THE HALL PROBE MAGNET MEASUREMENT FACILITY FOR BEPCII

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Abstract

The Hall Probe magnetic field measurement facility is used to measure the dipole and quadrupole prototypes of BEPCII storage ring and the special magnets of IR. The longitudinal motion range of the device is 2.5 meters. Two axes can be automatically controlled. It support point by point measurement and can measure different kinds of magnets, for example, the bending magnet with the circle measurement trajectory. The features and architectures of the control and DAQ system are described. The measurement interface and measurement process are also presented.

INTRODUCTION

The Hall Probe magnetic field measurement facility is used to measure the prototype magnets of BEPCII storage ring including dipole, quadrupole and the prototype of IR special magnets. This device can be used to perform the field measurement and analysis of

- The point by point field mapping and field integral
- Field strength
- Gradient field
- The harmonic field analysis of multipole magnets.
- Check and calibrate the measurement results of the long coil method .

LAYOUT OF THE FACILITY

The Hall Probe measurement facility is composed of a Teslameter with a Hall Probe, 3-axis high precision mechanical motion bench, control box and power supply.

Figure 1: The measurement bench.

The hall probe is fixed on the measuring rod. The rod can be installed parallel to the longitudinal axis or horizontal axis. The layout of the Hall probe measurement bench is shown in figure 1.The Horizontal and longitudinal axes of mechanical motion bench can be automatically moved, vertical axis can be adjusted manually. The motion range are 300mm in horizontal (x), 200mm in vertical (y) and 2500mm in longitudinal (z) respectively. The position accuracy is less then 0.01mm. The bench is made of marble.

DESCRIPTION OF THE CONTROL SYSTEM

Hardware

Each component of the control system is commercially available instrumentation packages for PC(see Fig.2).

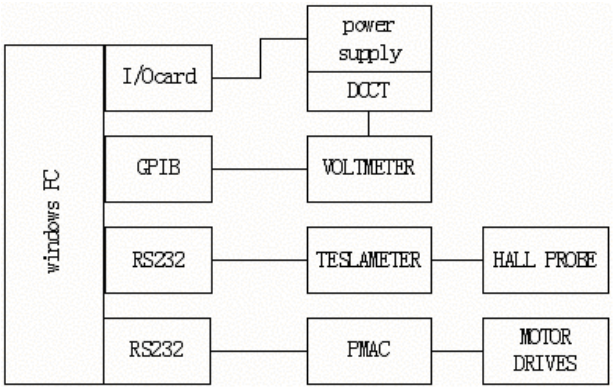

Figure 2: Block diagram of control system.

I/O card (pcl-730) is used to implement remote control of the power supply for magnets.

The value of magnet current from DCCT is read by voltmeter (HP 3455A) and then is transmitted to PC via GPIB.

The Teslameter (DTM-151) and Hall Probe(MPT-141) are supplied by GROUP3. The active area of the MPT-141 Hall Probe is 1×0.5(mm). The probe is calibrated at many hundred field values, each at a range of temperatures and the correction coefficients stored in the probe itself. Therefore, the measurement data of magnetic field need not to be corrected even though the environment temperature has a little change during measurement.

PMAC card controls the movement of horizontal and longitudinal axes of measurement bench. The motor adopts AC servomotor. The complex motion program, for example, the circular measurement trajectory for curvature bending magnet and the complex measurement trajectory that can not be expressed as expressions like ISPB (Interaction region SePtum Bending magnet) of BEPCII can be edited and downloaded to the PMAC card.

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The position feedback is provided by the incremental encoder with reference mark instead of the shaft encoder. The resolution of the incremental encoder is 1 micrometer.

Through using the position comparing function of the PMAC the "on the fly" measurement can be performed. The real-time capability of the teslameter is not good enough, and the point by point method is not time consuming. The interval of point by point measurement can be reduced to 0.5 s. The "on the fly" measurement method is not applied.

Software

We develop the measurement control/DAQ program based on Visual Basic. Most of the commercial products provide with drivers based on Visual Basic such as PMAC and I/O card. Furthermore, VB is easy to learn and program.

The interface for operator is friendly and graphical(see Fig. 3).

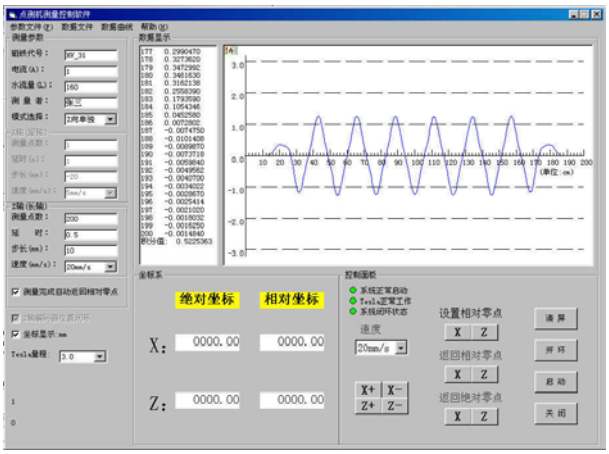

Figure 3: The Interface of operator.

FIELD MEASUREMENT

Before magnet measurement, hall probe should be put into the zero gauss chamber to make absolute zeroing. it also should be installed perpendicular to the measured component of magnetic field. The point by point measurement process is shown in Fig.4.

The Hall probe moves towards the measurement position. As soon as the probe arrives the measurement position, the in-position status flag will be changed from 0 to 1. After a short interval, the measurement value of Teslameter and position are transmitted to the PC. In order to improve the field measurement accuracy, it takes five measurement data at one measurement point. The magnetic field value at the point is the average of five readings.

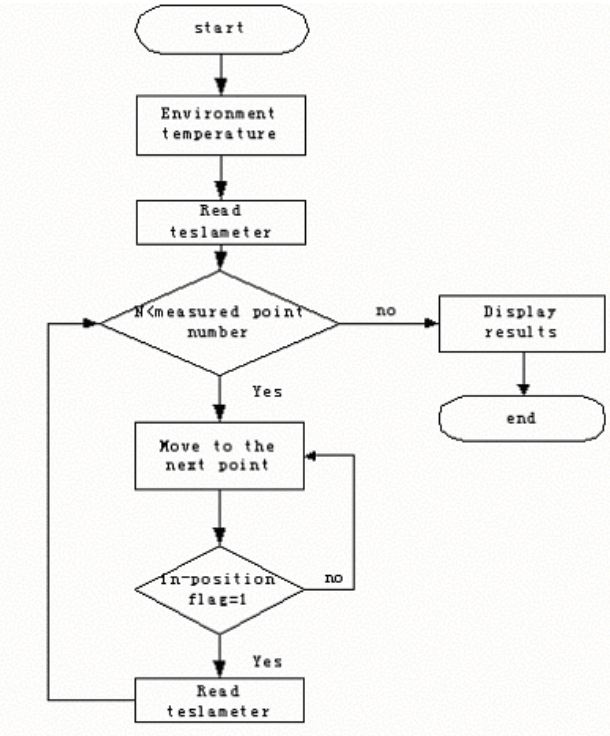

Figure 4: The flowchart of measurement.

CONCLUSIONS

The 1W1 wiggler for BSRF has been measured after the Hall probe magnetic measurement facility was fabricated. The facility has the following features:

- All components of the control system is commercially available. They are easy to program.
- The special magnet along the complex measurement trajectory can be measured effortless.
- The efficiency of measurements is high(the interval between the measurement points is about 0.5 second)
- The "on the fly" measurement method is tested.

However, the complex DAQ has to take advantage of EXCEL or MATLAB software packages because of the insufficiency of DAQ of Visual Basic.

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