**Encoders for Brushless Motor Commutation**

The process of steering current through the appropriate motor windings in order to produce an output torque is called commutation. Before start-up, permanent-magnet 3-phase motors must have an absolute position value available for electrical commutation. There are several solutions from HEIDENHAIN that make this possible, the first of which are absolute rotary encoders. Read more »

**PRODUCT SPOTLIGHT**

**New ADS Online Diagnostics Tool Enables Condition-Based Maintenance for Rotary Encoders**

Leine & Linde's new proprietary advanced encoder diagnostic tool analyzes the condition of rotary encoders and warns of impending faults before they occur. This allows for service to be performed only when necessary and in ample time to avoid unforeseen stops in production. Read more »

**Also in this issue:**

Did You Know...

...that four HEIDENHAIN tape encoders and an EIB interface system are used inside the new **Discovery Channel Telescope** (DCT) at the Lowell Observatory in Arizona to assist with its important positioning and speed functions? Read more »

Industry Pulse

**Excitement at Semicon as HEIDENHAIN Prepares for the Future**

The Semicon West trade show was abuzz as the conference proceedings included sessions on the
HEIDENHAIN HISTORY
For over 100 years, HEIDENHAIN has been a significant force in the precision measurement and motion control industry. This is the first in a series of columns to share the company's origins, background and impact. Read more »

Technical Tidbit

Power Consumption with Feedback Devices
Don't overlook the position feedback system when evaluating the total power usage of a machine. Read more »
Encoders for Brushless Motor Commutation

By Tom Wyatt, HEIDENHAIN Corporation

The process of steering current through the appropriate motor windings in order to produce an output torque is called **commutation**. Before start-up permanent-magnet three-phase motors must have an absolute position value available for electrical commutation.

There are several solutions from HEIDENHAIN that make this possible, the first of which are **absolute rotary encoders**. Single-turn and multi-turn versions provide the absolute position information immediately after switch-on. The exact position of the rotor is known, therefore, can be used for electronic commutation.
Electronic commutation can also be performed with incremental encoders. For sine/cosine encoders we apply a second track referred to as a Z1 track (C&D).

The Z1 track produces a single sine and cosine signal per rotation in addition to the incremental signals. For sine commutation, rotary encoders with a Z1 track only need a subdivision factor and a signal multiplexer in the subsequent electronics in order to produce the absolute position. Additionally, speed and position information will be derived from the incremental track.

The third commutation method is accomplished with an incremental rotary with what is called block commutation, U, V and W.

These encoders are available with various commutation tracks. Typical versions provide 3-signal periods at 120° mechanical or 4-signal periods at 90° mechanical per revolution. Independent of these signals there are also incremental signals used for position and velocity control.
The block commutation signals are transmitted as square-wave signals at TTL levels. 

**Figure 4** depicts 3-standard commutation configurations.

Regardless of the method used, synchronous motors require rotor position information immediately following switch-on. When these encoders are mounted, the rotor positions of the encoder must be assigned to those of the motor in order to ensure the most constant possible motor current. Inadequate assignment to the motor EMF will cause audible noise, heat and high power loss. Refer to **Figure 5**.

HEIDENHAIN also offers diagnostic systems and tools that aid the commutation process.

It is important to note that the RENCO brand offers block commutation with their modular rotary encoders.
Additionally, HEIDENHAIN linear scales of the LIC and LC product lines are used for commutating linear motors. These linear systems provide the exact position upon power-up. This makes it possible to start with maximum holding load on vertical axes, even at a standstill.

*Figure 5: encoder alignment*
Leine & Linde Nows Offers New ADS Online – An Encoder Diagnostic Tool

After 10 years of dependable service, an updated version of the popular ADS (Advanced Diagnostic System) has now been launched by Leine & Linde. The new ADS Online is Leine & Linde’s proprietary advanced encoder diagnostic tool that is tailored to supporting condition-based maintenance. The system analyzes rotary encoder condition and warns of impending faults before they occur. This allows for service to be performed only when necessary and in ample time to avoid unforeseen stops in production.

The significance of a system like this is especially noteworthy in large complex machinery, such as wind turbines or paper-converting machines, where the encoder constitutes a central component for speed feedback with the entire system dependent upon it. Since encoders are subject to wear (service life can vary from a couple of years to a couple of decades), an ADS Online system allows users to better predict and schedule maintenance at convenient times instead of waiting for inopportune breakdowns.

Currently available on Leine & Linde’s robust models 801 and 803 rotary encoder products, ADS Online operates by a connection from the encoder’s diagnostic system direct to a PC or to an Ethernet network which would access to important functioning or trends of the encoder anywhere worldwide. With the assistance of PC software, users can obtain detailed analyses. There are plans to offer ADS Online on other
Leine & Linde encoder models in the near future.

Encoder applications for those with ADS online include the ability to set custom warnings to ensure vibration doesn't exceed specific damaging levels, program levels for frequency and shaft speeds to indicate overspeed or standstills, ensure that the machine does not overheat, prevent voltage drops in the power supply, and choose to receive an automatic warning when the encoder reaches a certain operating time.

More information on Leine & Linde's ADS Online is available here.
HEIDENHAIN HISTORY

HEIDENHAIN has been in existence for over 100 years, with an illustrious history. Originating in Europe and now with approximately 7,500 employees worldwide, HEIDENHAIN continues to serve as an important and significant force in the precision measurement and motion control industry. This column is the first in our newsletter series to share its background.

The Early Days

When Wilhelm Heidenhain opened up his metal-etching company in Berlin in 1889, he had no idea of the successful manifestations it would eventually produce. Metal-etching numbers and symbols onto copper or other metals for weight scales was important work during those days. Successful for many years, Wilhelm's son Dr. Johannes Heidenhain joined him in business in 1923.

Continuing to grow the business with his doctor son in Germany, the two were forced to contend with World War II in the early 1940s. In order to best develop the business during those difficult times, the Heidenhains felt it necessary to move as much of their equipment as possible out of Berlin and onto rail cars. The railroad tracks ended in Traunreut, Germany, at the base of Lake Kimsey overlooked by the Alps, and the Heidenhain's new
Starting over in Traunreut in 1948, the company DR. JOHANNES HEIDENHAIN emerges. Soon after, the revolutionary DIADUR process is invented (production of resistant graduations onto glass by copying a master graduation) by HEIDENHAIN. This process sets the standard for today's machine measurement methods and motion control componentry.

Still the company's worldwide headquarters today, Traunreut has grown by leaps and bounds around its success and commitment to hard work.

Next newsletter History column will begin with the founding of the HEIDENHAIN as a non-profit organization.