Making FITS available in .NET and its Applications

Vivek Haridas[1], Tamas Budavari[1], William O'Mullane[1], Alex Szalay[1], Alberto Conti[2], Bill Pence[3], Antonio Volpicelli[2] and Ani Thakar[1].

1 Johns Hopkins University, 2 Space Telescope Science Institute, 3 NASA / GSFC

FITSLIB, the library

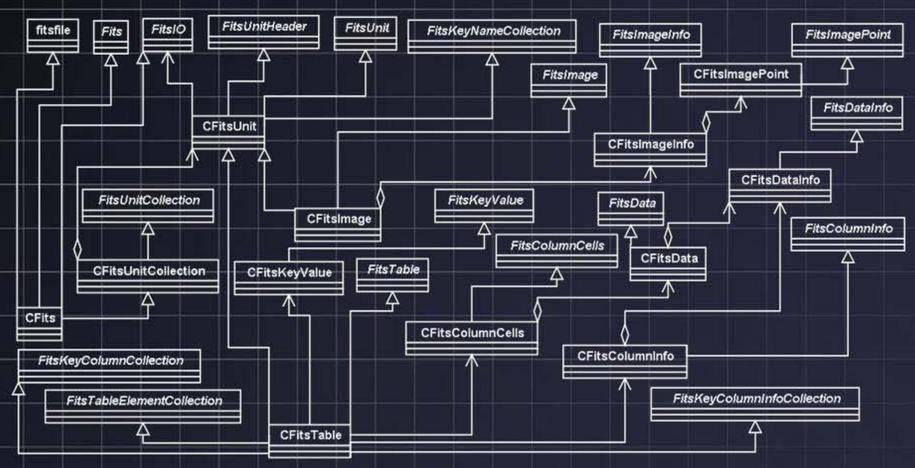
Fitslib is a library developed for facilitating operations on the FITS files on the Microsoft's Dot Net Platform.

The library is developed and depends on popular and well tested CFITSIO package, it provides the object oriented interface to the FITS world.

The Implementation

The implementation focuses on issues such as memory management, invoking the underlying CFITSIO routines, error management, implementing OO data structures and maintaining CFITSIO data structures.

CFitsTable and CFitsImage are the two major implementation classes.
The CFitsTable class implements a major portion of the different interfaces to the Fits Table.



Performance Metrics

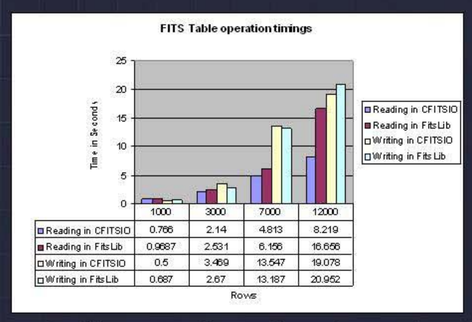
The object oriented and memory managed .Net interface is easy to use but, introduces a small overhead compared with direct CFITSIO usage.

Performance testing of such interfaces is non trivial. The graphs on the right show some timings for reading and writing images and rows of fits data of varying sizes.

Although not shown in the graph for very large files the .NET package appears faster than CFITSIO which seems anomalous. This could be due to host of independent variants such as memory paging, code optimization or garbage collection on the .Net platform. However, when tested over a range of different operational requirements and loads some overhead can be observed.

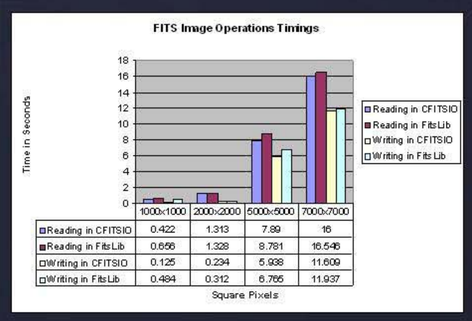
The performance comparisons are between some similar pieces of CFITSIO and FitsLib program code.

Additionally, some mathematical operations were done on the data being used in the tables and images. This was done to minimize the effects of code optimization.



	1000	3000	7000	12000
Reading in CFITSIO	0.766	2.14	4.813	8.219
Reading in FitsLib	0.9687	2.531	6.156	16.656
Writing in CFITSIO	0.5	3.469	13.547	19.078
Writing in FitsLib	0.687	2.67	13.187	20.952

Each table was made up of 20 columns of vectors of 100 elements each



	1000x1000	2000x2000	5000x5000	7000x7000
Reading in CFITSIO	0.422	1.313	7.89	16
Reading in FitsLib	0.656	1.328	8.781	16.546
Writing in CFITSIO	0.125	0.234	5.938	11.609
Writing in FitsLib	0.484	0.312	6.766	11.937

The Design

The essence of the library is the object oriented design completely written in Microsoft's managed C++ language.

Issues such as memory management, interoperability in the .Net Languages have been the focus of the design.

Provision has been made for developers who would like to have direct access to the underlying data..
The design has been developed in two phases, the interface design and the implementation design

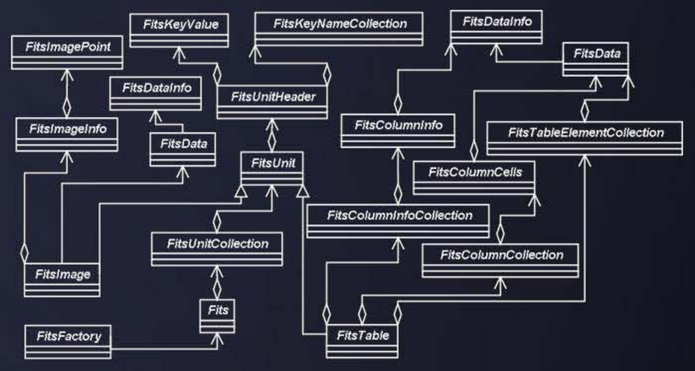
The Interface

The interface intends to provide an intuitive Document Object Model (DOM) like layout for a FITS file.

The FitsFactory provides methods for creation of new interfaces to FITS files. The Fits interface opens FITS files for read or writing operations. There are also specific interfaces for Fits Table and Image units.

The FitsHeader interface provides access to header information in every unit.

Fits Data is the data structure representing a cell of a Table and also the image buffers.



Applications

Thanks to active usage and support from a small number of developers from the initial stage, the tool is already employed successfully in a few applications and WebServices some of which are listed below.

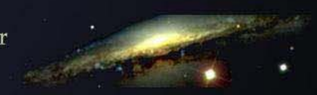
GALEX Summary

The GALEX summary page allows users to browse images in depth and obtain details of individual GALEX objects

Thumbnail images of objects on the summary page are generated on the fly from the full fits image using C# and FitsLib.

http://galex.stsci.edu/Tools/Explore/explore.aspx

Sloan Digital Sky Survey / Skyserver



Catalog Archive Server – JOBS

This is a system used to process queries against large astronomical databases. It uses a system of queues and personal databases to accommodate a variety of different queries in a timely and efficient manner.

http://skyservice.pha.jhu.edu/devel/casjobs/

CAS - Service

This is an XML Web Services interface to the SDSS Catalog Archive Server (CAS).
It provides access to catalog data and returns the result in different formats.
http://skyservice.pha.jhu.edu/devel/casservices/casservice.asmx

Summary

FitsLib is a library meant for for astronomers and developers working on Microsoft's .Net Platform. It offers a DOM like layout and the convenience of a .Net language along with the speed of CFITSIO.

The latest documentation, samples, source and binary downloads are available at
http://skyservice.pha.jhu.edu/develop/FitsLib/

THE US NATIONAL VIRTUAL OBSERVATORY

Supported by the National Science Foundation's Information Technology Research Program
under Cooperative Agreement AST0122449 with The Johns Hopkins University