Efits, a new efficient and flexible FITS library

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Abstract. We present the work in progress on a new FITS library named Efits which has been developed to achieve efficiency, flexibility and accuracy. These goals have been obtained through the usage of shared memory, through the possibility to extract the data directly from Multiple Extensions FITS (MEF) files without splitting them in advance, and through the implementation of a noise map propagation mechanism.

Introduction

We present a library with a special layer to support different I/O methods (disk and shared memory, currently). The usage of the shared memory allows us to efficiently exchange data among independent processes. In this way a real software modularity is intrinsically implemented without the necessity to write a monolithic code (Fig.1). A further way to reduce the I/O is achieved through the possibility of working on single extension of FITS file extracted directly from MEF files without splitting them in advance. In order to increase the precision of the image analysis we have also implemented a mathematical library which supports a noise map propagation.

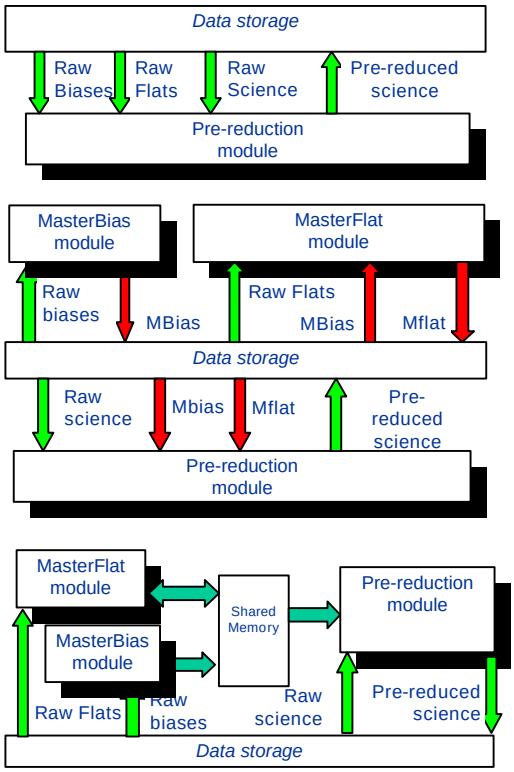

Figure 1.
Reducing I/O keeping modularity.

The Efits library

The Efits library comes as a low-level software facilities to perform processing of images in FITS format through the calls to a C library. It is written according to POSIX and ANSI standard in order to ensures the maximum portability. The main components of Efits library are: fits_io, gen_io, mem_io and Iscience (Fig. 2). Fits_io includes set of functions for manipulations with FITS-key representation, FITS-header attributes, FITS-header manipulations, FITS-header history, FITS data manipulations. It was not possible to use existent FITS library because we want to work not only with disk files, but with memory also. All the new functions will work with memory buffers, not with I/O streams directly.

Gen_io provides fixed, pre-defined, storage type independent interface, which is used by applications for I/O operations. Currently, shared memory I/O and standard file system I/O operations are supported by gen_io. The library provides also a program interface, allowing us to extend the set of supported low level I/O methods (external "plug-ins") or to substitute the existing ones.

Mem_io library includes a set of basic POSIX-like functions (open/read/write/seek/...) with the purpose of using the shared memory in the same way as a standard file-system file. The library uses special locking mechanism (semaphore based) to support multiple/parallel /concurrent access to the same data/ memory segment(s).

Iscience contains statistics functions, pre-reduction methods, noise map generation and propagation functions.

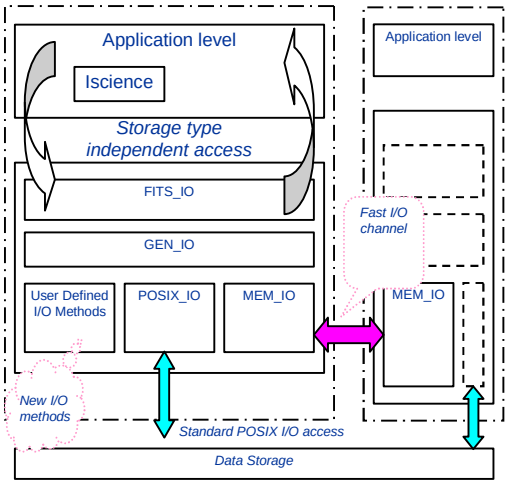

Figure 2. Efits schematic diagram.

The shared memory implementation

In oder to work with the shared memory it has been necessary to design the structure of the shared memory segments and a locking mechanism to allow us a concurrent access. One Shared memory Control Block (SCB) contains information about the status of the segment, the attached memory segment ID, the semaphore ID. The structure was designed to be able to create and manipulate chain of memory segments. This is why the SCB structure contains links to next/previous/top/last segments. Chain of segments is useful to separate FITS-headers and FITS pixels information easily.

Conclusion

We report the description of the on going work on a completely new set of C-code library to process FITS images. The main peculiarities regard the usage of the shared memory to exchange data among independent processes and the implementation of a true noise map propagation mechanism.