A. Pazos, M. DiCastro, D. Fulla, T. Gehrmann, C. Hermes, D. Jahn, F. Ridoutt, U. Ristau, B. Robrahn and S. Fiedler, EMBL Hamburg, c/o DESY, 22603 Hamburg, GERMANY

SOFTWARE CONTROL FOR A MULTILAYER MONOCHORMATOR

Abstract

The European Molecular Biology Laboratory is located at the DESY site in Hamburg and operates 5 beamlines at the DORIS III storage ring. Currently the EMBL Hamburg is in charge to build three new beamlines at the new PETRA III high-brilliance synchrotron radiation source which will start user operation in 2009. A new multilayer double-crystal monochromator has been developed in house. This project served as test application for the software and hardware architecture of the new PETRA III beamlines. An embedded-PC control the electronic integrated in the EtherCAT real-time Ethernet bus. Inside this PC, a logic of PLC's directly drives the hardware allowing real time data acquisition. The control of the system is distributed and remotely accessible by a connection to a TINE device server. During the commissioning phase a Labview TINE client application has been used. The client is able to perform on-the-fly scans, control and configure the motors of the instruments. In the following paper the different pieces of the system are presented and an overview of the instrument is given.

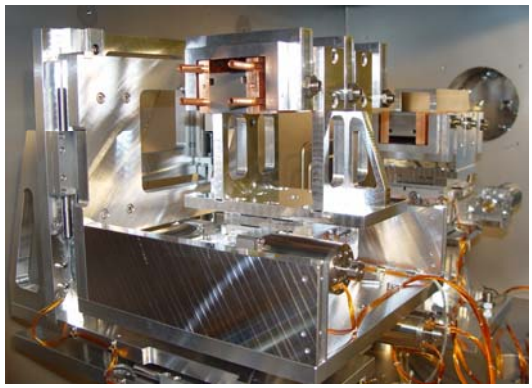

Figure 1. Multilayer monochromator installed in the vacuum vessel

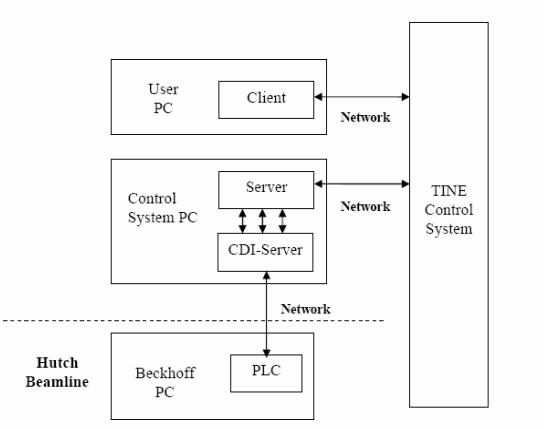

Figure 2. Multilayer software architecture.

Hardware Overview

• The main hardware components of the MLM are stepper motors, optical encoders, linear variable differential transformers (LVDT), potentiometers and a pin diode which measures the intensity of the beam. Each of these pieces is connected to an electronic driver provided by the company Beckhoff (Beckhoff Automation GmbH).

• All the control hardware is interconnected through an EtherCAT real-time Ethernet field bus, combined with an Industrial-Ethernet field bus. The field bus is based on a master-slave communication. An embedded PC is the master of the line and the electronic drives are the slaves.

• The embedded-PC runs a set of programmable logic controllers (PLC) in fast cycling and is the direct responsible for the hardware control. It allows high frequency synchronization of the motors and the analogue signals.

Software Overview

TINE has been selected as control system. A server has been developed in order to command the low level PLC. After developing the server, a Labview application has been created.

The developed application is subdivided in the following parts:

- Motor controller application: responsible for the control of all motors and encoders.
- Motor configuration application: with this tool it is possible to configure the motors.
- Scan application: this tool makes *step scans* and *on-the-fly* scans of the motors, encoders and intensity monitors. The results are presented in data sheets and in XY plots. At the on-the-fly scans every time a movement is started, the position and intensity information is recorded with high frequency by the PLC. At the end of the movement this information is transferred through the control system and displayed in the client plot.

Figure 3. Multilayer monochromator GUI developed in Labview.

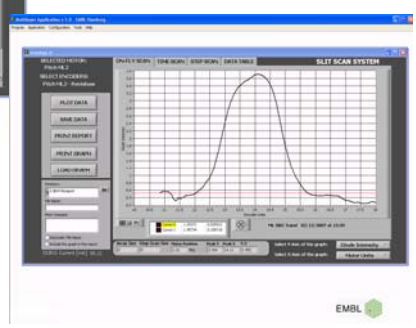

Figure 4. On-the-fly scan tool. Makes the acquisition of the data at 1kHz in the PLC an displays it in the distributed GUI.

Conclusion

The MLM has been commissioned and the first scientific results are already available. A major challenge in this project was the introduction of a new instrument control; a new field bus system has been tested and integrated with the TINE control system and with rich-client applications. This has provided valuable experience for the forthcoming developments.

A modular architecture has been implemented in the different software layers, so that it allows the reusability of many pieces of the system. The instrument will be available for the user community in November 2008.

References

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Contact: **andres.pazos@embl-hamburg.de**

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