Case study

Magnetic encoders help maximize the efficiency and safety of Sparkfield fitness device

Customer:
Sparkfield, Germany

Industry:
Robotics, health and fitness

Challenge:
To achieve high-precision sensing with a large bandwidth that perfectly adapts to the user's mobility and biometric data.

Solution:
AksIM-2™ redundant rotary absolute magnetic encoder

Background

Sparkfield is a company that develops the strength training device Sparkfield Core, which combines advanced robotic technologies with personalized strength training for all muscle groups. Founded in 2021, the company has received patents in the US, China, and Europe and continues to expand its intellectual property portfolio.

Sparkfield Core offers users a varied and effective workout with a particularly low risk of injury. It is aimed at a wide range of users, offering a safe and efficient introduction for beginners and helping professional athletes to achieve their ambitious goals.

Sparkfield Core replaces numerous specialized machines with already 20 released exercises, including the "Big Five": shoulder press, bench press, lat pulldown, squat and deadlift. The selectable training methods include eccentric overloads, isokinetic and isometric training, supersets and drop sets. Trainers and physiotherapists benefit from lab-grade data and comprehensive muscle training that can be individually adapted to the user's biomechanics, both in terms of resistance and the movement itself. In early 2023, Sparkfield Core successfully completed endurance and stress tests to meet studio standards. It also received approval and CE certification.

Sparkfield Core machine

Challenge

Sparkfield's goal is to offer a quality full-body strength training program in the environment preferred by its customers. It's benefits are time efficiency, customization of excercises and training progress monitoring.

Exercise on the device

Sparkfield has developed patented kinematics and combined it with modern human-machine interaction schemes and data analytics. Sparkfield Core provides the necessary mechanical degrees of freedom and flexibility of a robot to enable all movements horizontally, vertically and along any intermediate path. This enables the device to offer exercises for all muscle groups.

In contrast to conventional weight-based systems, the resistance in the Sparkfield Core is controlled by electric drives and managed purely via the software. This enables the use of all modern training methods. What is particularly noteworthy is that the system supports variable load profiles that take into account a person's individual strength capacity throughout the entire movement.

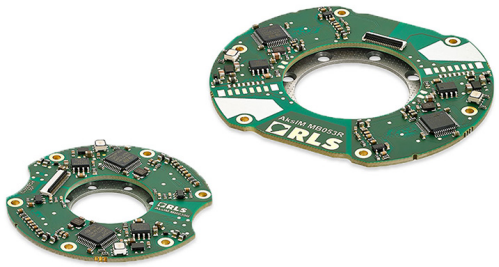
Sparkfield founding team with early prototype

In addition, the adjustable individualization is extremely precise. Sparkfield Core processes the forces on the left and right side of the body thousands of times per second, down to the gram. This helps to detect imbalances on horizontal and vertical dimension and it provides an objective assessment of execution and fatigue. This ensures balanced development of the individual and reduces the risk of injury.

Solution

Sparkfield Core is technically very similar to a collaborative robot. The interaction with the user is based on path planning and force interaction. This results in similar technical requirements for the system as for robots that require precision and safety functions. The company uses a redundant AksIM magnetic sensor to detect the movement of joint angles and to ensure the integrity of the sensor signals through redundancy. Continuous monitoring allows to detect operational errors and react accordingly.

The AksIM-2 has a built-in advanced self-monitoring function that continuously checks various internal parameters. Error reports, warnings and other status signals are available at all communication interfaces and via the integrated LED.



RLS AksIM-2 redundant rotary absolute encoder

The AksIM-2 redundant encoder system consists of two identical, fully independent and electrically isolated encoder modules combined on a printed circuit board and a separate, axially magnetized ring. The redundant version of the encoder is ideal for higher safety applications, as this configuration can be used to monitor the position via two independent channels, with a difference of approximately 180° between the channels. Thanks to the digital barcode magnetization on the ring, the encoder is fully redundant even when using a single ring.

Its low profile and non-contact design allows installation in tight spaces that are not accessible for conventional encoders. This is particularly important in applications where reducing the component footprint is essential.

Results

For Sparkfield, it was important to consider the entire system concept. Ensuring the required accuracy, data rate and appropriate interfaces was crucial for optimum performance of a fitness device. Additionally, the integration of the encoders into the overall system was critical, including the identification of the necessary mechanical components and their precision.

Sparkfield chose the AksIM sensor because it can be calibrated with little effort and is quick and easy to set up and use. This choice has streamlined the integration process and improved the overall efficiency and accuracy of the fitness device, demonstrating clear benefits in meeting Sparkfield's system requirements.

> *The cooperation with RLS is characterized by a high level of expertise. There is excellent documentation for all components and a competent staff provides rapid assistance with implementation concepts and troubleshooting.*
>
> Amos Albert, CEO and CTO of Sparkfield

Future goals

Following a successful pilot phase, Sparkfield has now launched the first series production based on the RLS sensors. Delivery of the first customer systems will begin in September 2024. Sparkfield Core demonstrates its full potential in quality-focused settings with limited space, including micro studios, physiotherapy, and corporate health promotion. This allows even SMEs to offer their employees the best possible training experience with a highly user-friendly design.

Micro-studio setting

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.

For more information visit **www.rls.si.**

About Sparkfield

Sparkfield offers compact, efficient strength training solutions, combining robotics with advanced fitness methods to deliver full-body workouts in minimal space.

For more information visit **Sparkfield website.**

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