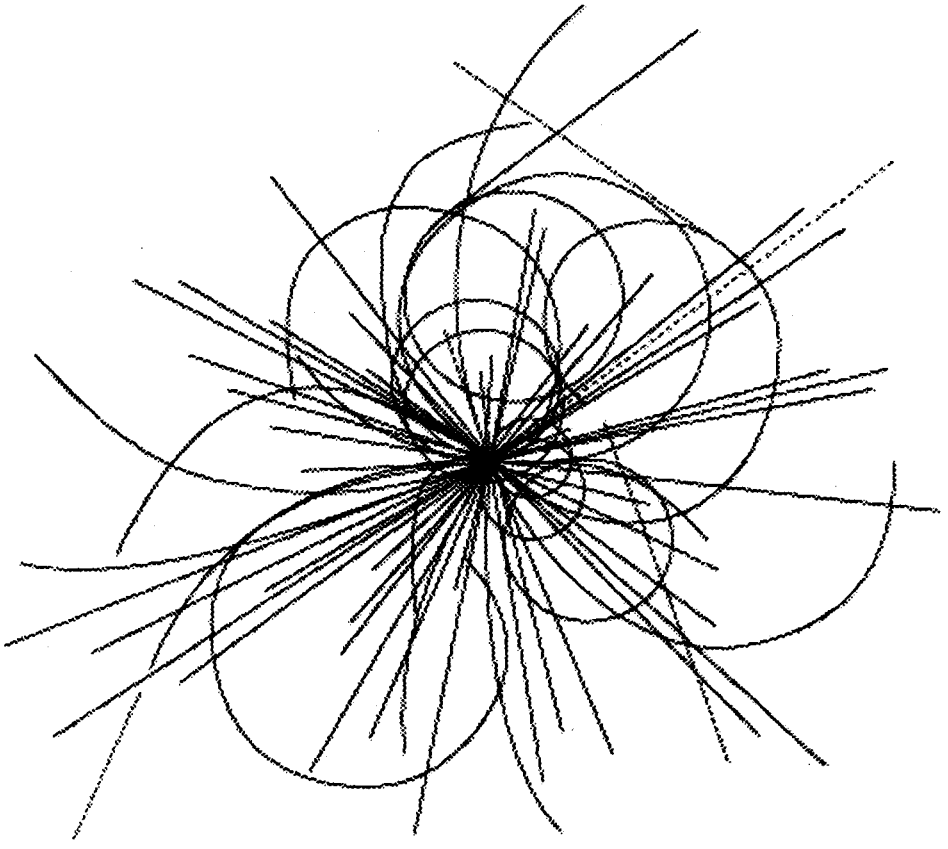
SSCL-Preprint-249

SSCL-Preprint-249
April 1993
Distribution Category: 414

M. J. Ball
N. Delagi
B. Horton
J. C. Ivey
L. Jones
R. Leedy
X. Li
B. Marshall
S. L. Robinson
J. C. Tompkins

Applications Interfaces to the Magnet Database System



Superconducting Super Collider Laboratory

To be published in *Supercollider 5*

SSCL-Preprint-249

Applications Interfaces to the Magnet Database System*

M. J. Ball, N. Delagi, B. Horton, J. C. Ivey, L. Jones, R. Leedy, X. Li, B. Marshall, S. L. Robinson, and J. C. Tompkins

Superconducting Super Collider Laboratory†
2550 Beckleymeade Ave.
Dallas, TX 75237

April 1993

*Presented at the Fifth Annual International Symposium on the Super Collider, May 6–8, 1993 San Francisco, CA.
†Operated by the Universities Research Association, Inc., for the U.S. Department of Energy under Contract No. DE-AC35-89ER40486.

APPLICATIONS INTERFACES TO THE MAGNET DATABASE SYSTEM

M. J. Ball, N. Delagi, B. Horton, J. C. Ivey, L. Jones, R. Leedy, X. Li,
B. Marshall, S. L. Robinson, J. C. Tompkins

Magnet Systems Division
Superconducting Super Collider Laboratory*
2550 Beckleymeade Ave., MS 1002
Dallas, TX 75237

ABSTRACT

The Test and Data Management Department of the Magnet Systems Division (MSD) of the Superconducting Super Collider Laboratory (SSCL) maintains a central database of information that is relevant for analysis and comparison of test results for all SSC superconducting magnets, including those from all the magnet subcontractors and those built in-house. Interactive interfaces have been developed to allow the SSCL magnet scientists to easily extract desired data in the format required by their analysis programs, so that the database can serve as the sole source for all magnet studies. Examples are given, including applications for strain gauge and quench voltage tap data analysis and magnetic field harmonics measurement.

DATABASE FUNCTION

Over 10,000 superconducting magnets will be required for the SSC collider and High Energy Booster rings. Some of these magnets will be built 'in house', but most will be built by industrial vendors under contract to the SSCL Magnet Systems Division. All magnets will be tested warm at the vendor site, and many (including all of the early units) will be tested cold at the vendor site or the SSCL Magnet Test Laboratory (MTL).

The Data Management Group of the MSD Test and Data Management Department is integrating all the data that is relevant for analysis of test results on all SSC superconducting magnets into a network-accessible data management system and developing a user interface that facilitates access to this data. The focal point of the data management system is a central database which we have named MagCom. This database will include test results for critical component materials, configuration information (serial or batch numbers) for critical components in all magnets, data collected at major production steps, summaries of test

* Operated by the Universities Research Association, Inc, for the U.S. Department of Energy under Contract No. DE-AC35-89ER40486.

results on all magnets, and reference 'pointers' to the computer files that have the full data. It will serve as the source for the standard information needed by the magnet analysis programs and any ad hoc requests for information. It will provide summary information for each magnet to the magnet installation contractor and the Accelerator Division controls databases. We are designing the user interfaces to allow simple access and manipulation of any magnet data, whether it is in the database or the external files.

The MagCom database is implemented using the Sybase relational database management system in a UNIX X11 environment on a SUN 4/280 server connected to Internet (grumpy.ssc.gov) and DECnet (SSCSUN)[1]. We recently acquired a faster server (SUN SPARCserver 630MP) with 24 GigaBytes of magnetic disk storage and are transferring the database operation to it.

Past effort [2,3,4] has focused on development of database structures and data import procedures for R&D data from magnets built at Brookhaven National Lab, Fermilab, and Lawrence Berkeley Lab. An automatic input processor has been developed that detects the presence of new files and runs the import procedures for known types of input files. A text menu system provides access to standard reports. Specialized user interfaces have been written for strain gauge, quench, and harmonics test runs, to assist the analysis staff in selecting data from the database for input to their application programs.

QUENCH ANALYSIS INTERFACE

For quench analysis, we created an interactive interface which allowed us to build an integrated application from an existing FORTRAN quench analysis program (MPLOT) and an existing PV-Wave graphical channel analysis program (PLVT). The interface provides a means by which an external program can interact with the user via a graphical user interface (GUI) using windows called widgets.

The quench test data is stored in the SDS (Self-Describing Data Standard) format developed by the SSC Central Design Group with the ISTK project [5]. The MPLOT program reads a quench SDS file, computes certain additional information such as resistances on coils, allows the user to select channels to plot, and produces an output file suitable for PLVT. The PLVT program plots the channels in the output file, allows the user to zoom in on specific parts of the plot, and provides curve-fitting options.

The quench analysis interface was written in IMSL/IDL command language. IMSL/IDL and PV-Wave have a common core of commands; the 3200 line quench PLVT runs under IMSL/IDL with no code changes. The interface is actually a more general tool which possesses the following capabilities:

1) The user can execute a FORTRAN program from within the interface and communicate with the program using IDL widgets or the text window.

2) The user or an external program can invoke an IDL (PV-Wave) procedure and communicate with it via UNIX system pipes.

This approach is faster and more intuitive than a text-based interface. In this application, the interface speeds up the operation of selecting a magnet and test, selecting channels to plot (within MPLOT) and then displaying them (using PLVT). A specialized widget procedure facilitates the selection of a magnet and test by displaying a list of existing data files for user selection. The user selects channels within a test by another specialized widget.

The interface has been used to analyze quench test data from FNAL and BNL. We have also created a program which imports quench and ramp rate test results from the Short Magnet and Cable Testing Laboratory (SMCTL) at the SSCL so that it can also be analyzed with this interface.

STRAIN GAUGE INTERFACE

The strain gauge interface links data in the database with the user's PV-Wave graphical interface programs. Full advantage of the Sybase utilities was taken to provide a file in the format needed by the PV-Wave programs. Sybase utilities use 4th generation tools for faster development and easy maintenance.

The user runs a Unix script which provides calls to C code and the database. The C software requests choices of magnet, test run, etc. and sends these choices as parameters to a Sybase Report. Some of these reports will also prompt the user for further information. This use of parameters within the reports makes the reports more general purpose. However, as the user's needs change (for example, based on experience gained as the prototype magnets are built), the reports can be easily changed within Sybase's Report Workbench utility without having to recompile the C code that calls the report or accesses the report output.

Most of the file formatting is done with the Report Workbench utility. However, some reports require additional massaging of their output files that is more efficiently done with Unix utilites such as "grep". After this last step, the PV-Wave software grabs the generated file as input to its graphical user interface (GUI) environment from which the user generates plots interactively.

The set of reports currently available provides various views of the data: measurement data from a specific strain gauge and run, or summary data over a run (with averages, maximum/minimums and standard deviations), or listings of channels for non-zero or zero amp data by test run, or listings of timestamped user comments entered during the test runs. Existing plots display the stress values from eight strain gauges for a given strain gauge run vs. current squared.

Future plans include developing a more general application program interface to directly link the database to the PV-Wave programs, thus eliminating the intermediate formatted file.

HARMONICS INTERFACE

A prototype harmonics database, graphical user interface (GUI), and data loaders are now available for use by the MSD Test Department. The interface allows analysts to select individual magnet test runs, and then specify the dataset (subset or entirety of the full harmonics test data) to download to files that may be used as input into existing analysis programs.

Data for input to the database came from R&D magnet tests at BNL, FNAL, and LBL, and the new magnetic field measurement system (mfm) developed by the MSD Test Department. All of these sources use different data formats and methods of organizing the data in subdirectories. A two-step loader was developed to load all the data for a given magnet from its directory structure. One module (common to all data sources) interpreted the subdirectory hierachy "database" which contained information about the test conditions (Warm/Cold), type of test, etc. and in turn called the second module (format specific) that actually read and loaded the data. The first module was written using Perl and SybPerl while the module that actually loaded the data was written in C++.

Two approaches to the graphical user interface were implemented; one downloads data to an ASCII file and the other creates SDS format files. Both use the ISTK tools (glistk, sds, glish) and C++ to provide a 'point and click' access to the database, allowing the user to specify the data source by working through a menu of selections for the magnet type, magnet-id, test type, and test number. The user then specifies the dataset content (full test results or selected subsets) to be returned for that selected test. One interface allows the user to output the requested dataset to an ASCII file which can be used as input to existing

analysis routines. The other interface creates output in an SDS file format which can be used as input to an existing analysis program or to a display program. The display program allows the user to select subsets of the SDS file to send to a graphics server which was written using PV-Wave in server mode. Thus the user could choose to look at one harmonic plotted along the length of the magnet, or several harmonics at a specific z-position.

Several lessons have been learned from experience with this prototype.

1) File system databases (which rely on directory structure for certain identifying information) are very error prone and probably not a good way to store important experimental data. This descriptive information should be included in the files themselves.

2) It is difficult to deal with multiple types of data inputs that were not designed with consideration of data management plans.

3) The user interface needs to provide links to analysis programs but also needs to provide more ad hoc ways to specify contents of datasets.

FUTURE PLANS

The next step is to standardize formats and procedures based on our past experience. We are developing data content and format specifications for data to be submitted by the magnet vendors and are collaborating with the MTL Software Group on development of test data file structures and general data processing software that is needed for their initial operations. This general software, which will be usable with the MagCom database also, includes an application program interface and an interactive browser that will allow ad hoc selection of data to be displayed in table or plot format. Our goal is to have a library of procedures that will facilitate study of data, from fabrication through testing steps, on one magnet or comparison of data across a series of magnets.

REFERENCES

1. James Ivey, Xiaoyu Li, Joe Garbarini, Penny Ball, "System Design Overview for the Magnet Test Database System," Supercollider 4, M. McAshan, ed., Plenum Press, New York (1992).
2. M.J. Baggett et al., "The Magnet Components Database System," Supercollider 2, M. McAshan, ed., Plenum Press, New York (1990).
3. P. Baggett et al., "The Magnet Database System," Supercollider 3, M. McAshan, ed., Plenum Press, New York (1991).
4. M.J. Ball et al., "The Magnet Database System," Supercollider 4, M. McAshan, ed., Plenum Press, New York (1992).
5. Erika Lutz, "The ISTK Overview Document," Lawrence Berkeley Laboratory (1991).