

TIME TRAVEL MADE POSSIBLE AT FERMI BY THE TIME-MACHINE APPLICATION

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Abstract

The TANGO archiving system HDB++ continuously stores data over time into the historical database. The new time-machine application, a specialization of the extensively used save/restore framework, allows bringing back sets of control system variables to their values at a precise date and time in the past. Given the desired time stamp t_0 and a set of TANGO attributes, the values recorded at the most recent date and time preceding or equalling t_0 are fetched from the historical database. The user can examine the list of variables with their values before performing a full or partial restoration of the set. The time-machine seamlessly integrates with the well known save/restore application, sharing many of its characteristics and functionalities, such as the matrix-based subset selection, the live difference view and the simple and effective user interface.

TERMINOLOGY

Context

The context is a set of TANGO attributes gathered together under a name; the context structure is exactly the same as the one beneath the classical save/restore database.

Snapshot

The snapshot is always associated to a specific context and stores the values of the attributes at the very moment the snapshot itself was taken. The relation between a context and the snapshot is represented by the context ID and a snapshot has a unique snapshot ID. Each context can have multiple snapshots taken at different instants, while each snapshot is linked to a unique context. Of course, there is no constraint in the definition of the contexts: distinct ones can have one or more attributes in common.

WORKING PRINCIPLE

The classic save/restore [1] control room application was designed to save a snapshot of a set of TANGO attributes on a database at a given point in time. The snapshots can be later revised and restored on the field. Only previously saved sets of values, identified by an ID, a comment, the date and time the snapshot was taken, can be put back on the equipments. The time machine takes a different approach. Relying on an event-based TANGO historical database archiver, named HDB++ [2], it is able to restore a set of attributes to their values at any date and

time in the past. The HDB++ constantly saves TANGO attributes into the database according to a given threshold. Taking advantage of the event-based archiver and the specific extraction library, it is always possible to retrieve the value of a quantity at an arbitrary point in the past. Historical database snapshots can thus be created on the fly at a given date and time.

THE HISTORICAL DATABASE LIBRARY

The HdbExtractor++ framework allows fetching data from a historical database in a simple object oriented fashion. The library currently supports the HDB (the original version of the TANGO archiver) and HDB++ MySQL database schemas. Scalar and vector data can be fetched from the database, given a start and stop date and time. A separate module provides a Qt interface to the extraction library and also a dedicated GUI, aimed at displaying scalar and vector data over time. Extraction in the Qt module operates in a separate thread. Vectors are displayed over time by a surface plot, based on the MathGL framework. Errors are notified by NULL values. They typically reflect a read error from the device at the moment of the save process. If the data of a given source is not recorded in a given period, it is possible to fetch values older than the start date. Moreover, data sets pertaining to different curves can be aligned in time, so that a point on the curve is associated to each time stamp in the x axis. Even if the HdbExtractor++ library is tailored to deal with TANGO data (as far as data type, write mode property and data format are concerned), it is not dependent from TANGO specific types and libraries. The Qt module is multi threaded and can be easily integrated in graphical user interfaces [1].

THE GRAPHICAL USER INTERFACE

The Time-Machine graphical user interface is written in Qt and is made up of two sections: the classical save/restore and the new time machine mode. When the application is launched, the classical save/restore mode is selected by default (see Fig. 1). A radio button allows to switch to the time machine view (see Fig. 2). The design of the user interface unifies the approach to the selection of the contexts and the restore process in both modalities. The top left view is a list of the available contexts. Note that the save/restore contexts and time machine ones are defined in distinct databases, so in principle they don't overlap. The right view displays the TANGO attribute names and properties. The information is updated with the read and write values of each quantity as soon as a

snapshot is selected or historical data is fetched from the database, according to the active modality. NULL values

are highlighted by a red square in the set point column. In order to restore a set of attributes, you must select them

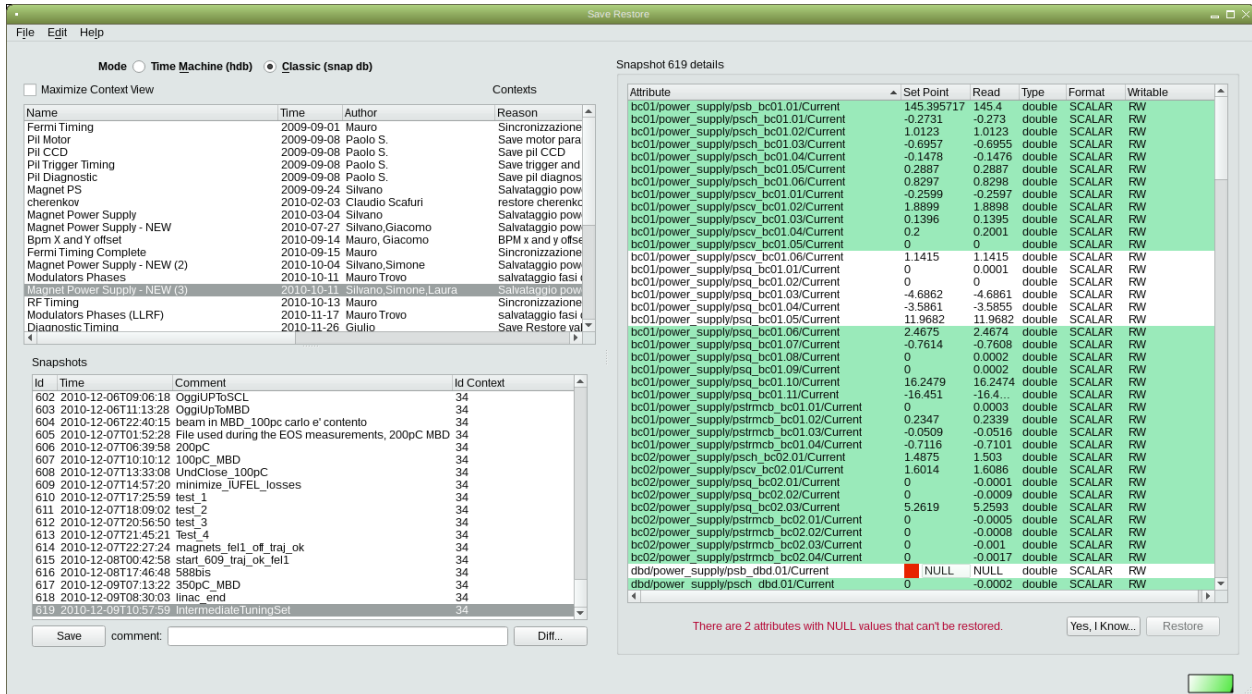


Figure 1: The save/restore classic view.

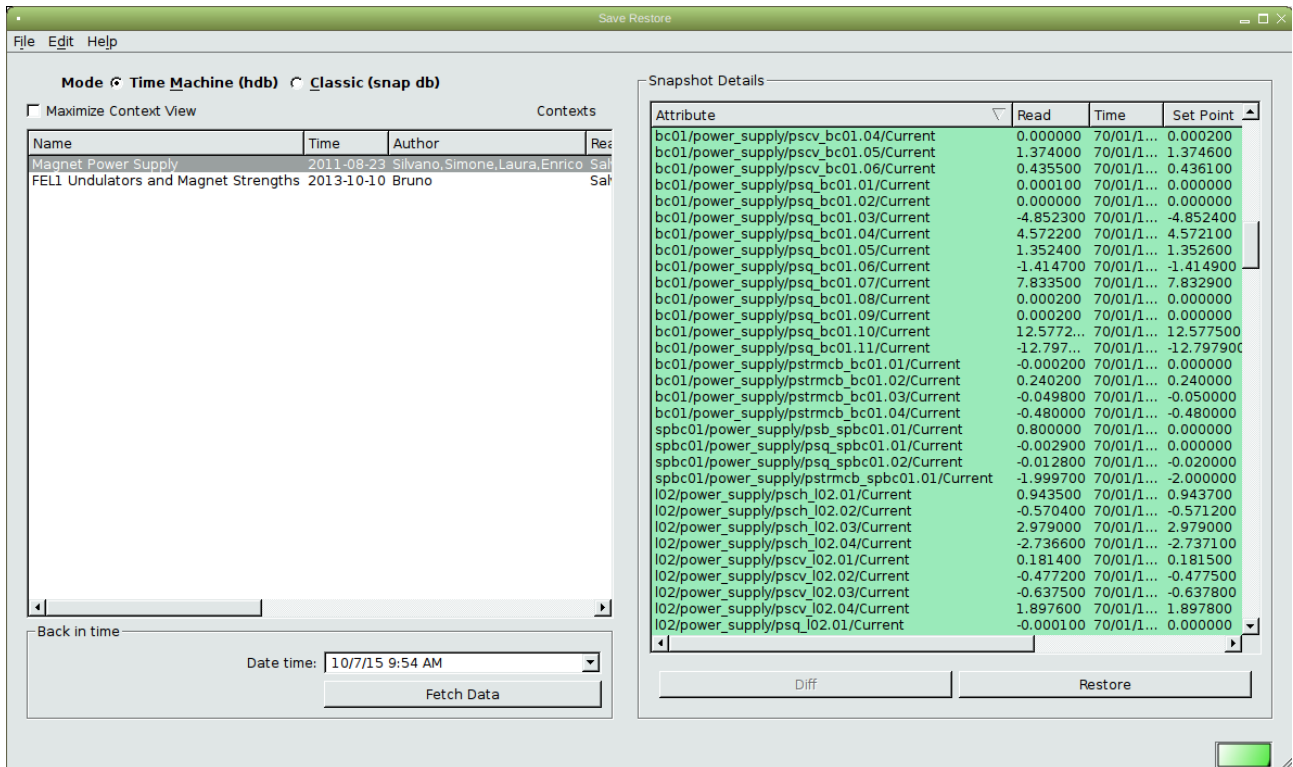


Figure 2: The save/restore application in time machine modality. Note that all the attributes have been selected for restoring and the presence of the *back in time* box.

with the mouse. All items can be selected at once by right clicking on the view and activating the corresponding option from the menu. If NULL values are present, it is compulsory to click on the “Yes I know” push button before restoring (see Fig. 1). In time machine mode (see Fig. 2), the restore process requires the following steps:

- selection of the desired context;
- fetch data from the historical database, specifying a date and time in the past (see Fig. 2, bottom left box) and clicking on the “Fetch Data” button;
- select the attributes to restore and restore them.

The save (in the save/restore mode) and the restore processes are run on a separate thread so that the graphical interface remains responsive. A progress bar appears at the bottom of the panel to indicate the advancement of the process. For further information about the classic save/restore application, please refer to [1].

The “diff” View

When save/restore mode is enabled, selecting two or more snapshots of the same context makes it possible to view the differences between the snapshots and the current values read from the field (see Fig. 3).



Figure 3: The diff view

The Matrix Selection

Alongside the classic item selection mode in the attribute selection list, a matrix selection is available. The selection groups and the different kinds of devices are defined into the database itself and reflect the sections in which the machine is organized. The actual matrix structure is based on the plant structure and the operational needs of FERMI. As shown in Fig.4, toggling an element of the matrix allows the selection (de-selection) of the items of the same type belonging to the corresponding section of the machine.

Helper Application

Right clicking on an item of the attribute list view gives the user the opportunity to launch a linked helper application. Helper applications are defined into the TANGO database and are fully equivalent to helper applications used by the QTango framework [3].

CONCLUSION

The combination of the classical snapshot-based save/restore procedure with the new historical database extraction opens new possibilities to restore the state of a complex machine, bringing it back to a previous condition. In particular, the time machine has been introduced in the FERMI control room to repair a situation after an accident or an unforeseen occurrence, such as a device failure, a thunderstorm and so forth, bringing back the system to a known healthy working state at a given time in the past.

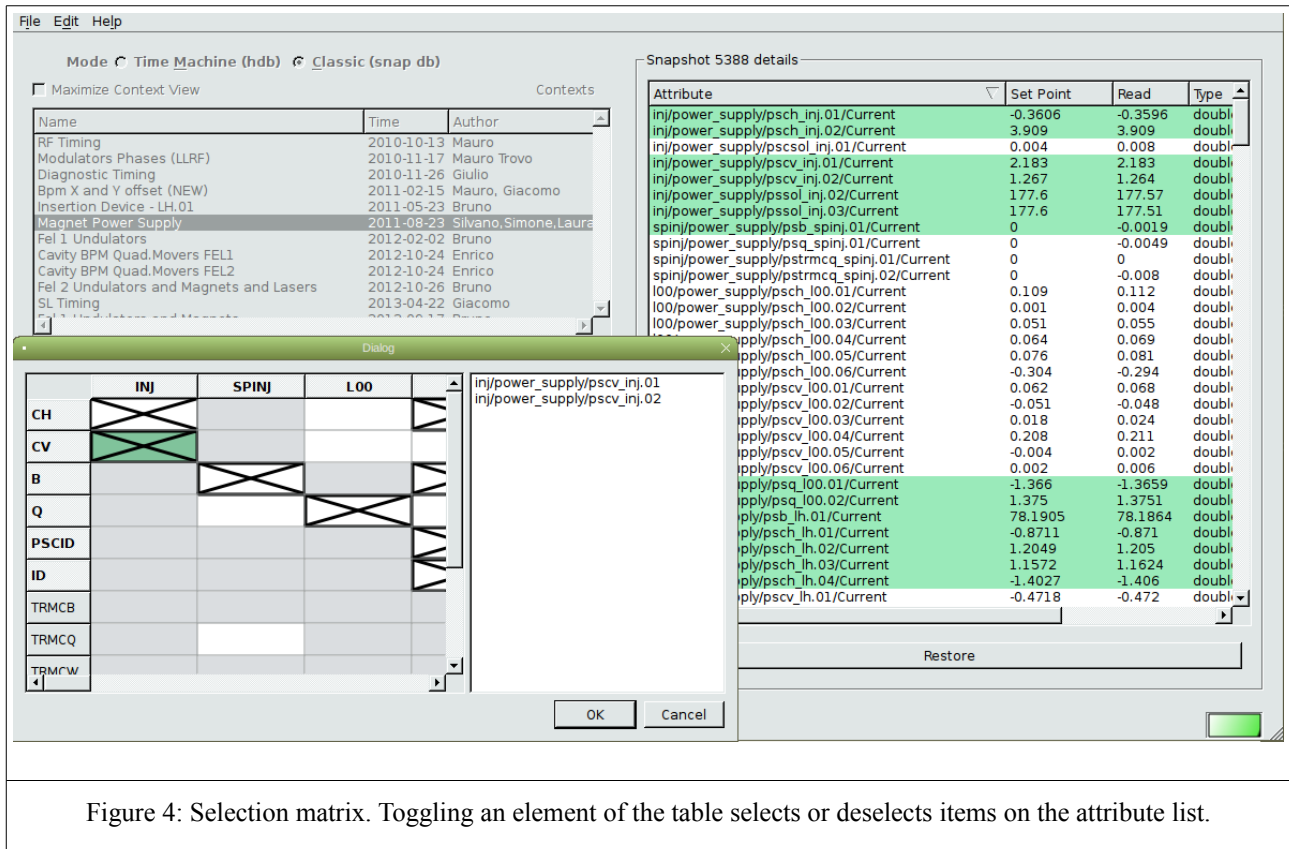


Figure 4: Selection matrix. Toggling an element of the table selects or deselects items on the attribute list.

REFERENCES

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