The Advantages of Capacitive vs Optical Encoders

CUI INC®

CUI, in partnership with Ingvar Andermo, has developed a proprietary method of measuring rotational movement by implementing an ASIC to detect changes in the frequency of a signal modulated by capacitive reactance. Used for years as the key technology in digital callipers, it has been applied to position encoding in the form of the AMT series modular encoder. Compared to the technology most commonly used in rotary encoders today, capacitive encoding holds many advantages over optical encoding.

TECHNICAL CONSIDERATIONS

PID SYSTEM MODIFICATIONS

An important aspect of motion control is system optimization and loop time modification. When a system's response needs to be modified due to irregular or undesired behavior, the correct change can be difficult to find. Either the system PID times need to be adjusted with timely code review and modification, or the line count (resolution) can be adjusted. With the AMT, the ability to dynamically modify the resolution greatly simplifies the system response modification process. The PID control engineer simply adjusts the line counts of the encoder, evaluating the overall response time until the desired result is obtained. Using an optical encoder, this process would require several different versions to be purchased, increasing overall cost and lengthening the design cycle.

DUST & DIRT

An optical encoder's performance is influenced by dust, dirt, and other contaminants gathering on the optical disk. This causes repeatability issues because the LED cannot pass light through the disk to the optical sensor. Once an optical disk is contaminated, the encoder must be replaced. The AMT, being an ASIC driven product, is not affected by dust and dirt build-up. This results in much more rugged, reliable performance.

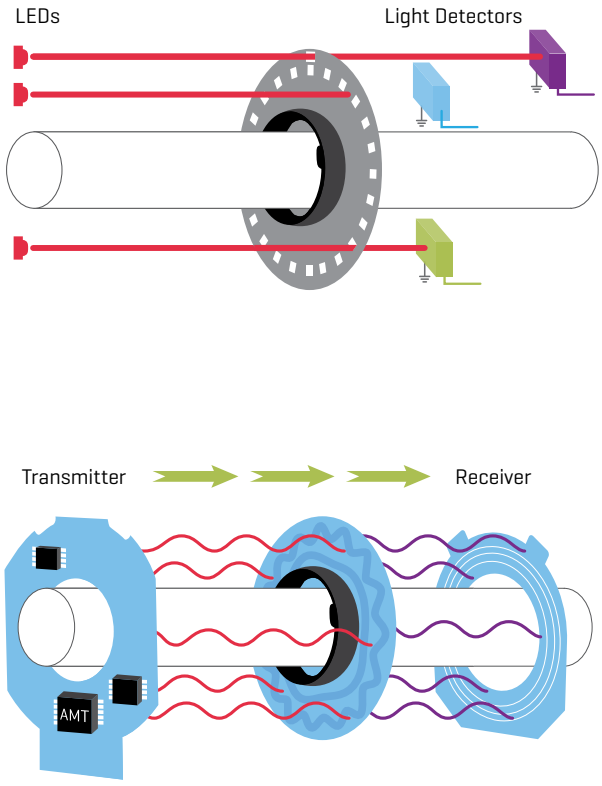

Figure 1: Unlike an optical encoder that relies on line of sight optics, the AMT utilizes an electromagnetic field to transmit signals, eliminating vulnerabilities to environmental contaminants such as dust, dirt and oil.

TEMPERATURE

Just as contaminants have the possibility of influencing the incremental output of an optical disk, temperature variations also impact the performance of an optical encoder. The LEDs, and to some degree the optical disks used in optical encoders are susceptible to thermal stress and have limitations on both ends of the temperature range. The AMT's ASIC technology is less sensitive to heat and cold, offering reliable operation between a wider temperature range.

VIBRATION

The AMT encoder's ASIC-based construction is far less susceptible to vibration than the fragile glass disk of an optical encoder.

Figure 2: An optical glass disk and AMT rotor compared side by side.

LED BURNOUT

All optical encoders use an LED to generate the light signal that passes through the etched disk to the optical sensor on the other side. The LED has a limited lifespan, leading to eventual failure of the encoder. The AMT avoids this issue thanks to the use of a semiconductor instead of an LED.

CURRENT CONSUMPTION

As designers look for ways to meet the market's growing demands for "green" products, every mA saved becomes vitally important. A typical optical modular encoder meets a current consumption range of 20~50 mA. The AMT provides a range of 6~10 mA, offering a much more efficient solution ideally suited for mobile and battery-operated applications.

INSTALLATION

The AMT was designed with ease of installation in mind. Compared to an optical modular encoder, the AMT is quicker and easier to install, saving the OEM precious installation time and fall-out expense that typically occurs through misalignment of the modular optical disk. For detailed assembly instructions please visit *www.cui.com/resources/product-resources.*

Certain models, including absolute and commutation models, incorporate a "One Touch Zero" feature, allowing the user to flash the zero position to the encoder in mere seconds. Installing a commutation optical encoder onto a brushless DC motor (BLDC) can be an iterative and time consuming process. The optical disk must be physically and precisely rotated to align with the correct motor windings. Once aligned, the assembly must then be checked via back EMF to ensure mounting accuracy. This process can take upwards of 15 minutes per motor. The AMT, being ASIC and MCU based, reduces this time consuming process to a few mere seconds via the "One Touch Zero" feature saving endless hours and dollars during the manufacturing process.

VERSATILITY

The AMT series capacitive encoder offers up to 20 programmable resolution choices from 48~4,096 PPR. The AMT also comes with multiple sleeve sizes to fit any round back shaft and numerous mounting options in each base. A customer could therefore implement the same encoder sku number across multiple applications, reducing inventory costs and increasing purchasing power. A standard optical encoder comes with a single fixed resolution, a single bore diameter, and a smaller selection of mounting options, greatly reducing its ability to be used across multiple applications.

SLEEVE SIZES AND COLORS

Blue	8mm
Snow	6.35mm (1/4 in)
Red	6mm
Green	5mm
Yellow	4.76mm (3/16 in)
Gray	4mm
Purple	3.175mm (1/8 in)
Orange	3mm
Sky Blue	2mm

AMT kits come with 9 color-coded sleeves that will adapt to 9 different motor shaft diameters.

SUMMARY

Encoders are typically applied in environments that aren't considered ideal. Temperature, vibration, and contaminants are real threats to incumbent encoder technologies. The AMT series was specifically designed to operate reliably and accurately in challenging designs where precise motion feedback is required. This, paired with the flexibility and programmability of the AMT, makes it a compelling solution in a range of industrial, robotics, automation and renewable energy applications.

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