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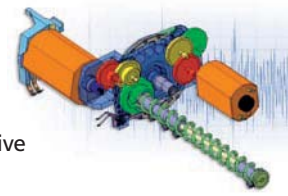

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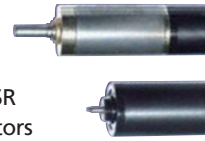
New

- **Precision micro-stepping** ARSAPE stepping motors ADM 1220/1220 S series



- **Maximum performance, miniature footprint** FAULHABER 1224 SR series DC micromotors

FAULHABER GROUP
We create motion

ENGINEERING APPLICATION

Customized packaging

Flexible plotter for cutting, printing and scanning tasks

MINIATURE DRIVES FOR THE REDESIGN OF A CUTTING PLOTTER

Practically all modern products require protective packaging for shipment and handling. Paper remains the number one choice of material because, in the form of cardboard or (corrugated) cartons, it allows a multitude of customized design options. Prototype models are essential for the quick testing of design and functionality of a new design in practice. Making them by hand is too expensive and imprecise. But handy cutting plotters come to the rescue for office use. The state-of-the-art all-rounder converts CAD data directly into finished cut samples.

Cutting systems for major series are expensive; stamping tools also cost a lot of money. So it's a good idea to test a new design on prototypes before making expensive investments. The specialist in cutting equipment, Lasercomb of Notzingen, has developed a new generation of multifunctional plotters for such purposes. Reliability, precision and an attractive price are right at the top of the specification. It requires in-depth know-how of plotter technology and powerful motors for the compact drive. To realize the demanding specifications, the manufacturer also works together with its long-term drive supplier, FAULHABER. This means proven modules can be employed as well as the rapid and expert implementation of optimum changes to the new concept.

Compact and maintenance-friendly

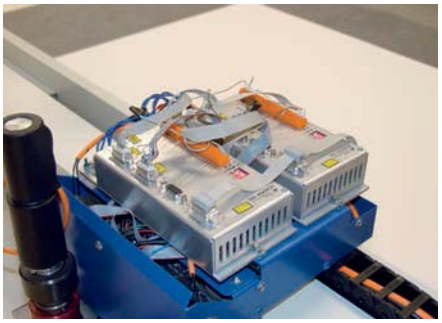
Initially the demand was for the development of a small, reasonably priced plotter with all the features of its big brother. But a straightforward transfer of the concept into a smaller version was not possible; the cabling costs alone would have taken it out of the price range. Hence, the decision was made to use a compact CNC controller in the top-hat module. A second innovation was to incorporate two CANopen nodes, thus minimizing the cabling costs. One node is responsible for the inputs/outputs as a control bus and the other – cycled at a higher frequency – operates as a control bus for the drives. This ensures rapid and precise guidance of the tool in the tool head. At the same time, it was possible to reduce the number of trailing cables to the head from 17 to just one cable, including the power supply, in the first draft.

The ProDigi plotter provides maximum performance despite its extremely compact construction. Depending on the model, work surfaces of 800 x 1,300 mm to 3,100 x 1,700 mm from the tool head are traversed at speeds of up to 100 m/min (1.66 m/s) and an acceleration of 5 m/s, saving time during empty runs. In full cutting operation, it achieves up to 30 m/min, and as a drawing plotter it can even reach 50 m/min. A simple change of tools on the head is all that is required for reconfiguration; the electronics then adjust the cutting or drawing parameters via the sensitive controllable motors – and all this at a very low noise level making it ideal for the office. The drive power required by the plotter and the tools is provided by state-of-the-art DC motors. Some users even produce their small series on these robust ProDigi plotters!

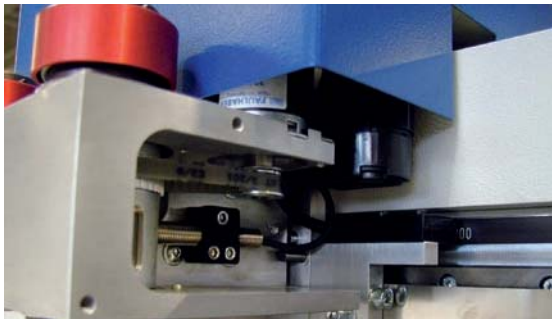
Custom-made DC miniature drives

Once the characteristics of the plotter were specified, the designers had to select the drive components to meet these specifications. As they have done for more than 10 years, they also started work on this with FAULHABER right from the outset. The compact dimensions of the motors in the tool head were the most important aspect in this case. Here, four motors must be mounted in a limited space for controlling the Z-axis (i.e. knife stroke movement) and the C-axis (i.e. horizontal movement of the head). Each pair of motors is responsible for a tool fixture. All motors are pre-configured with connection cables and incremental encoders. The connectors are then simply attached to a so-called "switching panel" that provides the connections for the motor and the add-on modules as well as the special plug configuration for the control side. The advantage of this solution is that, in an emergency, the customer himself can replace the motor using Plug-and-Play, which means the customary resoldering of special connections required in the past is no longer necessary. A seal against the inevitable paper dust also improves the lifetime of the robust motors – without disruptive foreign bodies, the frictional pairing of brushes/collectors is subject to much less wear.

To guide the cutting knife to the precise height, a 28 W motor with 180 mNm torque at a diameter of 35 mm and length of 57 mm is installed in the head. With a lifting spindle as a self-locking gear reduction, the cutting knife can be precisely positioned with zero backlash. In contrast, complete motor gear units consisting of an 80 W motor with 530 mNm and flanged metal planet gears are used for the C-axis. The high dynamics of the DC motors permit digital table height compensation (vertical tool tracking) over the entire work surface, thereby enabling a high degree of precision. This ensures a constant distance from the tool to the vacuum table and, hence, also to the material to be processed.



Controller and miniature drives call for different solutions: optimally implemented, only a single trailing cable is now required for the controller and power supply



Compact tool head with four motors for two-axis control. The drive is hidden under the cover to save space

Nowadays miniature drives can be individually adjusted to the desired requirements – just like their big brothers.

If the drive is matched with the application requirements from the outset, many problems and compromises that may arise with standard motors can be avoided during the design. This means special characteristics in the type of construction, performance, electromagnetic compatibility, Plug-and-Play or sealing against specific media are also easy to implement. The user saves his own development time and is quicker on the market with his product – an advantage that is otherwise difficult to achieve.

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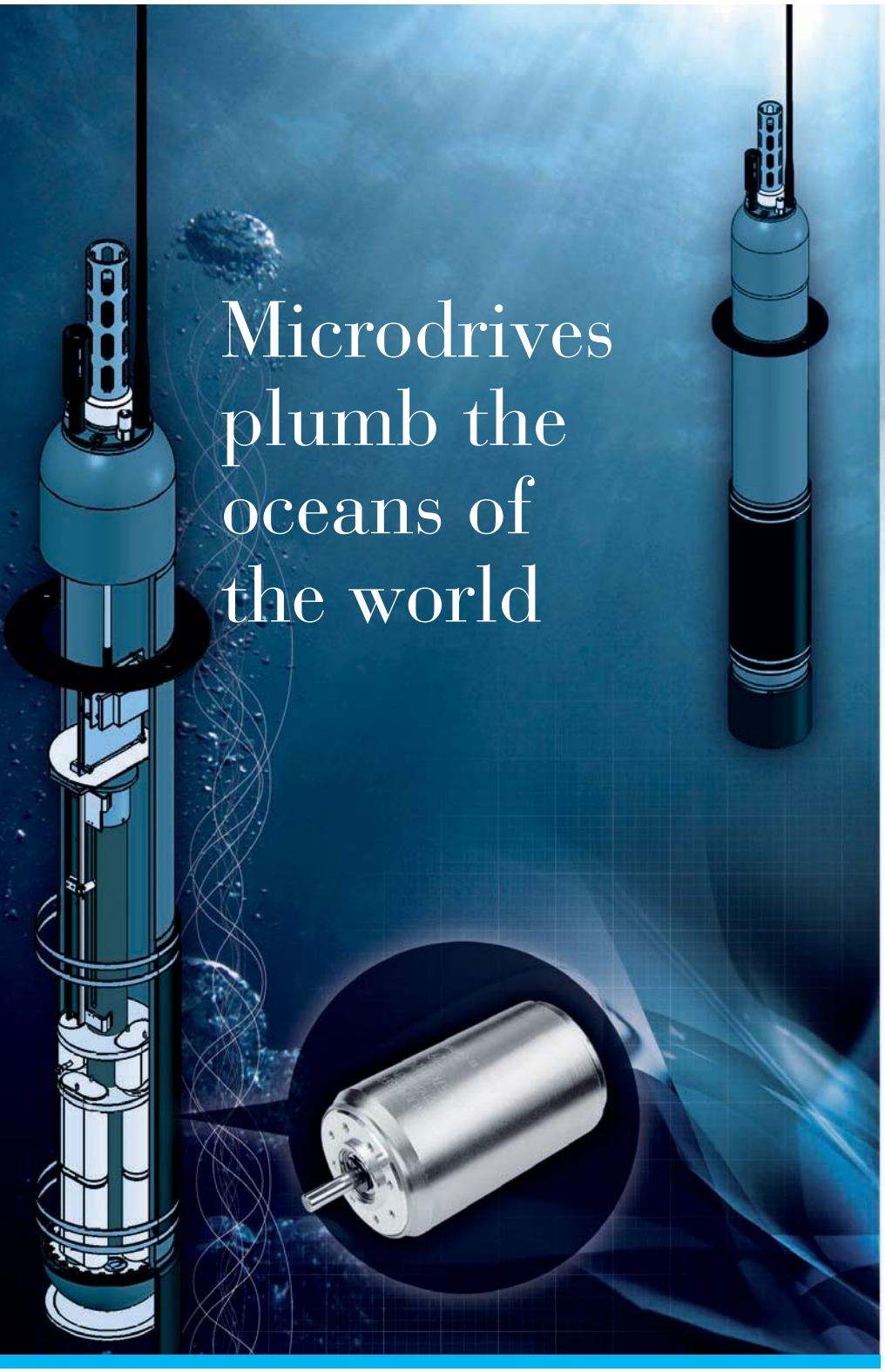
www.lasercomb.com



Microdrives plumb the oceans of the world

ROBUST DC MOTOR DRIVES DEEP-SEA SENSORS

Research often means coping with extreme conditions to retrieve the right data. Marine research is a case in point. Underwater sensors that plumb the depths of the world's ocean have to withstand not only temperature differences but also extreme pressures, yet still deliver reliable readings. Up until now, measuring devices secured to cables or hawsers have generally been used to record such data. This technique is proven and reliable, but the disadvantage is that the data does not become available until after the devices have been recovered. A different concept used in conjunction with state-of-the-art microdrive systems now allows completely independent recording by free-ranging underwater sensors and virtually online data transmission.

As part of the international Argo project to monitor the oceans of the world, around 2,500 free-ranging floats have been deployed so far. In the final phase of the research project, the aim is to have 3,000 permanently deployable floats. The main job of all the sensors is to measure water temperature and salt levels at different depths. Other readings such as clouding of the water and plankton content can be added at a later stage as required. German sensor manufacturer

Optimare Sensorsysteme AG, Bremerhaven, is responsible for building and servicing the NEMO floats contributed by Germany. To make the floats as universally productive as possible, they were designed as independently operating units. This means they are free-ranging, driven only by the currents of the ocean, and capable of recording data below ice as well as from a range of configurable depths. In order to transmit the data via satellite, they come to the surface at pre-determined intervals. To achieve the necessary level of reliability and absolutely maintenance-free depth control, Optimare works with German compact drive systems manufacturer FAULHABER. This is how they managed to come up with a robust, compact system for precise depth control of the underwater sensors.

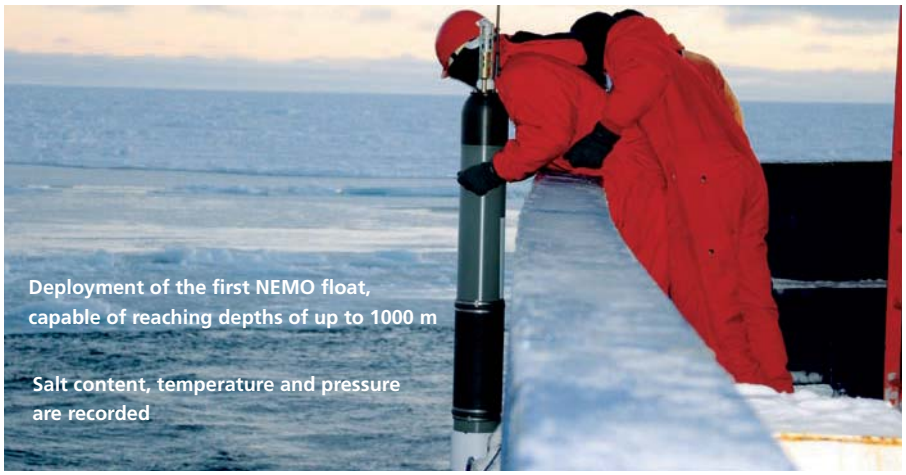
Putting a biological principle to technical use

Since the beginning of time, many species of fish have used a gas bladder to control their buoyancy in the water. This allows them to float in the water without expending any extra energy, by a simple process of regulating the amount of gas in the bladder. This is also precisely what is required of the monitoring floats if they are to record data for the longest possible periods of time. A hydraulic piston filled with oil is the main flotation device. As oil is practically non-compressible, flotation can be maintained at almost any depth. In order to be able to steer the underwater sensor to the desired depth, the amount of oil in the swim bubble is varied via the piston. Depending on how well the bladder is filled, the overall density of the sensor changes and it sinks, floats or rises to the surface. A control piston serves as the drive element, by varying the gas pressure. To add the necessary muscle to these sensors, a DC micromotor performing at around 26 W drives the piston. Thanks to flange-mounted planetary gears with a reduction ratio of 1526 : 1 and a secondary spindle drive, the torque is sufficient to keep it working even at depths of 2000 metres. The motor produced by the micromotor specialists from Schönaich by its very nature has the best possible credentials for the job.

DC drive still current

Timo Witte, Project Manager for developing the NEMO floats, has this to say about it: "For our purposes, the properties of the DC brush motor are ideal. It starts up even with minimal voltage, and the controls are very simple to install in the on-board electronics as an on/off switch". This highly reliable standard motor, with compact dimensions of 35 mm in diameter and 57 mm in length teamed with high-performance output, speaks for itself. Its high efficiency – for a DC motor – of around 80% saves on power reserves. Timo Witte cites another key factor in the selection of this drive system: "Particularly crucial for any free-ranging float is trouble-free start-up, even after long rest periods. This float is guaranteed to work for at least 3 years or for up to 150 dive cycles, but a service life of up to 5 years is quite on the cards. This means the motor has to be reliable enough to work for that period of time." As the actual transition time for setting the depth is only brief, brush wear and tear is not an issue, but the advantage of having a simple, reliable drive is huge. Temperature variations of more than 25 °C in the tropics through to subzero levels in the polar region or around 4 °C for long periods in deep-sea settings will not cause this standard motor any bother. The matching step-down gear is just like one of the standard gears in the catalogue, apart from its modified lubricating grease filler. State-of-the-art microdrives are now almost universally applicable to any field. In many cases a standard drive is sufficient; for tougher requirements it is no problem to produce perfectly adapted, customised versions.

NEMO floats being prepared for deployment (The current version can reach a maximum depth of 2000 m)



Deployment of the first NEMO float, capable of reaching depths of up to 1000 m

Salt content, temperature and pressure are recorded

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www.optimare.de

MEASUREMENT TECHNOLOGY APPLICATION

Precise measurement of bulk materials

BRUSHLESS DC SERVOMOTOR WITH INTEGRATED MOTION CONTROLLER

Bulk materials are, more or less, finely powdered solids with a certain ability to flow. They are stored and handled in many fields of technology. However, their tendency to form inclined surfaces or solidify over time – even at rest – can lead to the formation of bridges or shafts which can hamper (homogenous) discharge from the silo. What is more, collapsing bridges in the silo can even lead to the destruction of the container. To design the silo or pipelines appropriately, the designer has to depend on well-grounded data regarding the flowability of the respective material.

Even in the era of computer-supported calculation processes, results are only as good as the data on which they are based. Established measurement values are therefore essential, especially in face of the countless different bulk materials with what may be extremely different fluidity properties. A new method for determining the material properties can now provide assistance. The ring shear tester developed by Dr.-Ing. Dietmar Schulze Schüttgutmesstechnik relies on

a process that is largely oriented on the standards of the theoretical basics of bulk materials. Electronically commutated DC servomotors with an integrated motion controller from the miniature drive specialist FAULHABER ensure precise mechanical implementation of the control specification in the measurement instrument.

Automatically reproducible measurement values

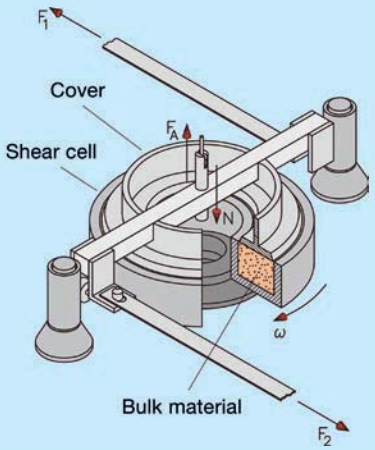
Current measurement processes for determining the properties of bulk materials are based on the measurement of angles of slope. Depending on the system used, this can result in (widely) differing values. A comparison of the data is therefore not possible but still provides good guidelines for assessing loads in practice. In contrast, the new method relies on sample preparation that is practically independent of the operator. The actual measurement then runs fully automatically and is easy to reproduce. For this, a material sample is filled into a circular shear cell and the surface is smoothed off. A cover ring, toothed on the lower surface, now presses on the sample in the rotatable bearing shear cell from above. This so-called normal tension, which is computer-controlled, is sensitively applied up to 20 kPa by an EC servomotor. The ring shear cell is then also driven by an EC motor with digital control in the direction of rotation and speed. The fixed cover on which the normal force acts is fixed via a beam system. In this way the shearing forces that occur in the sample can be determined with great precision. By varying the normal force and determining the associated shear forces, this provides a precise picture of the bulk material properties. Depending on the sample material, shear cells of 9 to 70 ml can be used with the same measurement tester. The servomotors supply the required drive power for this.

Focus on sustainable precision

Any precision measurement instrument naturally places exceptional demands on the drive. As well as excellent control of the RPM and power, a long service life is also important – with excellent long-term stability. Developer Dietmar Schulze (Dr. Ing.) stresses an additional point: "Measurement instruments of this type are only manufactured in relatively low numbers. It is essential that the drive can be quickly and easily incorporated in the instrument. Thanks to the integrated motion controller, the servomotor is quickly connected to the internal computer of the instrument. Separate development is no longer required for the controller. The compact dimensions and sensitive control of the sine-wave motor plus the well-graduated gears available for this solution are further advantages for the deployment of the measurement instrument."

In the case in hand, the RST-XS measurement instrument is equipped with two EC motors. One takes over control of the rotational movement of the shear measurement cell, the other is responsible for setting the normal force. With a diameter of only 35 mm and a length of 64 mm, the motors generate an output power of up to more than 90 W. Thanks to sinusoidal commutation, the drives can be sensitively controlled in compliance with application requirements in the RPM range of 5,000 to 10,000 rpm – an essential prerequisite for this application. As the EC motors are not subject to wear (except for the bearings), the reproducible long-term stability of the measurements is assured. Integrated Hall sensors allow precise positioning and the motion controller takes on communication with the instrument computer. This relieves the computer of the actual motor control, allowing it to process signals already evaluated. State-of-the-art EC motors with integrated control electronics are suitable for a wide variety of tasks – no matter whether high-precision positioning and superior long-term stability is required or it's a question of extended full-load service life for deployment in automation technology. Thanks to the electronics, integration in existing control environments is simple and special know-how of drive technology is not required, thus reducing the development costs and shortening the "time to market".

Measurement method using the ring shear tester



Closely related to the theoretical basics of the mathematical consideration of bulk materials is the measurement with a ring shear tester. Here the sample is preloaded vertically with a force and then exposed to a shear deformation by turning the measurement cell. During this process, the force required for shear deformation is measured. As all parameters are specified to be reproducible, the values that are obtained are also reproducible and can be used to calculate the stiffness of the silo hopper walls as well as the diameter of the discharge outlet in order to avoid the formation of bridges.

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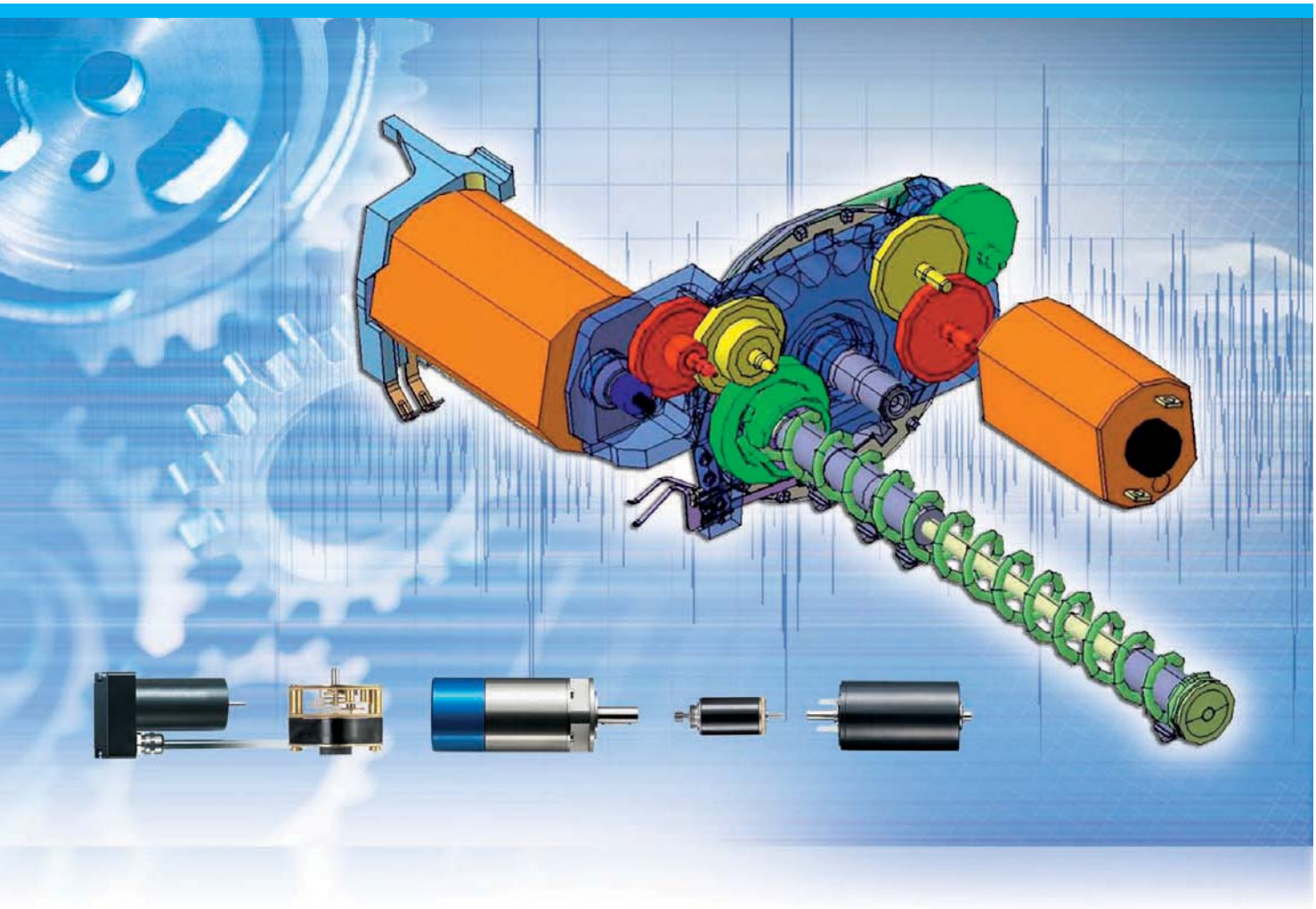
QUALITY

Tracking down vibrations



NOISE MEASUREMENT IN MICRO ELECTROMECHANICAL DRIVE SYSTEMS

Drive systems that have damaged or deformed components, such as gears, will generate undesirable noises during operation. Therefore, it is important to detect them during production so they can be dealt with accordingly. Laser vibrometry has proved to be an optimum measurement technique for this task, enabling non-contact, automatic and reliable quality inspection.

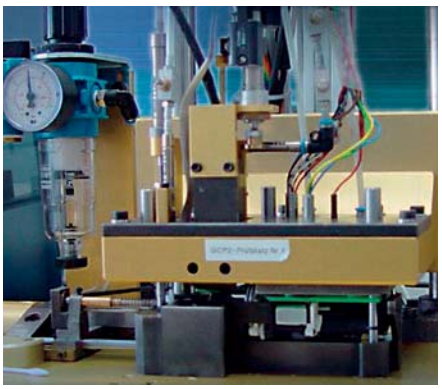
The demands for highest quality and reliability require ever more time-intensive procedures for checking quality. It is often essential to subject each individual product to an additional final check before delivery in order to ensure an error rate of zero as far as possible. Non-contact optical measurement procedures – distinguished by useful features such as absence of interaction, accuracy and, especially, their

advantages with regard to simple adaptation and stability – are being used increasingly for this purpose.

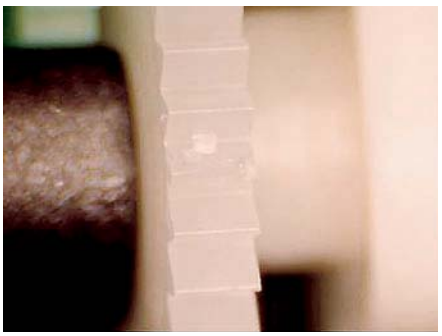
Studies were carried out first of all on the feasibility of automated quality monitoring regarding unwanted operational noise for a customized drive unit from FAULHABER which includes two motors, each with two drive units that have three gears. Even small deviations of the gear geometries produce typical noise characteristics that can be subjectively described as "rattling", "whimpering", "clicking" or "chirping" and that it should be possible to automatically detect in a test stand. The aim was to automatically and reliably analyze the noise characteristics described above at a throughput of 10,000 to 16,000 parts per day with a measurement duration of less than 50 s per test piece – in a cost-effective manner. The manual noise test stands constructed in an initial development phase were to be designed in such a way that integration in the automatic production line would be possible. In a trial run, the laser vibration meter proved to be the best measurement technique compared with airborne-sound measurement and the acceleration transducer.

Construction of the noise test stand

The test stand allows vibration-decoupled mounting of the test piece, where the vibration meter measurement head and the test piece holder are mounted on a common base plate. The vibration measurement is performed at suitable, empirically determined location of the drive at the optimum working distance of the laser. The evaluation software performs the recording and evaluation of the vibration meter data as well as the motor current for the calculation of the system rpm. From the two signals, the energy bands are analyzed using frequency analysis in the vicinity of the 1st and 2nd order of rotation. The classification of the test pieces is then carried out by comparison with a threshold value.



Noise measurement of the drive system in the test stand using a laser vibration meter



Typical gear damage

The system reliably identifies all noise characteristics; a test time of 17 seconds, including handling, was achieved. It was also possible to realize the necessary throughput of up to 16,000 drives per day with 8 test positions.

After the positive experiences obtained with the manual noise test stand, testing within an automatic production line is now in preparation with the aim of subsequent integration in an existing assembly line. Thus, the micro drive systems can be identified/sorted automatically and reliably in accordance with acoustic standards – a further contribution towards ensuring the recognized high quality of FAULHABER products.

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www.polytec.de
www.faulhaber-group.com

NEW DEVELOPMENTS

12 mm

Micro-stepping precision

Scale 1:1

ARSAPE ADM 1220/1220 S series

With the new ADM 1220/1220 S series – and true to the maxim "greater performance in the smallest space" –, ARSAPE has extended its product portfolio in the 12 mm diameter range by including another powerful drive. Boasting a length of just 17.2 mm, it has a lot to offer. A torque of more than 1 mNm is available at a resolution of 20 full steps per revolution. The "boost"-ability of the ADM 1220/1220 S series means torque can be significantly increased when required, which is particularly useful for critical motion sequences. A shaft diameter of 1.5 mm ensures maximum rotational stability.

The motor is constructed using magnetic disk technology that ensures the homogeneity of the magnetic circuit. It is available in two versions, where the standard version ADM 1220 provides a resolution of 20 full steps per revolution with a holding torque in the de-energized state.

Because of its exceptional sinusoidal torque, the motor in the ADM 1220 S version is fully micro step-capable and offers a resolution of 160 steps per revolution. This means the motor operates with extreme precision even at very low rpm. Its rpm range extends from below 10 up to and beyond 6,000 rpm.

The ADM 1220/1220 S series is designed primarily for applications in optics, telecommunication or medical device technology, where high precision is essential. A matching and varied gear program, also with a diameter of 12 mm, extends the operational possibilities of the ADM 1220/1220 S series and makes it possible to increase the torque up to 300 mNm.

weblinks

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12 mm

Maximum performance, miniature footprint

Scale 1:1

FAULHABER 1224 SR series

The new 1224 SR series of DC miniature motors in the 6, 12 and 15 Volt models features a diameter of 12 mm – for maximum performance in the smallest of packages. Its "Faulhaber® system" ironless rotor achieves unparalleled dynamics and high efficiency due to its very low inductivity and extremely small angular momentum. As a result, the new 1224 SR series achieves speeds of up to 13,800 rpm, a stall torque of 5.4 mNm, and 1.8 mNm continuous torque rating plus a delivery rate of up to 2 Watt.

The modular concept, with uniform 12 mm diameter, enables an impressive variety of possible combinations through a large choice of all-metal precision gearheads with reduction ratios of 4:1 to 154.000:1. True planetary gearing in a compact design offers high output torques of up to 450 mNm. Spur gearheads with pre-loaded gears provide high-precision, backlash-free movements of the output shaft.

The 30B series magnetic encoder, available to match the motor, uses a low-inertia, multipolar magnetic disk and Hall sensor technology, plus a TTL level output with 10 lines and 2 channels to ensure the precise velocity and position control of the output shaft of motor and gears as well as the direction of rotation.

These drive systems are extremely well suited for a wide variety of applications in fields such as medical device technology, instrumentation, safety engineering, automation and the aerospace industry, which demand high dynamics and reliability.

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NEWS FROM FAULHABER

Think global, drive local

FAULHABER GROUP ON EXPANSION COURSE

Global production and a consistently high level of competence delivered by qualified consultants providing support on site all over the world – these are the reasons why the FAULHABER Group is such a frontrunner in the global market.

SINGAPORE To ensure the best possible support for customers with projects in the Asian region, FAULHABER has now opened its own office in the promising Asian market. Starting 1 November 2006, the company's applications consultant, Karsten Weilandt will be available at the German Centre in Singapore to provide customer support on site and coordination of after-sales service and purchasing activities.

ROMANIA In July 2006 a new production plant was commissioned in Jimbolia, Romania. Assembly work for various components and the FAULHABER gear range is completed there in a total production area of 900 m². Relocating these production processes to the new site allows FAULHABER to manufacture its recognized high-quality products at marketable prices and thus ensure the global competitiveness of its own operations and its customers.

GERMANY On 23 October 2006 in Schönaich, the birthplace of Fritz Faulhaber GmbH, the first sod was turned of the third construction phase for further expansion of FAULHABER's production and administration buildings. As well as a new customer center with generously proportioned training rooms, additional space for other automated production lines and a new logistics area is being built to house the very latest materials handling technology.

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NEW: THE FAULHABER CATALOGUE

Drive Systems 2006-2007

More than 200 pages are devoted to the enormous range of FAULHABER products featuring in the new 2006-2007 Catalogue. These include micro-drives, DC micromotors, precision gears, power components and controls – high-quality drive technology capable of meeting demanding and complex tasks.

Clearly laid out tables of products and services, including combination options, simplify the selection process and take you quickly and directly to detailed descriptions and technical specifications of individual components.

Order your free copy now!

More information? No problem!

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❑ FAULHABER Drive Systems Catalogue
❑ ARSAPE Stepper Motors Info Pack
❑ FTB Thin Profile Micromotors Info Pack
❑ mymotors & actuators Info Pack
❑ MPS Info Pack

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