PinK: A TCL/TK based Database Interface to ADAMO and DAD

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PINK is a TCL/TK extension developed initially for the HERMES experiment at HERA/DESY. Like other HEP experiments, HERMES needs a highly structured database to cope with the complexity and amount of data being handled. HERMES uses the ADAMO Entity Relationship database concept together with the DAD package which extends the use of ADAMO towards a distributed database with flexible, fast I/O and time dependent data handling. With a large and complex time dependent database and many programs accessing it, there is a strong demand for a flexible common user interface. PINK incorporates the functionality of ADAMO and DAD providing an Object Oriented interface to the database. It can be used as an interactive command line, as well as a graphical user interface to access and manipulate data on the database servers and files.

1 Introduction

PINK[2] was designed for the HERMES [1] experiment at HERA/DESY measuring the spin dependent structure functions of the nucleon.[a] The HERMES software is using the ADAMO[3] Entity Relationship database for data handling and storage in the analysis chain, calibration and geometry databases as well as in the experimental control and monitoring. The DAD[4] library package provides a powerful extension distributing the databases and enhancing data access for multiple processes throughout different platforms in different institutes around the world. PINK has been developed to serve as an interface to both ADAMO files and DAD servers. Its object oriented implementation represents an intuitive approach to the ADAMO

[a] utilizing the longitudinally polarized electron/positron beam and a polarized internal storage cell gas target

and DAD data structures and their functionality. Combining the features of an interpreted language and the GUI (Graphical User Interface) power of TCL/TK [5] and its extensions with a HEP database, PINK is a generic tool for all database applications. For HERMES PINK is currently used for experimental control and monitoring as well as analysis and organisational database handling.

2 General Concepts

PINK as an extension of TCL/TK consists of the TCL/TK code plus a PINK library which in turn makes use of the DAD library. Although ADAMO itself is not object oriented in its actual implementation, the object orientation lies in the concept of the Entity-Relationship Model it is based on. It is therefore natural to reflect this especially in the user interface. Consequently the first step in the PINK project is the identification of the different objects holding the information. The next step is to introduce the dependencies among the objects resulting in the ADAMO hierarchy before finally the objects are equipped with their corresponding methods.

The data structures are implemented in a hierarchical set of objects supplied with specific methods providing access to the data (see fig. 1). The basic objects are:

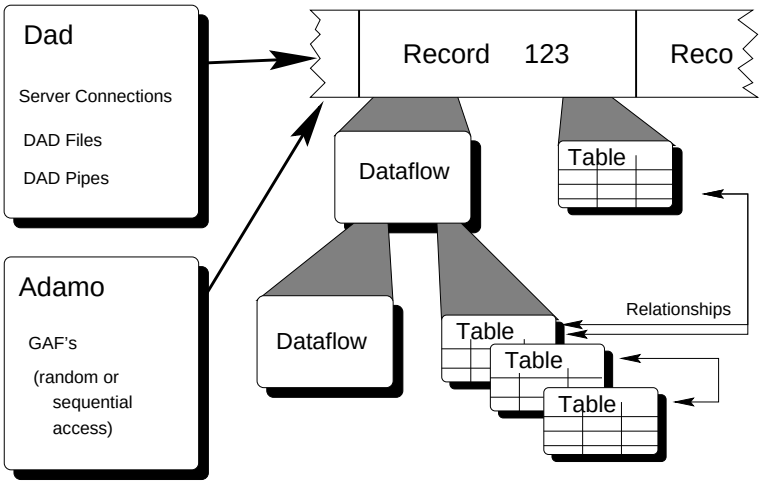

Figure 1: The hierarchical structure of the PINK objects. The main objects (represented by the big boxes on the left) contain a number of records. Below the records are the subobjects shared by D AD and ADAMO including their relarionships. The format of the dataflows and tables fixed for each record, whereas the data itself varies.

GAF: a Generic Adamo File (using different drivers) is a file containing dataflows and tables inside records and the *keytable* serving as a table of contents with respect to the records. In an event file containing physics events for example each record represents the data of one event in different TABLEs organized in DATAFLOWS .

DAD-connection: a connection to a specific dataflow in a DAD server, a file in DAD format or a DAD pipe like the event stream, e.g. the HERMES time dependent calibration

data can be accessed via a DAD connection to a server.

dataflow: a collection of dataflows and tables connected via relationships, e.g. track data of a physics event are stored in separate tables containing hits and tracks interconnected via relationships.

table: a table with fixed column definition holding a flexible amount of rows containing data in different formats (strings, integers, floats, logicals and bitpatterns).

selector: a selected subset of a table.

index: a complete table with user selected order of the rows.

The hierarchy of the objects is at all times transparent to the user through common methods inquiring the type and structure of the objects inside the data model. The definition of the data model is conventionally done using the ADAMO Data Definition Language DDL from which one can automatically produce source code for *C* and FORTRAN to be included into program code. PINK as a shell can not rely on these predefined data models and is independent of them. All ADAMO and DAD data structures are implemented data model independent. PINK determins the data model (data structures) of a specific database at the time an object is created. On the other hand one can create ones own data model with PINK itself.

3 Implementation

TCL/TK is embeddable and hence provides an interface for extensions which is used to implement the DAD and ADAMO objects. All Objects are implemented as *C* data structures which serve as templates so that instances of them can be created during run time. Each class of objects has its own set of methods which mirror the DAD and ADAMO functions staying as close as possible to the original ADAMO and DAD functions concerning their functionality. The handling of the objects in the interpreter language is very similar to those of TK-widgets. A few additional functions are added combining internal TCL/TK functions with DAD procedures. The DAD connection for example provides methods to create a file handler which reacts on booked data coming from a server. These file handler events are processed the same way TCL/TK processes the X-events. The user then can specify a shell script procedure to react on each of these file handler events.

4 Applications

At HERMES PINK is used wherever the database is involved. The major applications are presented here:

Control & Monitoring: PINK scripts connect to database servers communicating via command tables and data tables. The command tables are used to communicate with the so called "low level" clients mostly connected to hardware. The commands are bound to widgets like buttons or slidebars. Data tables are booked under user defined conditions specifying either a certain data set or conditions[b] on the data itself. The data

[b] using the DAD parser by W.Wander

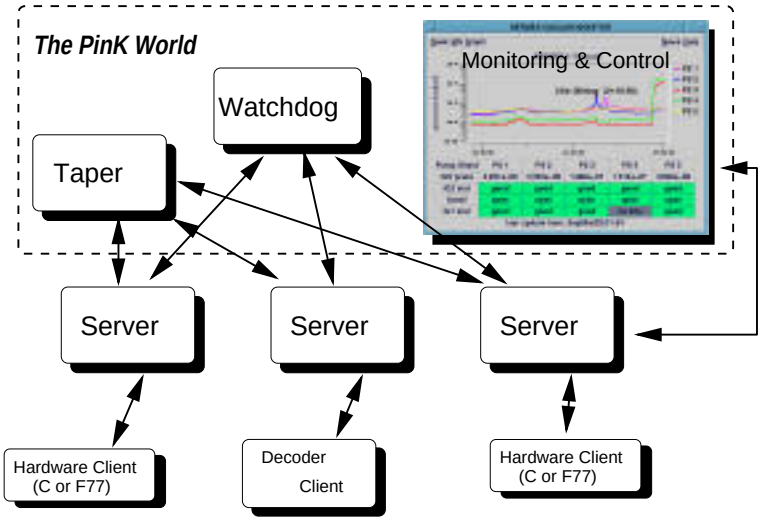

Figure 2: PINK application at HERMES . The "Taper" writing data from servers to files/tape and "Watchdogs" monitoring the experiment are running in the background. Other applications are GUI's for monitoring and control.

are presented in graphics widgets (e.g. BLT [6] graphs) or they are processed together with other information to generate status information. Information from various destinations can easily be combined in real time applications this way (see fig. 2). HERMES for example uses a PINK application monitoring all changes in the calibration database as well as the status of programs essential for the experiment.

Data Storage and Management: PINK scripts running in the background[c] receive data from all online and offline servers. These data are processed and stored in files which are later used for analysis (see fig. 2).

Interactive Database Management: PINK scripts are used to browse and edit the database. Data residing in files and servers can be accessed independently of their format. One example is the HERMES PINK browser (see fig. 3) in which relationships among data tables can be navigated interactively. All data can also be accessed from the command line of the shell itself.

Analysis: PINK is used for analyzing data online, providing real time performance monitoring of various parts of the HERMES detector. The Luminosity monitor for example calculates the luminosity measured by a calorimeter using the Bhabha scattering rate. Slow Control information like target parameters, beam information or hardware status information can be analyzed online and offline. PINK is also used for event displays offering different viewpoints, interactive movements and zooming of the displayed region.

The HERMES PINK applications use a library of PINK procedures which provides a customized interface to the database and contains widgets to display time dependent data

[c] using the windowless versions of the PINK shell

Figure 3: The HERMES PINK browser showing a table of the geometry database. The last two columns represent a generalized relationship . In this example each row of the table represents a detector plane (e.g. of a wire chamber), specifying the name, physical location and size. The relationship column points to the corresponding detector volume, which is described in a different table, which can be followed/browsed by double-clicking with the mouse cursor on it

from online monitoring tasks. Together with utilities for printing graphics etc. this ensures a common "look and feel" for the HERMES GUI's. This library can easily be extended and customized for other purposes.

5 Conclusion

PINK is a generic tool and a modern object oriented interface to the ADAMO and DAD packages. Together they provide a software concept especially suited for HEP experiments in international collaboration. Their use at HERMES shows the power of a distributed time-dependent database with a modern user interface. The concept is beyond its testing phase and can be applied and customized for other experiments in High Energy Physics.

References

1. Hermes Collaboration, HERMES *Technical Design Report,* DESY-PRC 93-06, MPIH-V20 1993, 1993.
2. M.A. Funk, K. Ackerstaff, PINK *Documentation*, WWW: http://dxhra1.desy.de/∼maf/pink/pink.html,
3. *ADAMO – Entity-Relationship Programming System, Version 3.3*, WWW: http://www1.cern.ch/Adamo/ADAMO_ENTRY.html, Programming Techniques Group, ECP Division, CERN, Geneva, 1994.
4. W. Wander, *DAD-Distributed Adamo Database system at Hermes*, WWW: http://dxhra1.desy.de/dad/, Proc. of CHEP 95, Rio de Janeiro, 18.-22. Sept. 95, to be published.
5. J.K. Ousterhout, *Tcl and the Tk Toolkit*,Addison-Wesley Massachusetts, 1994.
6. G. Howlett, *The BLT Toolkit Extension*, WWW: http://web.cs.ualberta.ca/w̃ade/Auto/HyperTcl/Tcl_extensions.html#BLT,