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UPGRADING THE VIBRATING SAMPLE MAGNETOMETER WITH NEW HW AND SW

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Changes in hardware and software used for data acquisition from the EG&G vibrating sample magnetometer are reviewed. At the last upgrade, besides a new control computer also an Agilent USB/GPIB interface and the Keithley KPCI-3104 multifunction board with DA/AD converters were introduced. These changes were accompanied by developing of new control software in the form of a Windows 32-bit application controlling all basic functions of the magnetometer, data transfer, and output of measurement results.

Keywords: vibrating sample magnetometer, data acquisition, hardware, software

1 INTRODUCTION

Though more then 15 years old, the Vibrating Sample Magnetometer (VSM), model 4500 of the EG&G Princeton Applied Research corp. [1], is still a powerful experimental device in our laboratory. Originally it was purchased with an IBM PS/2 computer having the XT architecture, equipped with a GPIB interface card and some primitive software package with many bugs left. For having the comfortable measurement and especially after finishing the construction of a furnace, the urge on changes starts to be very strong.

2 FIRST UPGRADE

The next control computer was based on the 486 processor on an ISA board and was equipped with a new communication and auxiliary hardware and home-made software. Also in this case, GPIB interconnection was arranged for coupling the magnetometer electronics. It utilized a National Instruments plug-in interface card. Newly, for controlling the heating power of the magnetometer furnace and picking-up the actual heating characteristics, the DA/AD plug-in 12-bit converter card was implemented [2]. To program the sample temperature sweep small separate regulating unit LTC RS 04 was added and connected via the RS232C line. The new control software was programmed with Borland Pascal for Windows compiler as a 16-bit Windows 3.1 application.

2 ACTUAL STATE

In the mean time, also the second computer became out of date. Although the whole external system became very sophisticated and quite reliable after many years of debugging, it is more then obvious that its total upgrading was already necessary. The new control computer with a PCI MSI board is based on the AMD 1GHz Athlon processor, the operating system is Windows XP Professional. The main communication channel between computer and VSM electronics is now realized using the Agilent 82357A USB/GPIB interface without any plug-in card. Its electronics is placed in just a little bit bigger GPIB connector box with signal LEDs and USB cable to be plugged into the computer (see Fig. 1).

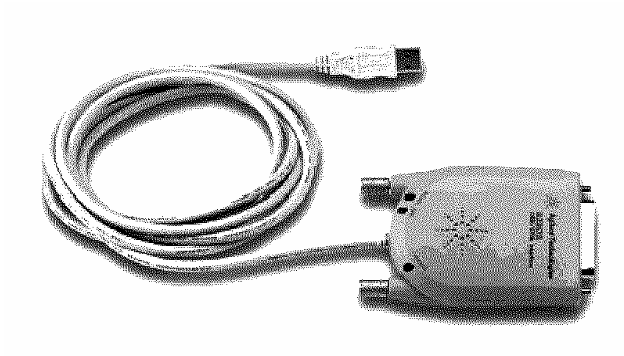

Fig. 1. Agilent 82357A USB/GPIB interface.

It is used for the most intensive data exchange. Solution with a plug-in card remains in case of the DA/AD converter, where the Keithley KPCI-3104 multifunction board was chosen.

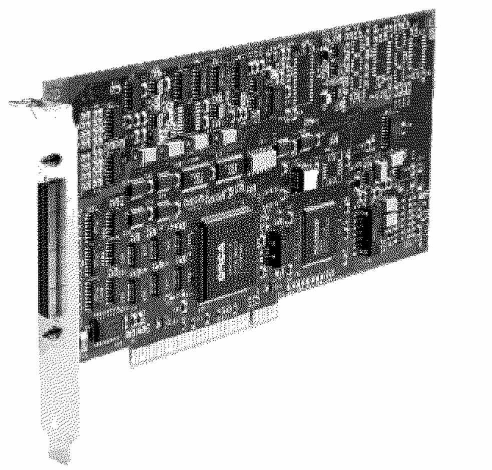

Fig. 2. Keithley KPCI-3104 multifunction board.

There was no necessity to upgrade the temperature regulating unit LTC RS 04 itself and its connection as well. However, there appeared the requirement to measure

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in a defined atmosphere instead of vacuum; therefore new set of PID constants had to be found only and the producer provided us with a slightly modified firmware.

4 NEW SOFTWARE

4.1 General

The new system hardware required also developing of new control computer software. As both USB/GPIB interface and DA/AD converter were equipped with C++ drivers, Microsoft Visual Studio 6.0 Enterprise Edition with a C++ compiler was chosen for the controlling program development. This task was solved in the form of a diploma thesis by the second of the authors.

4.2 User

Of course, the software has to be able, similarly as the previous version, to start the basic measurements of hysteresis loops (moment *vs* field) and thermomagnetic curves (moment *vs* temperature) upon the user requirements and realize the necessary data acquisition. Dialogues for setting up the measurement conditions you can find in Figs. 3 amd 4. In both cases four basic values are scanned: time, field, temperature, and moment. However, there are many other auxiliary activities in the background during and after the measurement.

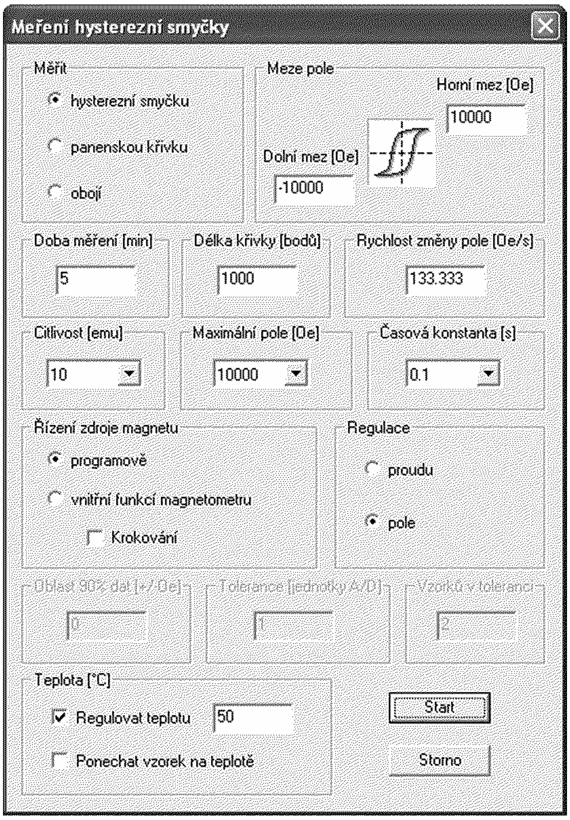

Fig. 3. Dialogue for setting up the hysteresis loop measurement.

For measuring at elevated temperature the program changes the heating power of the magnetometer furnace according the actuating signal of the temperature regulator.

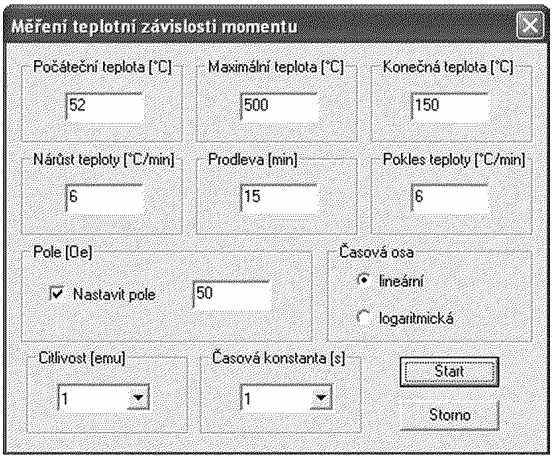

Fig. 4. Dialogue for setting up the thermomagnetic curvemeasurement.

During measurement all data are collected in files and displayed in the graph. The final file of results is created after measurement finishing. For the graphical display any combination of measured values can be set, optionally CGSM or SI units system it is possible to be selected. One of available output modes is printing, too.

4.3 Developer

From the point of view of the developer, it was necessary to install drivers and libraries: Agilent VISA Library 3.0 for the USB/GPIB interface and Keithley Driver LINX Library for the multifunction converter card. In the development environment the Document-View architecture was used form the Microsoft Foundation Class Library, separating the data from the user's view of them. Our application works with documents using a so called Multiple Document Interface, where multiple child windows correspond to specific documents. It allows to use also multiple data views (graph, tables, *etc*), where actualization of data in one view changes all other views of the same data.

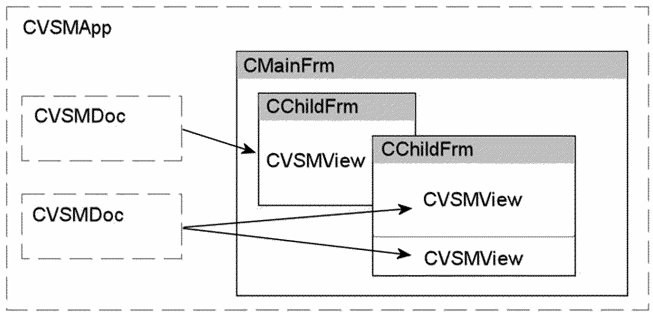

Fig. 5. Structure of the application.

Using the above mentioned properties, the program includes the class "Application" CVSMApp (representing the whole application and the application entry point), the class "Main Frame Window" CMainFrm (constituting the main window of the application), the class "Child Window" CChildFrm (giving space to one or more view classes – splitted window), and the classes "Document" CVSMDoc (containing structures with data) and "View" CVSMView (window with a specific data image). The structure of the application will be more evident from the figure above (Fig. 5).

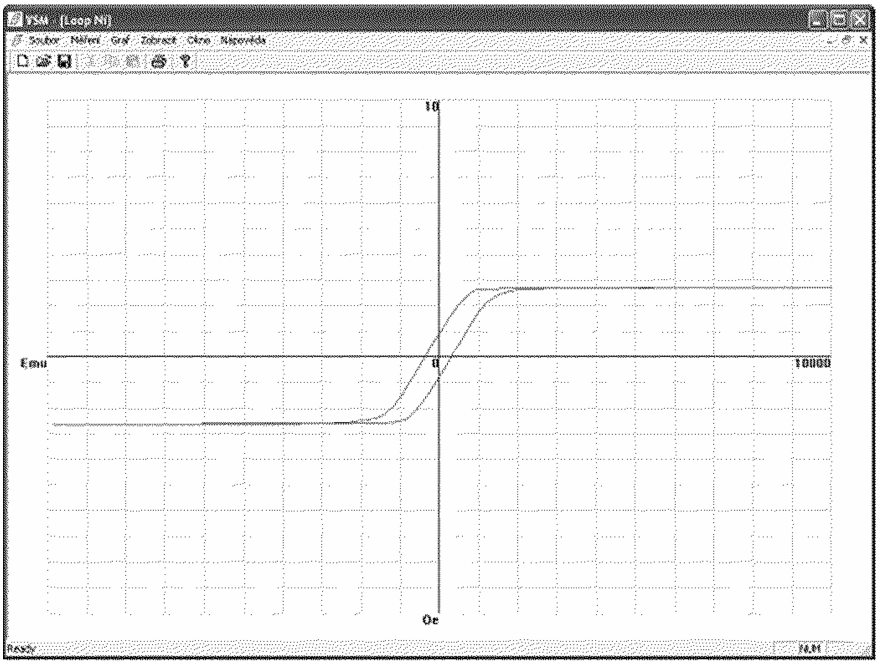

Fig. 6. Example of the data view after finishing the hysteresis loop measurement.

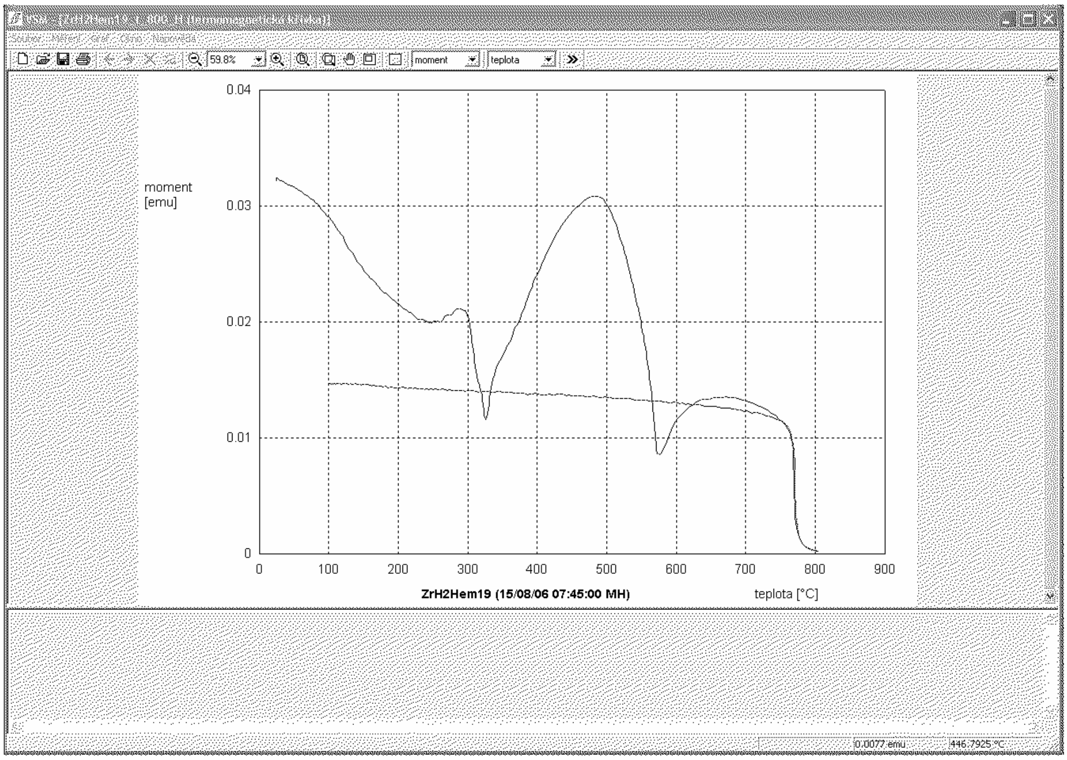

Fig. 7. Example of the data view after finishing the thermomagnetic curve measurement.

5 CONCLUSIONS

Already now, after few month of testing, the new software and hardware is able to substitute all basic functions of the previous system, however, on a substantially higher level. The routine for measurement of combination of temperature dependence with slowly oscillating field has not been completed yet.

Naturally, the system is never closed, and up to a next radical upgrade it will be continually submitted to debugging, improving, and completing. However, on the first place is achieving the maximum reliability.

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