Magnetron Sputtering Cathode Magnetic Field Mapper

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Category:
Design R&D

Products Used:
NI USB-6008
LabVIEW 8.0
Trio Motion Controller 206

The Challenge:
Developing a system to provide and accurate two-dimensional map of the magnetic field produced by complex cathode geometries used for custom sputtering applications.
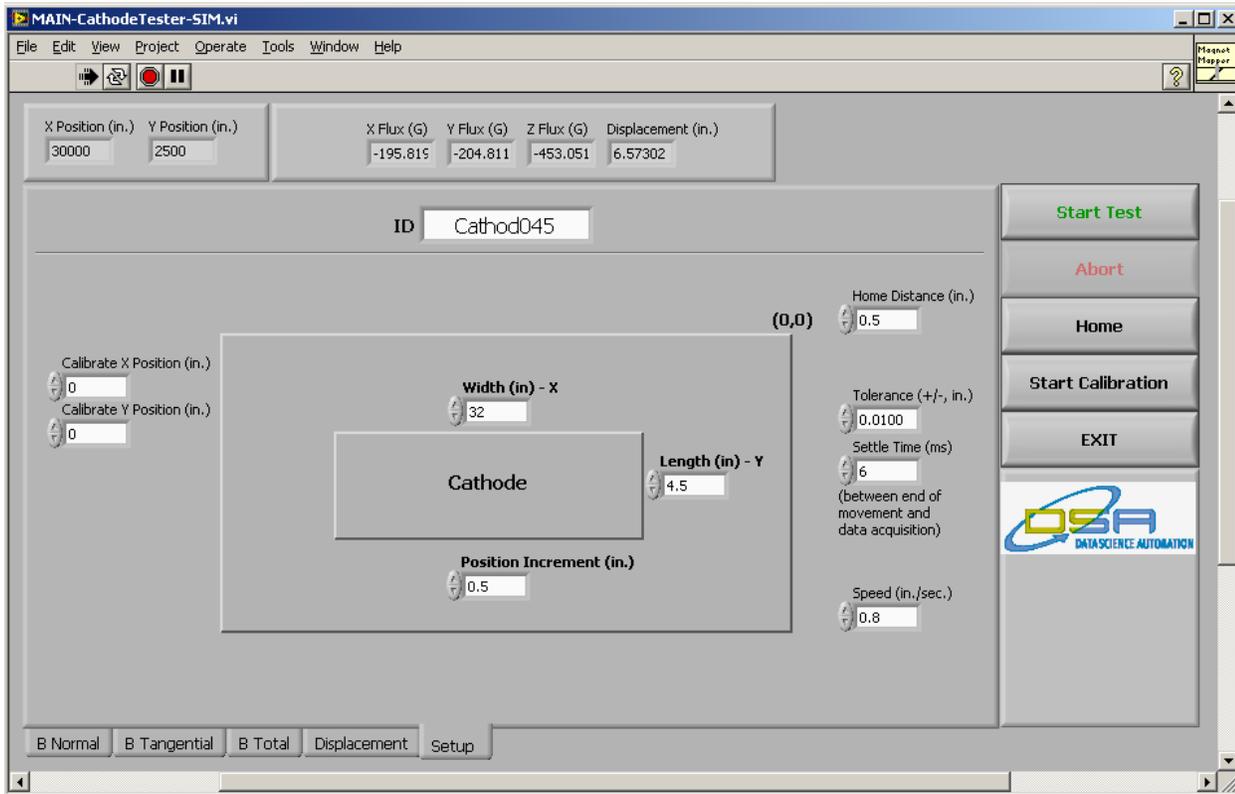
Figure 1. Setup Tab

The Solution:
Data Science Automation was selected to develop an automated test application which would control a third-party Trio Motion Controller using an ActiveX interface, acquire data from the magnetometer via a low cost NI-USB 6008 data acquisition device and store the results to a Microsoft Excel spreadsheet.

The Abstract:
The client specializes in the manufacture of custom cathodes that are a critical component of magnetron sputtering technology. They required a test application to map the two-dimensional magnetic field of the cathodes they create and use to conduct sputtering. Sputtering is a vacuum deposition technique for coating objects from semiconductors to credit cards.

Previously, the testing was done by a technician holding a magnetometer above the cathode from a certain distance and writing down the measurement readings. This was very tedious as some cathodes are large in size. The testing of the cathodes is important for the profiling of their magnets in order to better control the sputtering process.
The challenge was to improve the current procedure by automating the cathode testing. Instead of the technician holding the magnetometer over the cathode, a motion controller would move over the area of the cathode taking the required readings.

The Details:
The ease of NI's data acquisition using USB was demonstrated in this application, it took only minutes to configure the USB-6008, set scales in Measurement and Automation Explorer and begin reading the scaled values from four analog input channels of the USB-6008 into LabVIEW. Three of the analog input channels measure magnetic field parameter; the fourth is measured a displacement. The three inputs from the magnetometer measure the magnetic flux in the X, Y and Z vectors. The four signals are continuously displayed on the application's front panel, along with the current position of the sensor arm.

A Trio Motion driver was developed for the 206 Motion Controller that performs actions such as obtaining the current position, controlling movement and monitoring digital inputs on the motion controller. The driver was developed using an ActiveX server provided by Trio Motion. A home function was also developed that uses the digital inputs which are connected to four limit switches on the outer edges of the test table. The home function moves the arm in the X direction until it trips the limit switch associated with that direction. Upon tripping the limit switch, a stop command is issued, followed by a command to move the arm in the opposite direction 0.5 inches. The same process is repeated for the Y direction. Once the arm reaches the position in which it is 0.5 inches from the two limit switches in the top-right corner of the table, the driver defines this position to (0,0) in the encoder.
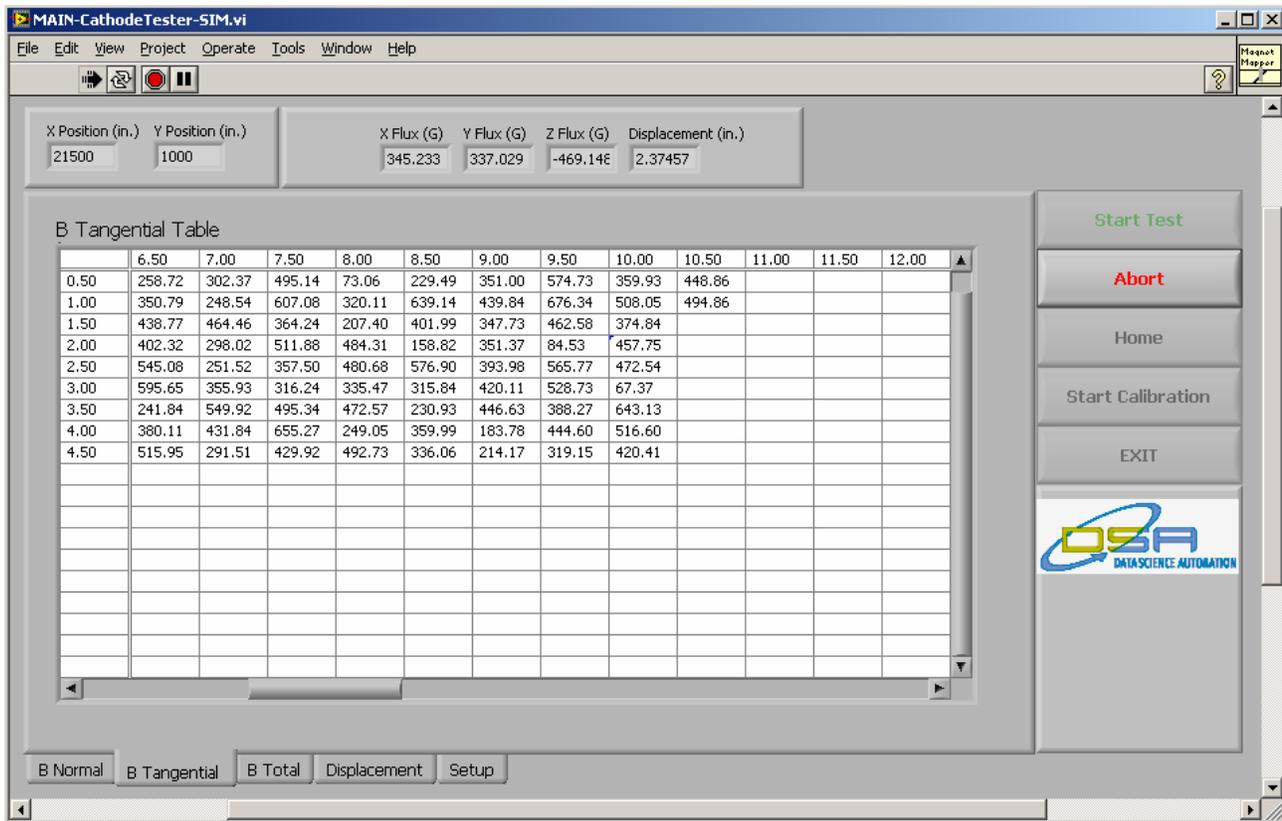

Figure 2. Test Data Table

To perform a test, the user enters the Length, Width and Increment, all in units of inches, and clicks the Start Test button (Figure 1). The software steps the sensor arm over the area of the entire cathode step by step, based on the specified increment value, taking the four measurements. Each of these four measurements is stored in both a table on the front panel (Figure 2) and a worksheet in a Microsoft Excel spreadsheet file. In doing so the customer now has a numeric representation of the cathode's magnetic field profile. Once the application scans over the entire cathode, the sensor arm returns to the Home position. The software also has the option of moving the sensor arm to a Calibrate position, which the user specifies on the front panel. The purpose of this functionality is to move the sensor arm to a position where the user can perform manual calibrations of the sensors.

Summary
Two factors that contributed to the success of this project were NI USB data acquisition and LabVIEW's capabilities to develop leverage ActiveX components. Due to the straightforward setting up and coding of data acquisition using the NI USB-6008 device, more time was able to be put into developing the code that used ActiveX components: Trio Motion Controller and Microsoft Excel. This test application greatly helped out the customer's productivity since they are now able to let this software do the work for them while they focus on using the measurements to improve their cathode designs.