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System tests and debugging using Python

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The CMS Global Calorimeter Trigger (GCT) control and test software is described. An object-oriented model of the GCT hardware, based on the CMS Hardware Access Library (HAL), was written in C++. The SWIG software interface generator was then used to produce a python interface to the model. This allows the hardware to be controlled from a python script or shell, providing a flexible environment for rapid development of hardware and firmware tests without requiring detailed knowledge of software.

Summary

The CMS Global Calorimeter Trigger control and test software is based on an object model of the hardware and firmware, that is itself based on the CMS Hardware Access Library (HAL). Classes are included to represent boards, devices, busses, links and firmware blocks. Each class contains methods to build and navigate the model, and methods to initiate operations on the hardware or firmware component represented by the class. A single GlobalCaloTrigger object provides a point of entry for the user that automatically initiates building of the model, hidden from the user. The navigation methods follow the physical structure of the hardware, and the logical structure of the firmware. For example, one may obtain (pointers to) the module objects from the crate object, or the firmware blocks within an FPGA from the object representing the FPGA. The operation methods include low-level register read/write commands that are generally common to all objects, and higher-level methods that are generally specific to the component being represented, eg. the Link object has a method that initiates a self-test.

A SWIG header is written for each class, including the navigation and operation methods, but not the build methods, as they are only required internally. The resulting python library allows the user to navigate and control the hardware from a python script, or interactively from the python shell. The user then requires very little software knowledge to write scripts to perform complex operations and tests, or to access and debug the hardware interactively. Python

scripts are also envisaged
to be the main mode of initialising the system for all modes of operation, include
running tests and taking data.

The control software is integrated with CMS run control by including the object model
in a XDAQ application. This allows a SOAP interface to the object model to be
defined, which generally uses the highest-level methods on the GlobalCaloTrigger
object. The XDAQ application also includes an embedded python interpreter, allowing
the use of python scripts within the run control framework.

Primary author: BROOKE, Jim (H.H. Wills Physics Laboratory)

Co-authors: Mr HUCKVALE, Benedict (H.H. Wills Physics Laboratory); Dr NEWBOLD, Dave (H.H. Wills Physics Laboratory); Prof. HEATH, Gregory (H.H. Wills Physics Laboratory); Mr FRAZIER, Robert (H.H. Wills Physics Laboratory)

Presenter: BROOKE, Jim (H.H. Wills Physics Laboratory)

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