



CASE STUDY

Enabling High-Precision Hollow Shaft Actuation with **AksIM-2 Encoders**

Customer:

MAB Robotics, Poland

Industry:

Robotics

Challenge:

Integrating reliable, high-precision absolute position sensing into a compact hollow shaft actuator with limited internal space.

Solution:

AksIM-2™ off-axis absolute magnetic encoder

BACKGROUND

The rapid evolution of mobile robotics in logistics, agriculture and service sectors is driving demand for more advanced motion control solutions. This creates new challenges for companies developing robotic systems.

One of those companies is **MAB Robotics**, a Poland-based developer of motion control technologies and robotic systems. The company specialises in high-performance actuators and integrated solutions for mobile and industrial robotics. With a focus on precision, reliability and durability, MAB uses its motion control expertise and proprietary motor control technology to develop actuators that can be adapted for different applications. These include legged and mobile robots, as well as aerospace, research and industrial automation.

In robotics, actuators are a critical component. They determine how precisely and efficiently a system can move and interact with its environment. Modern robotic applications require solutions that combine high power density, compact design and precise control. At the same time, they must be easy to integrate into increasingly complex systems.

These demands are even greater in mobile robotics. Systems must operate reliably in harsh, real-world environments. Actuators need to perform consistently despite exposure to vibration, dust and moisture. They must also provide accurate and stable position feedback to ensure smooth and predictable motion.

CHALLENGE

MAB Robotics develops a range of actuator solutions to support different robotic applications. These include direct drive actuators (MA-d), actuators with planetary reducers (MA-p), harmonic reducers (MA-h), and the MA-hs series, which features a hollow shaft design.

The **MA-hs actuators** are designed with a central opening that allows cables and hoses to pass through the actuator. This approach provides several advantages, including improved space efficiency, simplified integration, and reduced clutter and wear on external connections. It also prevents restrictions in the actuator's range of motion.



MA-hs actuator

However, this design introduces significant engineering challenges. Creating a compact, high-torque actuator with a hollow shaft leaves very limited internal space. There is little room for bulky or complex components, particularly sensing systems, which are essential for precise motion control.

To ensure accurate and stable operation, MAB Robotics required an encoder capable of delivering precise position feedback within this highly constrained space. The solution needed to provide absolute position data from start-up, without the need for homing procedures. It also had to operate reliably in demanding environments, where exposure to vibration, dust and moisture is common.

At the same time, the encoder had to integrate seamlessly into the actuator design. The MA-hs architecture uses a brushless motor and mechanical reducer arranged to preserve the central passage, along with advanced sealing to protect internal components. Position feedback is required both for motor communication and output shaft measurement, further increasing integration complexity.

These combined requirements created a clear need for a compact, robust and highly accurate sensing solution that could operate reliably without compromising the actuator's design or performance.

SOLUTION

The **RLS AksIM-2 absolute magnetic encoder** provided an effective solution to the challenges of integrating position feedback into the MA-hs hollow shaft actuators. Its compact, off-axis design and simple two-component structure allow it to fit within the limited available space, without affecting the actuator's mechanical layout.

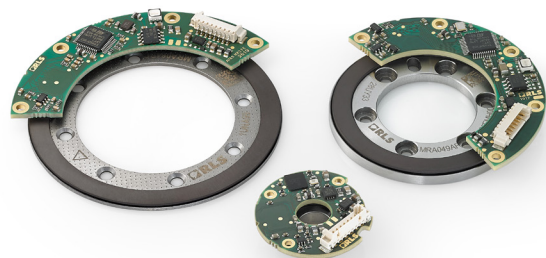
The encoder delivers **true absolute position feedback** from the moment of start-up eliminating the need for homing procedures. This ensures immediate availability and simplifies system operation, which is particularly important in mobile robotic applications.

At the core of the system is a custom magnetic sensor ASIC, which enables high-resolution and accurate position measurement. With accuracy in the range of $\pm 0.004^\circ$ to $\pm 0.020^\circ$ and resolutions of up to 20 bits, the encoder provides the precise and consistent feedback required for smooth motion control.

The low-profile readhead and thin, axially magnetised ring enable seamless integration into hollow shaft designs. This allows position feedback to be implemented without adding complexity or increasing the size of the actuator.

In addition, the encoder supports multiple communication interfaces, including BiSS-C, SSI and asynchronous serial protocols. These standard interfaces simplify integration with a wide range of motor drives and control systems.

The AksIM-2 encoder also integrates effectively with MAB Robotics' motor control architecture, forming a compact and high-performance motion control solution suitable for a wide range of mobile robotic applications.



AksIM encoder family

RESULTS

The collaboration between MAB Robotics and RLS enabled the development of a new generation of compact, high-torque hollow shaft actuators without compromising performance or reliability.

By providing accurate and stable position feedback within the space constraints of the hollow shaft design, the AksIM-2 encoder contributed to improved motion control, increased system precision and consistent actuator performance. Its ease of integration also supported a more streamlined design process, helping to reduce development complexity and accelerate time to market.



AksIM encoder integrated in the MA-hs actuator

As a result, MAB Robotics has expanded its actuator offering with modular solutions that combine compact design, high torque density and reliable operation. These actuators are used across a wide range of mobile robotic applications, where precision and dependable performance are critical.

We see RLS not just as a supplier, but as a trusted technology partner. Their encoder technology perfectly complements our actuator designs, enabling us to achieve unparalleled accuracy and reliability in our solutions. Together, we're helping our customers innovate faster and set new benchmarks in robotic motion control.

– Jakub Bartoszek, CEO of MAB Robotics

FUTURE GOALS

MAB Robotics aims to further advance motion control technologies that enable more capable and efficient robotic systems. The company continues to focus on developing modular, easy-to-integrate actuator solutions that reduce system complexity and support faster development cycles.

Looking ahead, MAB Robotics plans to expand its technologies across a broader range of mobile and industrial applications, supporting the continued growth of robotics in demanding real-world environments.

ABOUT MAB ROBOTICS

MAB Robotics is a Poland-based developer of motion control technologies and robotic systems. The company specialises in high-performance actuators and integrated solutions for mobile and industrial robotics, with a focus on precision, reliability and durability.

For more information visit mabrobotics.pl

ABOUT RLS

RLS is a Renishaw associate company. RLS produces a range of robust magnetic rotary and linear motion sensors for applications such as industrial automation, metalworking, textiles, packaging, electronic chip/board production, robotics and more.

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