WEPV013

DESIGN OF MAGNET MEASUREMENT SYSTEM BASED ON MULTI-HALL SENSOR

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Introduction

- Magnetic confinement plays a decisive role when stabilizing the accelerator beam.
- Directly using magnetic field strength, as a feedback signal is a promising solution.
- Limited by the sampling rate and accuracy of magnetic field measurement.

Magnetic Field Measurement

Fig1. NMR(PT2026)

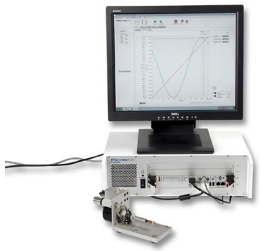

Fig2. Fluxmeter

Fig3. Group3 HALL

Overall Structure of System

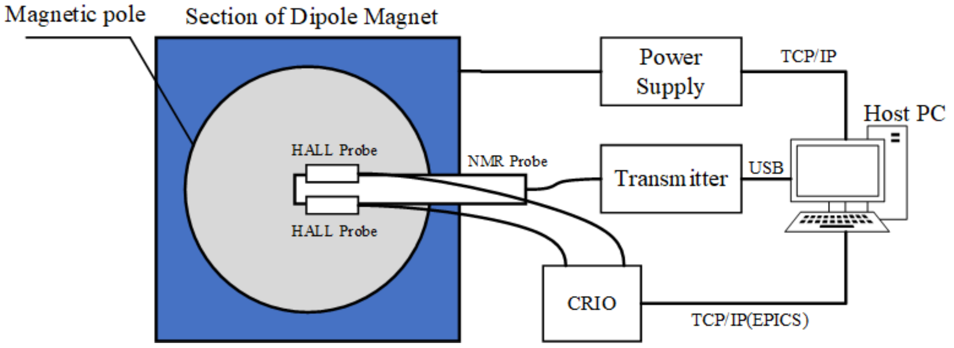

Fig4. Overall structure of magnetic field measurement system

Simulation Performance

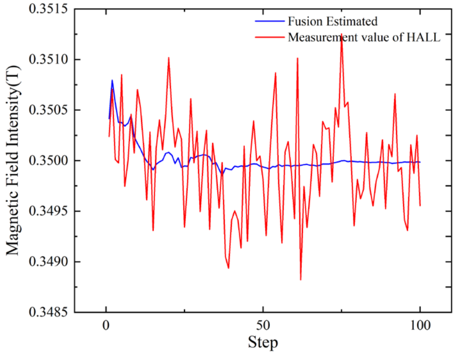

Fig5. Performance comparison(a)

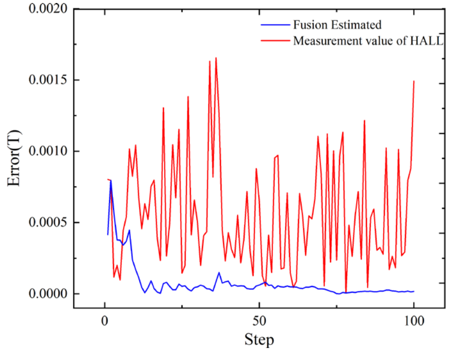

Fig6. Performance comparison(b)

Introduction

- Magnetic confinement plays a decisive role when stabilizing the accelerator beam.
- The control of magnetic confinement is mostly based on the feedback of the power supply current to implement of the current input of magnet which indirectly ensures the stability of the magnetic field. However, this method is difficult to ensures the effect of the control of the magnetic field, due to magnet’s own factors such as magnet eddy current and iron core aging.
- Directly using magnetic field strength, as a feedback signal becomes a more promising solution. Nevertheless, it is limited by the sampling rate and accuracy of magnetic field measurement.
- In this paper, A measurement system is designed with multiple-Hall sensor. The final simulation results show that the measurement error of the magnet measurement system can be significantly reduced by using the adaptive fusion algorithm of multi-hall sensors.

Magnetic Field Measurement

Fig1. NMR(PT2026)

- ✓ High precision
- x Sampling frequency is than expected
- x Need a certain period of time to lock the value of non-uniform magnetic field

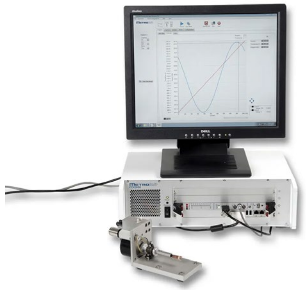
Fig2. Fluxmeter

- ✓ Dynamic measurement
- x Size is large, which makes it difficult to be broadly deployed


Fig3. Group3 HALL

- ✓ High sampling rate
- ✓ Excellent dynamic characteristics
- ✓ Small volume and easy deployment

Overall Structure of System

- Standard dipole magnet is used as the detection object
- NMR is used as the measurement datum
- NI CompactRIO (CRIO) is used for data acquisition and processing of four-way Hall sensors

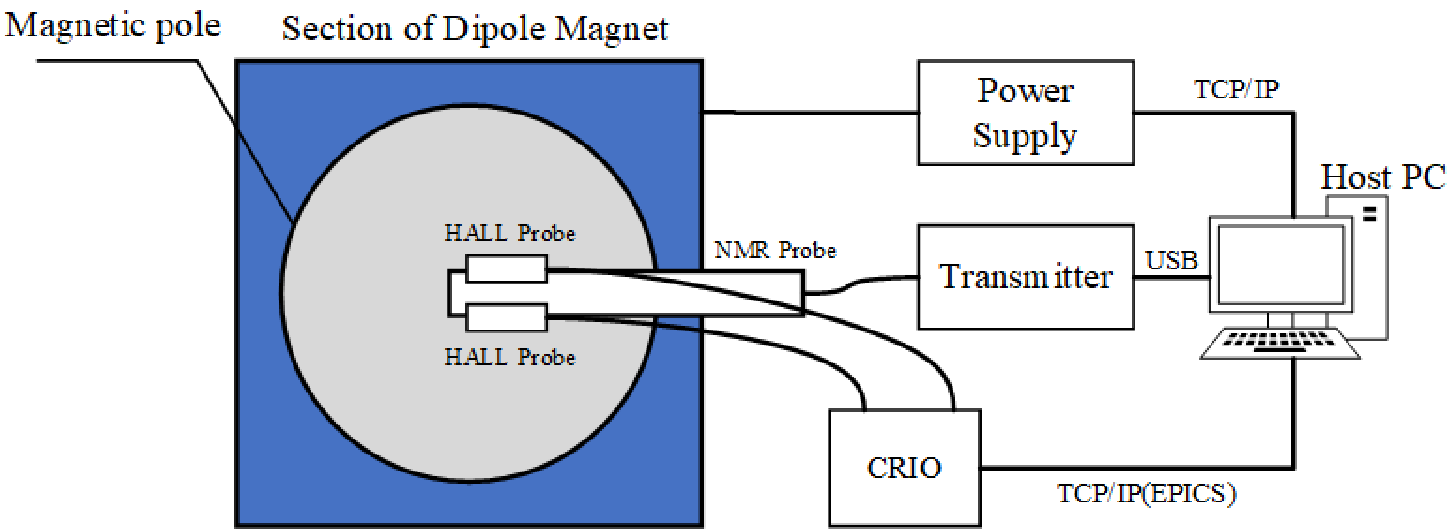

Fig1. Overall structure of magnetic field measurement system

- ☐ The host connects with CRIO and power supply through TCP/IP .
- ☐ The CRIO runs the EPICS program to publishes PVs.
- ☐ Magnetic field measurements of NMR are directly transferred to the host through USB.

Simulation Performance

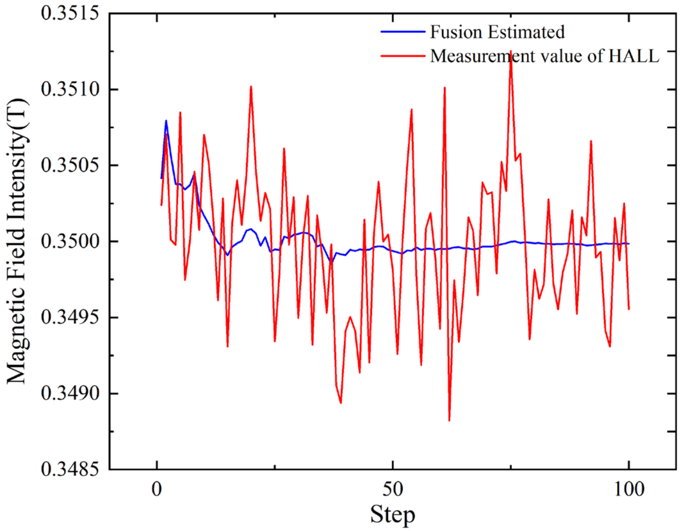

Fig1. Performance comparison(a)

- The measurement value of a single Hall sensor fluctuates around 0.35T.
- The estimated value of adaptive fusion will have a short-term drift at the beginning due to insufficient data. As the number of data increases, the magnetic field data will become stable and converge to the true value.

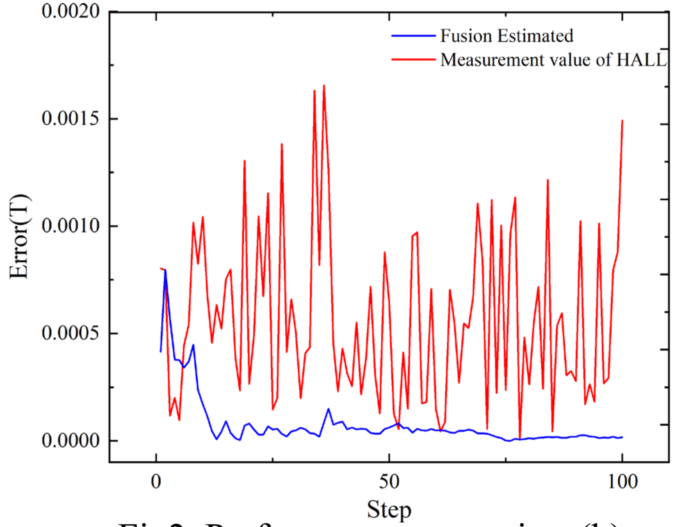

Fig2. Performance comparison(b)

- The adaptive fusion algorithm can greatly reduce the measurement errors
- After using the adaptive filtering algorithm, the error quickly converges to the minimum with the step size