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Modeling and Developing the Information System for the SuperAGILE Experiment

Francesco Lazzarotto

DISP Tor Vergata & IASF-CNR, via del Fosso del Cavaliere, 100, 00133, Rome, Italy, e-mail: lazza@rm.iasf.cnr.it

Enrico Costa, Ettore Del Monte & Marco Feroci

IASF-CNR, Rome, Italy

Abstract. We will present some formal description of the SuperAGILE (SA) detection system data, the relationships among them and the operations applied on data, with the aid of instruments such as Entity-Relationship (E-R) and UML diagrams. We just realized functions of reception, pre-processing, archiving and analysis on SA data making use of Object Oriented and SQL open source software instruments.

1. Introduction

The data stream expected from the SuperAGILE instrument, onboard the AGILE gamma-ray mission, are continuous and massive flows (20 kb/s) of raw information sent to ground for a minimum of 3 years, plus a larger rate during ground tests (see figure 1). Data coming from the instrument concern physical measurements and equipment housekeepings. We have developed and are improving an information system to handle and archive the data produced at first by the prototypes and later on by the SA flight model. A big effort in the design phase has led us to achieve an integrated modular software system responding to most of the functions needed to extract knowledge from SA archives.

2. Requirements and Conceptual Design

The SuperAGILE experiment is described by processes, the processes scheme induces a scheme on the SA information system. We arrive at the goal of extracting scientific knowledge from SA data following these steps: first we pursued an accurate operation of requirements definition joined with reflections on our past work (Feroci et al. 1999; Lazzarotto 2001) and the study of some standards coming from other researches (see IVOA working team 2003). Then we developed an E-R scheme to have a conceptual level project, modeling the data items and operations on them. It describes concepts of interest to the application s such as detectors, analogue and electronical hardware, software components and operators and the relationships among these concepts, in a simple but precise way, not computer specific (see Fig. 2). At this level we isolated some metadata

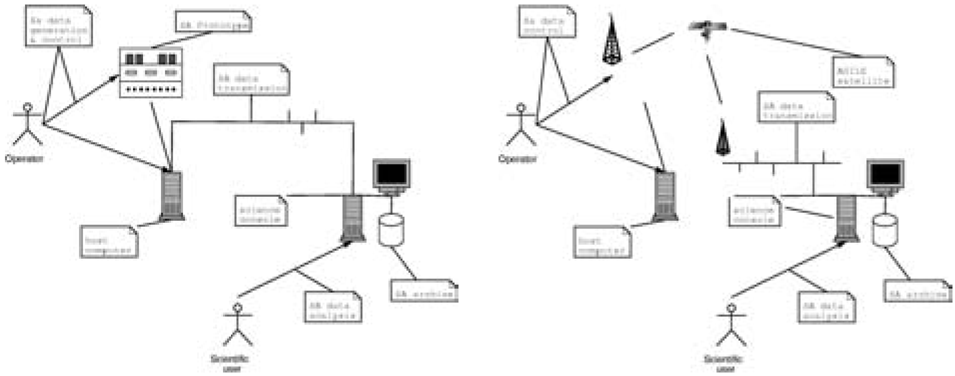

Figure 1. Use cases for SA ground and flight prototypes data applications

describing measurement data. The metadata will be contained in the persistent Data Base Management System (DBMS), massive measurement data are stored in a repository (e.g. large computer hard-disks).

3. Performance Study and Logical Design

Logical rendering of the conceptual model materializes in the realization of a relational database scheme (Fig. 3) for 'run' (measurement or simulation) metadata. Also the scheme of scientific contents data is realized following the object oriented and the relational paradigms. The definition of a metaformat for experimental data and a formal model for the operations on them, make it possible to do a performance study on the applications (see part of the model in the Operation Table (Table 1)).

Table 1. SA data operation table

Operation	**Type(I/B)**	**Frequency**
ReadData	I	50 per day
CreateAddLUT	B	1 per month
CreateResMat	B	1 per day
AddCalibrate	I	50 per day
EnCalibrate	I	50 per day
GetDetImg	I	20 per day
GetSpectrum	I	20 per day
GetLightCurve	I	20 per day
GetSkyImage	I	15 per day

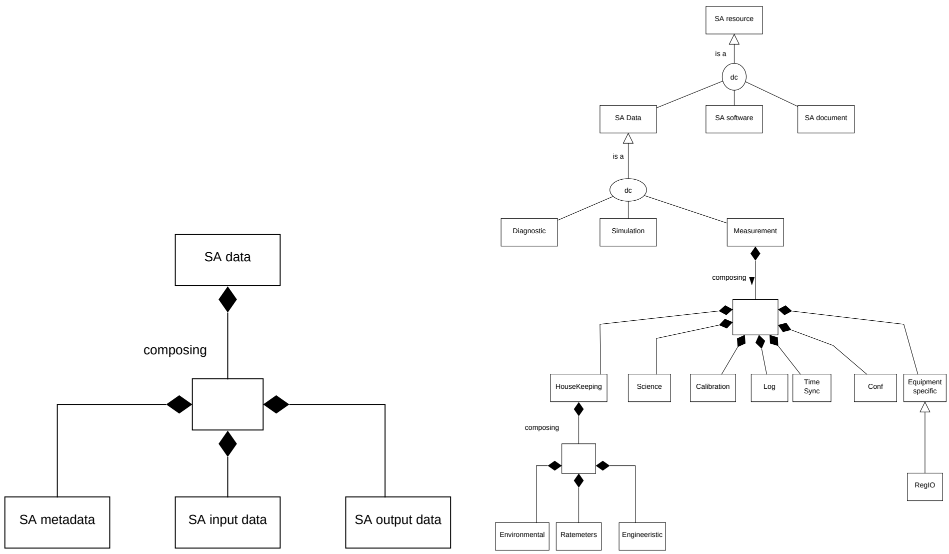

Figure 2. Composition and gerarchy of SA data

4. Physical Scheme of DBMS and Architecture of the Analysis Software

To handle the experiment archive we use a DBMS based on SQL to store metadata realizing a RAM persistent short projection of the repository. We save archiving, summarizing instrumental information and textual information from the acquisition logfile. The content of the database image at a certain time is given in html format and put in a public web area, from where every authorized user can read useful information and download desired files with ftp links. The procedures are written in C++ embedding mySQL and science libraries, Root (Brun 1997; see also `http://root.cern.ch`), cfitsio (Pence 1999; see also `http://heasarc.gsfc.nasa.gov/docs/software/fitsio/fitsio.html`), AstroRoot (Beck 2004; see also `http://isdc.unige.ch/index.cgi?Soft+astroroot`). The implementation is also realized with the help of a C/C++ interpreter "Cint" that permits development and easy tests of C++ code macros. We also used postgresSQL to implement DBMS functions, the linking with the Root library is more efficient with mySQL. For data analysis software we use OO approach, (a simple classes scheme is reported in figure 3), it implements functions analysis operations and produces higher level of abstraction scientific data products such as light curves, detector images and spectra.

5. The Final Goal of the System: Scientific Knowledge Extraction Applications

The idea is to save structured reports regarding automatic analysis on large amounts of data, in other metadata saved in the DBMS archive. Then it will be possible apply comparative studies on SA data sets, with the application of advanced statistical and Computer Science techniques. The results of analysis

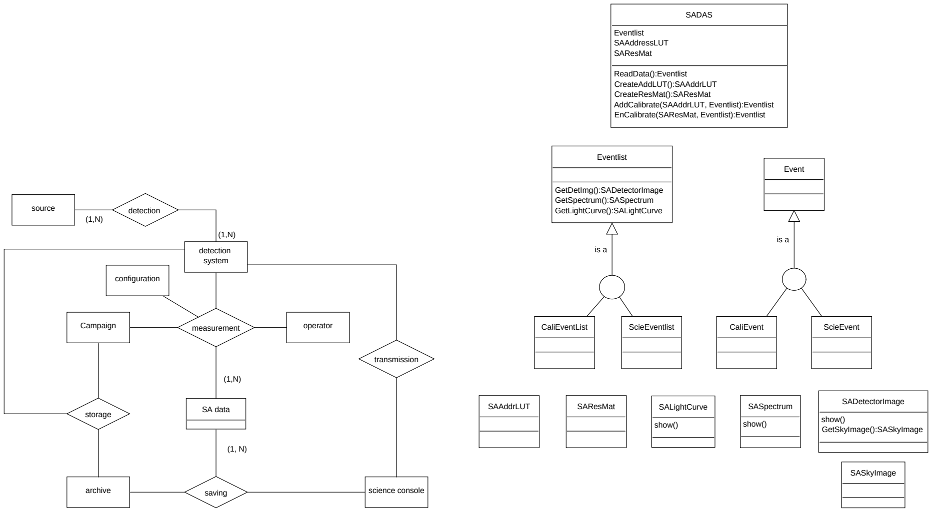

Figure 3. SA measurement session conceptual scheme and classes for sadas software

operators will be stored in compact data sets rendered, for istance, in XML. We created a raw prototype of this system in 2001 using SAX mission data archives, then we defined the whole Scientific Knowledge Extraction (SKE) process for our contest expressed above, suggesting the approach we are developing and testing now on laboratory and simulations SA data with the purpose of applying the refined and tested SKE system also to SA flight data soon after its launch in 2005.

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