to third-part servodrives; in this prospects we started interesting preliminary discussions with top managers of Italian branch of Danaher Motion and partners of Yaskawa Group. We are very open to cooperate with any Company interested to our solution or determined to buy an OEM licence to use our technology on their products.

Application for cam profiling

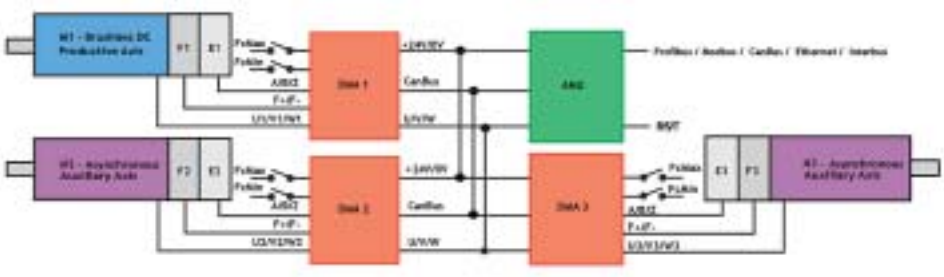


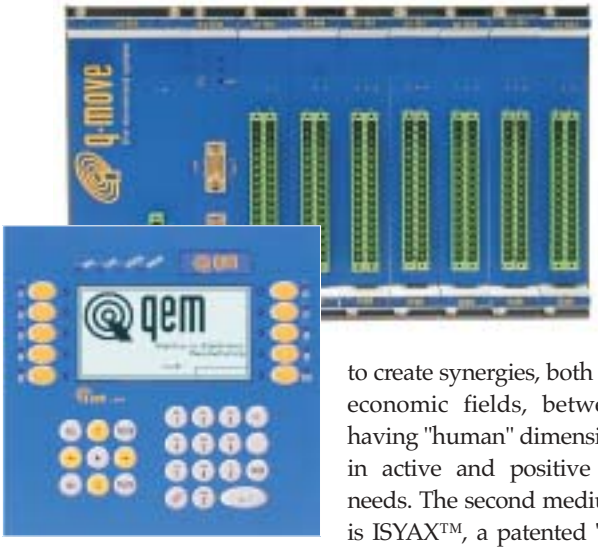
What are your plans for the future?

In the short term, we are working to offer a wider range of Qmove with cheaper sales prices, more powerful and more user-friend than actual ones. Soon we will have on our price list motion control systems at very cheap cost/axis.

In the medium term we will be engaged in development of two interesting and innovative projects: PTQ (QEM's Technological Partner) and ISYAX™. PTQ is mainly a marketing operation strongly oriented to reach some goals. We can mention as goal the creation of a network of international technological companies that can manufacture, sell and give support locally to a range of motion control systems based on our technology. We hope to help our PTQ partners to improve their success, for example, opening our experiences to their markets and improving our application library adding their applications done with our technology.

Simple architecture ISYAX™





Exemple of products manufactured by QEM

We would also offer to network PTQ the possibility to have a better support worldwide both for software and hardware. We wish also to create synergies, both in technical and economic fields, between companies having "human" dimensions, to compete in active and positive way to global needs. The second medium-term project is ISYAX™, a patented "architecture" to reduce costs to drive electronically axis when not all axis must run in the same time, this means that there are some axis that are always motionless when other axis are running.

There are two typical application of ISYAX™, with auxiliary axis or working axis.

Auxiliary axis can be more easily controlled in sequence, especially when they are used as format definition, but also some working axis could be included in such system if they are used in sequence under intermittent duty.

Multiplexing technique is a common way to save money in active components and cables, and was used a bit up to today to distribute energy and control signals to servomotors in positioning systems.

QEM believes that this is the right moment to start a project to realize standard hardware to integrate in few components, reliable and cheap, all necessary functions to realize axis multiplexing.

Such devices will be embedded into servomotors or near the servosystem to be controlled, thus rationalising cabling and normalizing connections to cut cabling costs, connection costs and reducing commissioning time for each machine.

This feature and concept is particularly interesting: up to certain power, connections and cables between power supply and control system and AMU could be standard, independently from typology and supplier. This means that machine tests, commissioning, start-up, service and maintenance are greatly simplified. In this architecture, it is very easy to add or remove axis from an existing machine, this means that option axis application could be decided as last-minute job.

Using DSPs and fieldbuses and our experience in motion control, we designed ISYAX™ architecture using DMA (Axis Multiplexing Device) and AMU (Universal MultiAxis Drive).

What are innovations in ISYAX™ architecture?

First, integration of all necessary components for multiplexing in only two devices connected via bus. Bus solution demonstrated to be one of the most reliable, safe and cheap, especially when there are available on the market standard devices fur such bus. In DESINA project (DistributEd and Standardised INstAllation technology, www.desina.de) there are solutions to decentralize power and reduce installation costs, using standard products. Some components manufacturers have already in production devices meeting DESINA specifications, and such components could be employed in ISYAX™ architecture.

In the meantime, there is a job to do, designing new drives (AMU) covering specifications for wide applications (i.e., possibility to modify by software the type of connectable motor: stepper, three-phase asynchronous, DC or AC brushless, DC permanent magnets on the same power drive). During redesign, it is possible to make something new in interface to position transducer using DMA capabilities. Thank to fieldbus connection between AMU and DMA, position and speed could be transmitted to related drive in a deterministic sampling time of 200 mS, thus reducing wire number.

How do you think to develop and market components for ISYAX™ system?

QEM is open to any type of cooperation with other companies operating in motion control, to define and standardize the components used in the ISYAX™ system to reduce costs and simplify the implementation of the systems architecture.

We are also ready to stipulate "licensing" agreements with companies interested in the development, manufacture and marketing of the basic elements of the system, and to promote the implementation of Synchromove technology close to the AMU drives in order to synchronize productive axes by field bus interface.

"Quod Erat Meliorandum", abbreviated as Q.E.M.; a great deal for OEMs to make improvements to their products catching this great opportunity offered by QEM technology. MC

Who is QEM

QEM means "Quality in Electronic Manufacturing". Since 1982 QEM manufactured products under quality control when rules was not so mandatory like today, paying attention to EMC, reliability and safety first of all, also to price detriment.

ACTUALLY, QEM employs 35 people, mainly for engineering and design, in a factory located in Northeast Italy, near the Italian capital of electronics, Vicenza. All QEM technologies are developed internally (hardware, firmware and software). Also all development tools for PC are fully contrived and developed in QEM.

Product's manufacturing is done externally using QEM's components and specifications. QEM has a good reputation for their training courses and for direct technical support to customers for feasibility; finding the best solution for a specific problem, help in developing applications, and professional support for prototype tests and for commissioning.