magnetfabrik bonn

Applications Brief

Current information from Magnetfabrik Bonn

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New solutions to new challenges – Magnets for high-resolution angle measurement based on the Vernier principle

Absolute magnetic position sensors, incremental encoders and commutation encoders are used for high-precision position control, for example in the robotics field. IC encoders controlled by means of magnetic multipole wheels generate position data in real time. The achievable angular precision is to a great extent limited by the possible interpolation depth and the available field quality. Using sensor techniques based on multi-track/Vernier principles, it is possible to achieve significant improvements in accuracy during absolute measurements. Due to the narrowly defined and highly precise magnetization, the tracks are either generated using a bipolar technique with a write head or through the magnet geometry within a unipolar approach (see Fig.1).
Magnetfabrik Bonn GmbH has developed a technology with which bipolar magnetization is achieved not by means of a writing technique but using a pulsed method. In this way, the sensor requirements can be optimally fulfilled using economical polymer-bonded hard ferrite magnets.

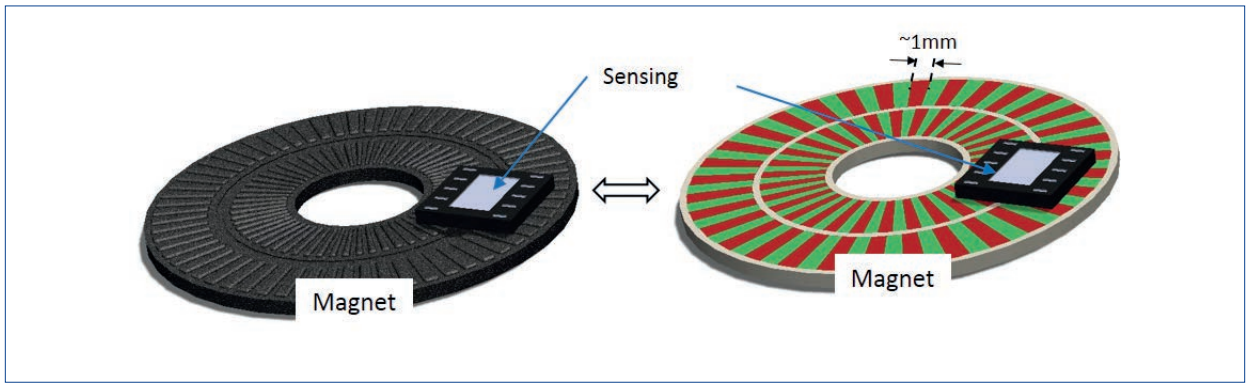

Fig. 1: Structured/unipolar vs. bipolar magnetization with the same mode of operation

In most cases, magnet field sensors scan a diametric magnet centrally (on-axis) at the end of the shaft. By contrast, off-axis solutions are based on radially or front-magnetized multipole rings. Generally speaking, the resolution and precision of magnetic sensing are poorer than that provided by optical angle sensors. However, magnetic solutions are more economical and are suitable for environments characterized by the presence of oil and dust.

Robotic applications demand the high-precision detection of joint angles. To achieve this, incremental sensors with multiple Hall elements are combined with muli-pole magnets.

For absolute measurements, Vernier measuring techniques have been successfully implemented in the robotic components. A combination of multitrack magnetization with multisensor ICs detects the absolute angle at high resolution and in high precision.

The magnetization pattern for this measurement method consists of two or more multipole tracks with a distance between the poles of just a few millimeters. These magnets can be produced by imprinting a mechanical structure on the magnet surface (unipolar) or by means of a direct magnetization pattern (bipolar) (see Fig. 1).

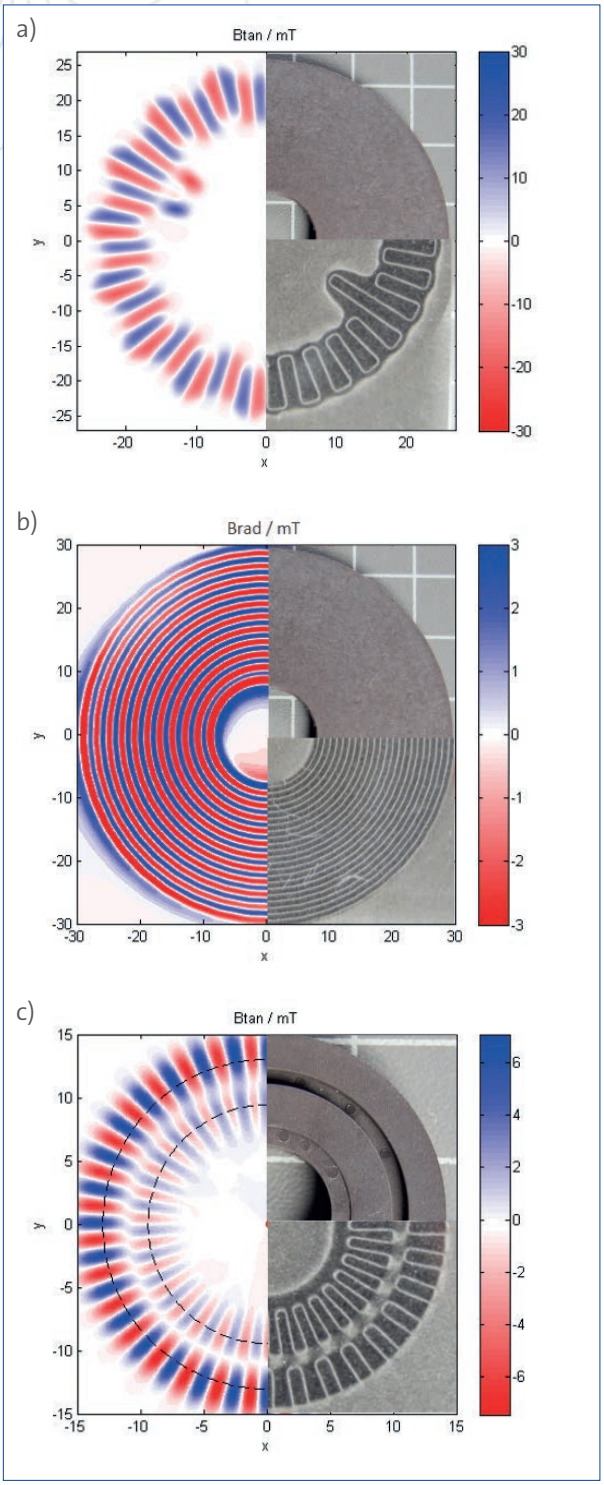

Fig. 2: a) Magnetization pattern for incremental encoder;
b) & c) Multi-track magnetization for Vernier signal

Magnetfabrik Bonn GmbH has developed a new magnetization technology for direct multipole magnetization with a very small distance between poles as of approx. 1 mm. A pulsed technique makes possible the economical, highprecision magnetization of polymer-bonded hard ferrite magnets. Thanks to the bipolar magnetization, the magnetic flux density is considerably higher than in the case of structured magnets. Based on the use of this technique, it is possible to suppress the signal offset in the case of flat geometries.

Fig. 2 shows examples of (a) magnetization patterns for incremental encoders, (b) a Vernier measurement system used in robotics and (c) a magnetic ring with two-track magnetization as Vernier for a sensor in series production at iCHaus.

The low cost of the material used in the magnet and the carrier-free design are considerable advantages compared to the magnet systems available on the market. The chosen magnetic material, a hard ferrite in a PA6 matrix, is suitable for applications up to 140 °C (depending on the thermal and mechanical load). Depending on the application, the material can be adapted and the magnetization principle can be transferred to different magnet geometries.

The newly developed multi-track magnetization technique can be used both in the abovementioned absolute angle detection for robotic joints as well as in torque sensors. Using the multi-track magnetic ring, it is possible to achieve high-resolution angle detection of up to 20 bits. Consequently, the torque can be detected by attaching multi-track magnet rings and magnetic angle sensors to the two ends of a torque rod.

We would be delighted to work with you to design a magnet solution specially tailored for your application.

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