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Grid Data Management for Liquid Time Projection Chamber Image Analysis

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Impact

Grid storage is novel to the LTPC community, so is the exploration of the CBIR discrimination potential for LTPC events. The automation of the image selection procedure for specific physics processes of interest using the technologies described yields a massive reduction in analysis times and allows inter-institutional sharing of the stored data. The integration of the GIFT analysis software with grid technologies allows the deployment of a tool for automated image selection that has a potential of impact on a range of research communities, such as medical groups. The potential also exists, to implement image retrieval tools to be employed in educational environments.

Overview

State of the art Grid technologies are used to implement a storage facility for Liquid Time Projection Chamber (LTPC) 2D event images and an analysis facility aimed at identification of similar images, using the GNU Image Finding Tool (GIFT) analysis software and event meta data. Content-based Image Retrieval provided by GIFT is based on automatic extraction of visual features of images and has been successfully employed in the retrieval of medical images from large scale data banks. Successful integration with Grid technologies has been demonstrated through the use of advanced Grid services, such as Virtual Organization Membership Service and the X.509 Public Key Infrastructure, a Disk Pool Manager Grid storage element, the Lightweight Middleware for Grid Computing. Here we describe a similar infrastructure for LTPC event images within the Swiss Multi-Science Computing Grid.

Description of the work

At the Laboratory for High Energy Physics (LHEP) of the University of Bern, many thousands cosmic muons, radioactive source and laser events from an LTPC prototype have been recorded for a total data volume of several terabytes. The events are available as 2D images. In the near future also 3D reconstructions will be available. The data are initially located on data acquisition servers located close to the readout electronics of the prototype detectors. Access to these machines is generally very restricted, so the provision of the images to the physicists for analysis involves their transfer to a durable data storage facility (DPM Storage Element), to which transparent and secure access is ensured from within the institutes participating in the research. A typical workflow involves users selecting an LTPC image of their interest for a specific physics process, following which the GIFT software will analyse the image features, retrieve from storage and display all images that visually resemble the source image. A web browser based interface acting remotely from a user's workstation also returns event lists to be used in processing on the ARC based Swiss Multi-Science Computing Grid (SMSCG).

URL

http://www.swing-grid.ch/index.php?option=com_content&task=view&id=14&Itemid=30

Conclusions

A DPM grid SE has been set up at the University of Bern as part of a grid-enabled tool aimed at the CBIR of images from a LTPC detector using the GIFT analysis tool in a grid environment. It provides safe and durable storage area for 2D LTPC images. A VO has been established within the SMSCG to ensure secure access to the data to collaborators owing the correct credentials. Interacting with a remote web browser based tool, users can pre-select an image representative of a physics process of their interest, and retrieve from the storage other images with similar visual characteristics. The intensive image discrimination processing occurs at computing sites that are part of the SMSCG, which deploy ARC compute elements. Therefore the interoperability of the ARC CE and the gLite DPM SE is an essential aspect of the grid service provided and is proven to be satisfied. The DPM SE is established in Bern as a storage platform for inter disciplinary and cross-institute e-Science collaborations.

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