APPLICATIONS SENCAM – 3D MAGNETIC FIELD CAMERA

TRUE high-resolution and high-speed 3D magnetic camera

Description

SENCAM is the World's First True 3D Magnetic Field Camera with the smallest head ever.

The 3D Magnetic Camera features a compact chip positioned within its small head, making it the perfect tool for magnetic systems development, quality assurance, inline inspection applications and on in production lines, where the mounting space is essential. Its space-efficient design ensures seamless integration into tight work environments, enhancing its utility for critical tasks in various industries.

It simultaneously measures all three magnetic field components (Bx, By, Bz) using SENIS proprietary 3D Hall technology. The camera provides comprehensive and accurate pictures of magnetic fields in three dimensions.

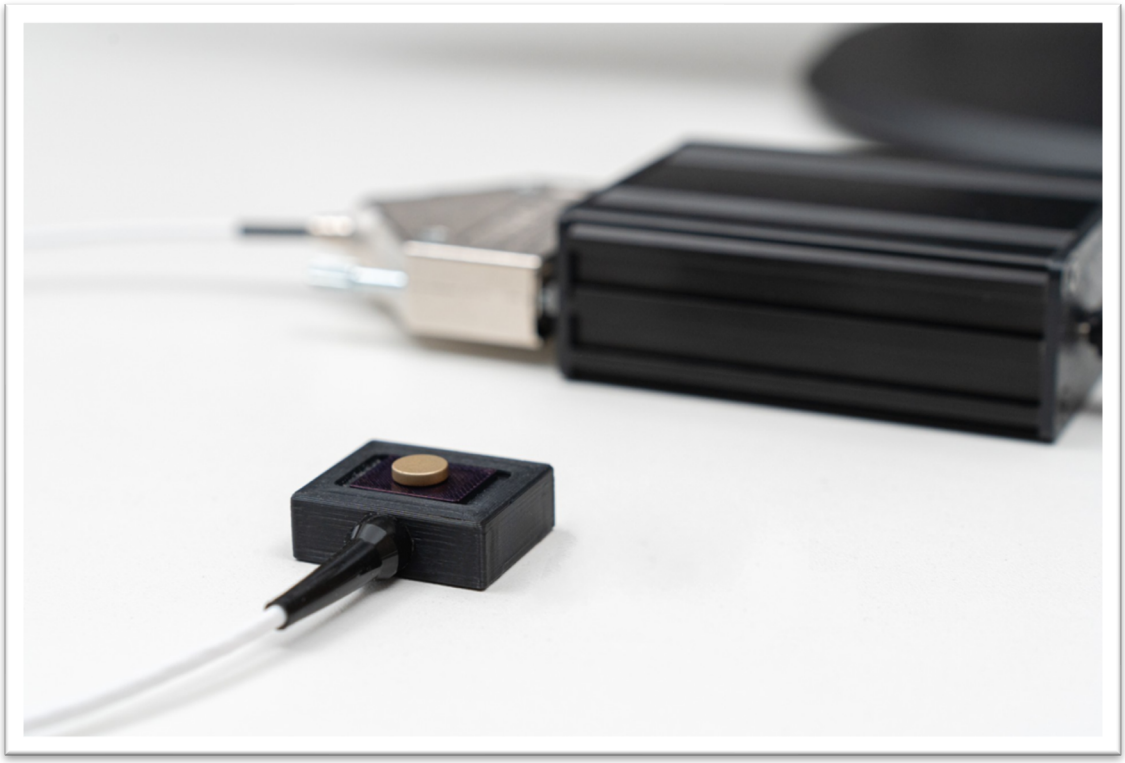

Figure 1: SENIS 3D Magnetic Field Camera SENCAM with USB cable output

Key Features

- Fast, true, and precise 3D magnetic field camera
- Compact head for easy installation into various application
- Measures all three 3 field components of a magnetic field (Bx, By, Bz)
- Very high magnetic and spatial resolution (**16k pixels**)
- World's smallest sensitive volume of **27µm x 9µm x 4µm** in each pixel
- High image acquisition rate of up to **7 image/s**

Applications

SENCAM enables measurement of a wide range of geometries with accuracy and efficiency, offering unparalleled speed and precision.

The 3D Magnetic Camera is enhancing measurement capabilities and enabling detailed analysis of samples ranging from micrometers to centimeters. With an industry-leading speed of up to 7 magnetic images per second, SENCAM delivers unmatched performance for applications requiring rapid and reliable results.

Whether in R&D labs, quality assurance, or production lines, SENCAM adapts seamlessly to diverse environments, making it a reliable tool for professionals aiming to push the boundaries of innovation.

The examples presented in this document showcase the exceptional capabilities of the SENIS 3D Magnetic Camera, a cutting-edge tool for precise magnetic field measurements. These demonstrations highlight the unique features and advantages of the system, including:

Accurate 3-Axis Magnetic Field Measurements: The SENIS 3D Magnetic Camera delivers unparalleled precision in capturing all three magnetic field components with more than 16’000 pixels which each has its own FSV with the size of 27µm x 9µm x 4µm. This capability is exemplified by the permanent magnet mapping, which relies on the system’s ability to detect minute variations in magnetic fields with high accuracy.

Exceptional Magnetic Resolution: The camera achieves remarkable sensitivity, measuring magnetic fields with resolutions below 0.5 mT. This is firmly demonstrated in the credit card magnetic stripe mapping, where the system detects subtle field variations that define the encoded data.

High Spatial Resolution: Designed for detailed analysis, the SENIS 3D Magnetic Camera offers spatial resolutions below 1 mm, enabling precise measurements of small-scale features such as those in credit card stripes and the magnetic fields generated by current-carrying wires.

Fast Measurement Capability: The camera combines speed with precision, capturing dynamic magnetic fields in real time with unpreceded speed of 7 frames/s. This is showcased by the magnetic pen demonstration, where high-speed acquisition enables detailed visualization of the letter “S” drawn with the pen.

Through these examples, this document underscores the SENIS 3D Magnetic Camera’s versatility and performance, making it an ideal tool for applications ranging from research and development to quality control in production environments.

Figure 2: SENIS 3D Magnetic Field Camera with Optical Camera - SENCAM Full Configuration

Permanent magnets

SENCAM delivers precise and efficient measurement solutions for permanent magnets, enabling accurate characterization of their magnetic properties. With its high-resolution, it ensures fast and reliable analysis of magnet field distributions, making it ideal for quality control and various applications development.

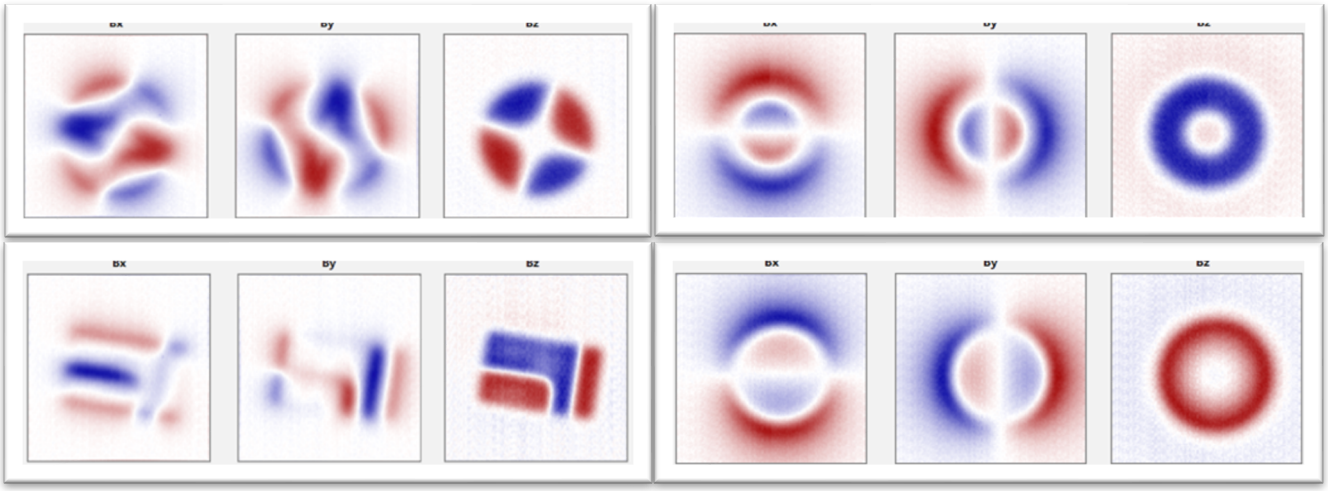

Figure 3: SENCAM permanent magnets visualization from SENIS Vision Software

The images showcase high-resolution 3D magnetic field measurements captured using the SENIS 3D Magnetic Camera. Each visualization represents the precise distribution of magnetic field components (Bx, By, Bz), illustrating intricate patterns and symmetries within various magnet geometries. The red and blue gradients highlight the polarity and intensity of the fields, offering valuable insights for analyzing magnetic properties.

These measurements demonstrate the SENCAM's capability to map magnetic fields with exceptional clarity and accuracy, making it an indispensable tool for magnet characterization and quality control across diverse applications

Applications:

- **Magnet Manufacturers**: SENCAM has ability to analyze the complex field distributions in permanent magnets of various geometries. Manufacturers can use SENCAM to verify magnetic designs and ensure uniformity in multipole or custom magnets.
- **Magnetic System Development**: SENCAM allows to inspect and optimize magnet patterns for magnetic sensors, encoders, and magnetic couplings.
- **Research and Development**: SENCAM assists academic and industrial labs to acquire detailed visualizations for studying and improving magnetic material properties and their field distributions.

Magnetic Field Measurement of Credit Card Magnetic Stripes

The magnetic stripe of a credit card contains encoded information stored in precisely aligned magnetic domains. Accurate measurement and analysis of the magnetic field distribution along the stripe are crucial for ensuring proper functionality, security, and compliance with industry standards.

Using the SENIS 3D Magnetic Camera, the magnetic properties of the credit card stripe can be visualized and analyzed with a very high resolution. This setup enables detailed mapping of the magnetic field components (Bx, By, Bz) along the stripe, identifying variations in intensity, alignment, and potential encoding errors.

The results provide valuable insights for quality control in manufacturing processes, optimization of encoding methods, and troubleshooting issues in the card's magnetic functionality. With its unmatched speed and precision, the SENCAM 3D Magnetic Camera is the ideal tool for inspecting and verifying the performance of magnetic structures.

Figure 4: Credit card magnetic stripe and credit card on SENCAM chip

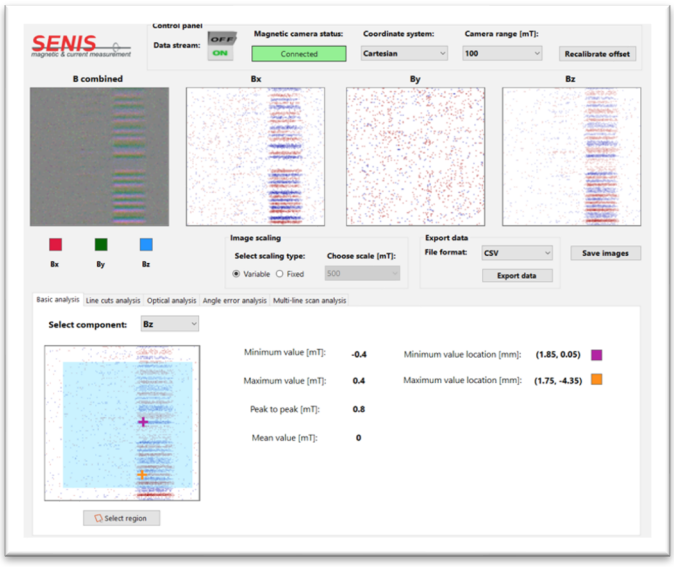

Figure 5: SENIS Vision Software with measurement of the Credit Card magnetic stripe

Applications:

- **Banking and Payment Industry**: Ensuring the magnetic encoding on credit card stripes complies with ISO/IEC standards for secure data storage. SENCAM allows to verify magnetic data integrity and detect potential errors or damage during the production process.
- **Security and Forensics**: Detecting fraudulent alterations or wear on magnetic stripes in financial fraud investigations.

Magnetic Field Measurement of a MacBook Power Cord Connector

The magnetic properties of a MacBook power cord connector play a vital role in ensuring secure connections, efficient charging, and proper alignment with the device. Analyzing the magnetic field distribution within the connector helps validate its design, functionality, and manufacturing quality.

With the SENIS 3D Magnetic Camera, the magnetic field around the power cord connector can be measured and visualized with exceptional precision and speed. This setup allows for detailed mapping of the field components (Bx, By, Bz), revealing the spatial distribution of magnetic flux and identifying potential anomalies or misalignments in the connector's magnetic system.

These measurements provide valuable insights for design optimization, quality assurance, and troubleshooting. The SENCAM 3D Magnetic Camera's high resolution and fast measurement capabilities make it a valuable tool for evaluating and enhancing the performance of magnetic components in consumer electronics.

Figure 6: MacBook Power Cord Connector and charger

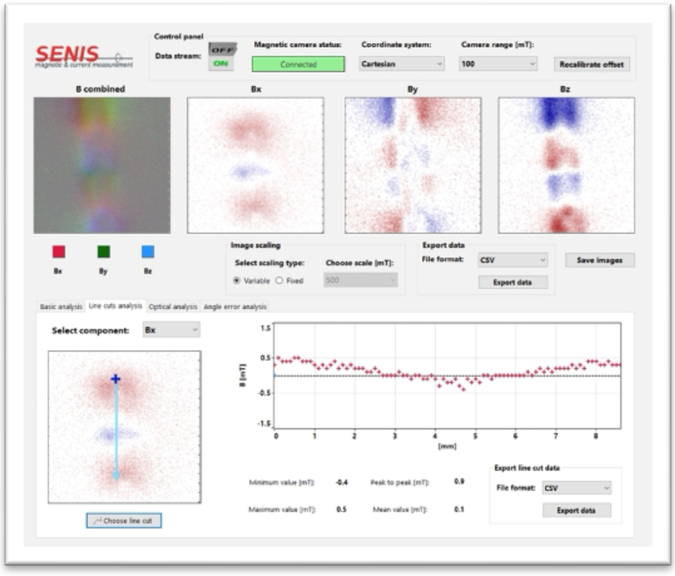

Figure 7: SENIS Vision Software with measurement of MacBook Power Chord Connector

Applications:

- **Consumer Electronics Manufacturing**: SENCAM properties allows to analyze and optimize the magnetic alignment of connectors in power cords or magnetic charging systems, ensuring proper functionality and a secure fit.
- **Quality Control**: During production, manufacturers inspect connectors for consistent magnetic performance, ensuring alignment for charging safety and reliability.

Magnetic Field Measurement of a Cracked Magnet

Cracks or defects in magnets can significantly affect their magnetic performance and reliability in critical applications. Analyzing the magnetic field distribution of a cracked magnet provides valuable insights into the extent and impact of the defect.

Using the SENIS 3D Magnetic Camera, the magnetic field of the magnet can be precisely measured and visualized. The resulting magnetic field map reveals variations in the magnetic flux caused by the crack, highlighting distortions or disruptions in the field components (Bx, By, Bz). This allows for accurate identification of the defect's location and its influence on the overall magnetic behavior.

These measurements are essential for assessing the magnet's quality, diagnosing production issues, and ensuring its suitability for use. The SENCAM 3D Magnetic Camera's high resolution and speed make it the perfect tool for detecting and analyzing defects in magnets, ensuring consistent performance and reliability.

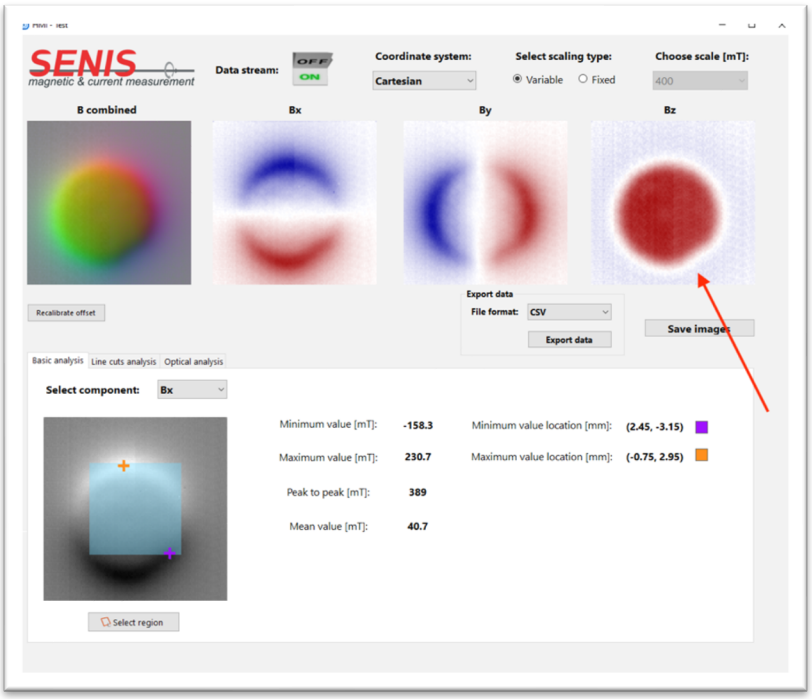

Figure 8: SENIS Vision Software with measurement of a Cracked Magnet

Applications:

- **Automotive Industry**: Assessing the quality and durability of permanent magnets used in electric vehicle motors or sensors, ensuring no defects compromise performance.
- **Industrial Machinery:** Inspecting magnets in rotating equipment like generators or magnetic couplings to detect cracks that could lead to operational failure.
- **Aerospace and Defense**: Inspecting high-performance permanent magnets used in navigation systems or advanced machinery to ensure structural integrity and performance reliability.

Visualization of Magnetic Writing with Magnetic Pen

The ability to capture and analyze dynamic magnetic patterns demonstrates the versatility and precision of the SENIS 3D Magnetic Camera. Using a magnetic pen, the letter "S" was written directly on the camera's chip surface, creating a visible magnetic field pattern that was instantly detected and displayed in the software.

To capture the entire letter visibly, the camera operated at a reduced acquisition rate, allowing the system to average and stabilize the magnetic image over fewer frames. This adjustment ensured that the full magnetic trace of the letter "S" was clearly visible, showcasing the flexibility of the camera's acquisition and image averaging capabilities.

This demonstration emphasizes the camera's adaptability for capturing dynamic magnetic fields while maintaining high-resolution detail. Such functionality is ideal for analyzing custom magnetic patterns, exploring transient magnetic phenomena, and optimizing acquisition settings for different applications. The SENCAM 3D Magnetic Camera provides unmatched control and precision for studying magnetic field behavior.

Figure 9: SENCAM with Magnetic Pen and letter "S" writing

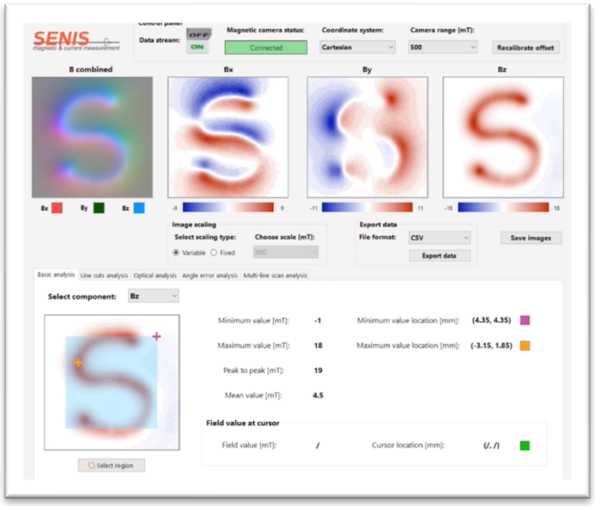

Figure 10: SENIS Vision Software with visualization of "S" letter

Applications:

- **Magnetic Ink and Material Testing**: In manufacturing environments, companies producing magnetic inks or materials (used in anti-counterfeiting measures or secure documents) can use SENCAM to verify the precision and strength of magnetic patterns produced during the printing or encoding process.
- **Magnetic Device Prototyping**: Engineers testing magnetic sensor arrays or custom field designs can use magnetic writing to visualize how fields interact with their prototypes in real-time.

Current-Carrying Wire Measurement

The ability to accurately measure and visualize magnetic fields around current-carrying conductors highlights the exceptional performance and versatility of the SENIS 3D Magnetic Camera. In this demonstration, the magnetic field generated by a single current-carrying wire was mapped in detail.

To ensure precise visualization, the camera's high spatial resolution captured the magnetic field profile with very high accuracy. Additionally, the system's ability to measure all three magnetic components provided a comprehensive view of the field dynamics surrounding the wire.

This demonstration underscores the camera's suitability for analyzing magnetic fields generated by electric currents in various settings. Such functionality is particularly valuable for assessing current distribution, verifying electromagnetic behavior in circuits, and optimizing designs in applications like power electronics, automotive systems, and electromagnetic compatibility testing. The SENIS 3D Magnetic Camera's precision and adaptability make it a perfect tool for studying and controlling current-induced magnetic fields.

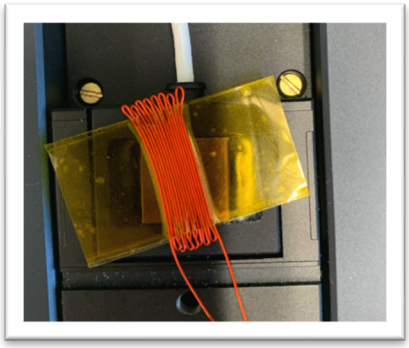

Figure 11: Wire coil placed on SENCAM chip

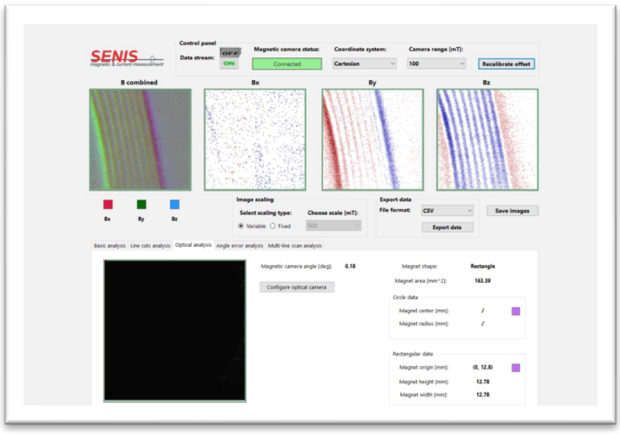

Figure 12: SENIS Vision Software with visualization of the magnetic field of the wire with current

Applications:

- **Power Electronics Development:** Assessing and optimizing magnetic field distributions in PCB traces and high-current power supply lines.
- **Cable Testing and Diagnostics:** Verifying the current-carrying capacity and identifying potential hotspots in power cables and connectors.
- **Electromagnetic Compatibility (EMC) Testing:** Analyzing stray magnetic fields in current-carrying components to ensure compliance with EMC regulations.
- **Automotive and EV Industries:** Evaluating current pathways and electromagnetic interference (EMI) mitigation in electric vehicle wiring systems.

Angle error measurement of the sensor magnets

The SENIS 3D Magnetic Camera, together with an optical camera, provides a precise method for calculating the angle error of a sensor magnet by accurately mapping the magnetic field distribution of the magnet. By capturing all three components of the magnetic field with high spatial resolution, the system enables detailed analysis of the magnet orientation and uniformity.

In this demonstration, the SENIS 3D Camera Full Configuration measured the sample area and the magnet surface and correlated the measurement with an optical measurement derived from the optical analysis. Using SENIS's proprietary technology, correlation of the two measurements can be achieved with very high speed and accuracy. The software calculates the angle error by counting the number of poles and comparing the measurement to an ideal magnet.

These deviations were used to determine the angle error, making the magnet suitable for applications requiring precise angular measurements, such as rotary encoders or position sensors.

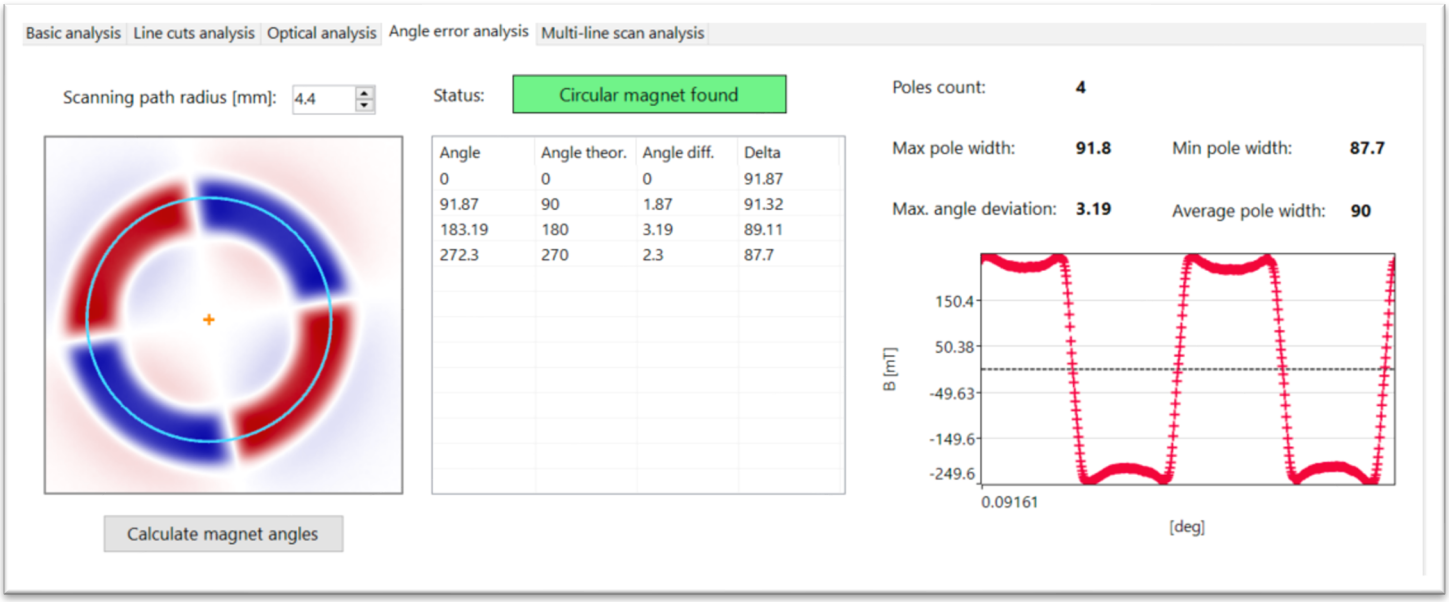

Figure 13: SENIS Vision software with visualization of the sensor magnet's magnetic field and analysis and angular errors

Applications:

- **Quality Control in Magnet Production:** Verifying angular accuracy of magnets used in sensors.
- **Sensor Calibration:** Ensuring precise alignment in applications like automotive steering systems and robotics.
- **R&D for Magnetic Sensors:** Optimizing magnet designs to reduce errors in sensing systems.

Multi-line scan analysis

The SENIS 3D Magnetic Camera's multi-line scan functionality allows users to analyze the magnetic field distribution across multiple straight-line paths, providing a comprehensive view of the field variations over a defined area. This feature is highly customizable, enabling users to adjust the number and orientation of the scan lines, as well as their positioning within the scan area.

In this demonstration, the system performed a multi-line scan with five horizontal scan lines, evenly spaced across the defined scan area. Users can set the start and end positions of the scan area, and the software automatically adjusts the spacing between lines to ensure uniform coverage. This flexibility is particularly useful for observing localized field variations, gradients, or uniformity over specific regions.

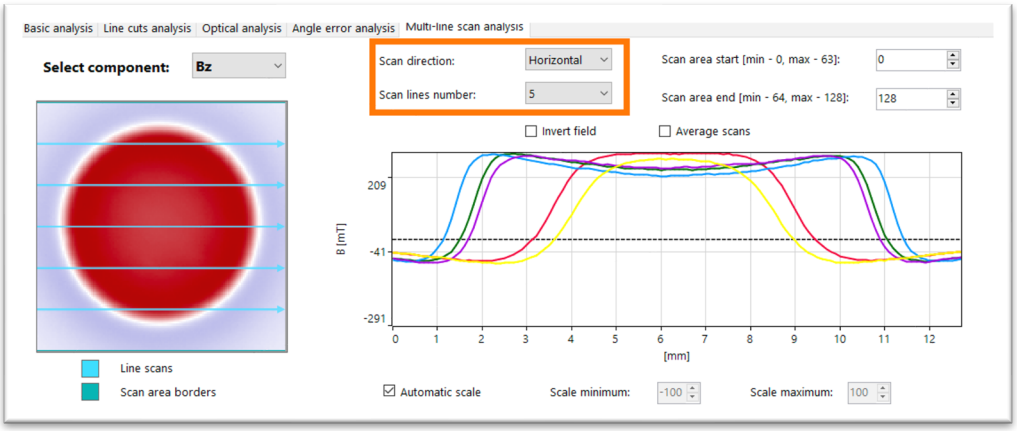

Figure 14: SENIS Vision software with visualization of the horizontal multi-line measurement results

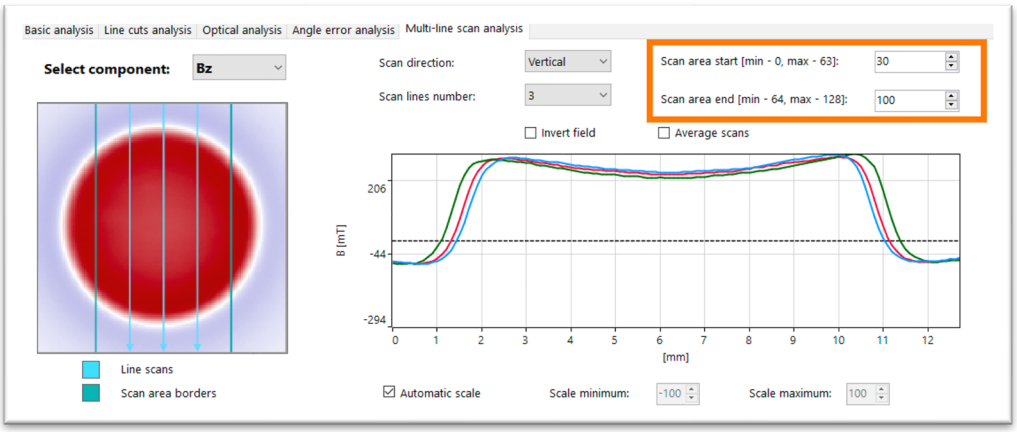

Figure 15: SENIS Vision software with visualization of the vertical multi-line measurement results

Applications:

- **Magnetic Array Analysis:** Evaluating the consistency and alignment of magnets in sensor arrays or motor assemblies.
- **Production Lines:** Performing fast verification of magnetic properties in large volumes of magnets or magnetic assemblies during manufacturing, ensuring compliance with quality standards.
- **Quality Control:** Detecting magnetic field irregularities in large components like magnetic sheets or encoders.
- **Research and Development:** Mapping field variations over multiple sections to optimize designs in magnetic devices.