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Memorie della

The Fasti Project

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Abstract. The Arcetri Infrared Group has developed a new architecture for the newer infrared astronomical array detectors, which is intended to overcome the limitation of present-day commercial controllers. Named Fasti, it is designed to be modular, flexible and extendible. Fasti is also suitable to be used with very fast optical detectors, as those used in Adaptive Optics.

Key words. astronomical detectors – infrared astronomy – adaptive optics

1. Introduction

Some recent technological advances enable us to develop a controller architecture for fast astronomical array detectors (for example the 1024x1024 Rockwell's Hawaii infrared HgCdTe detector) which is intended to fully exploit the capability of present-day detector. Named Fasti, it is a *light* electronic system, which is modular, flexible, extendible, and avoids obsolescence as much as possible. It is suitable to be used with both DRO and CCD detector and it is also well suited for very fast optical detectors, as those used in Adaptive Optics.

The design phase for infrared is completed and we are starting to build the infrared version of Fasti. Meanwhile we started a collaboration with Bologna Observatory for the development of a new Adaptive Optics detector system, based on the Marconi intrinsically intensified photon counting detector, the L^3CCD, needed by the new generation telescopes, the TNG and LBT.

2. Project Description

Fasti is a controller architecture developed to be powerful and extendible. Its extendibility enabled us to plan an optical version of it. As an added bonus, the design does not constrain the downhill controlling computer: Fasti is seen as a peripheral through a network connection, with easy integration in existing telescope control structure as in TNG case.

The basic ideas of Fasti design are:

- to divide the system in several *modules* with clear boundaries.
- to use, as far as possible, commercial parts at board level.
- to use largely accepted standards as boundaries, as a PCI bus, a parallel interface or a serial.

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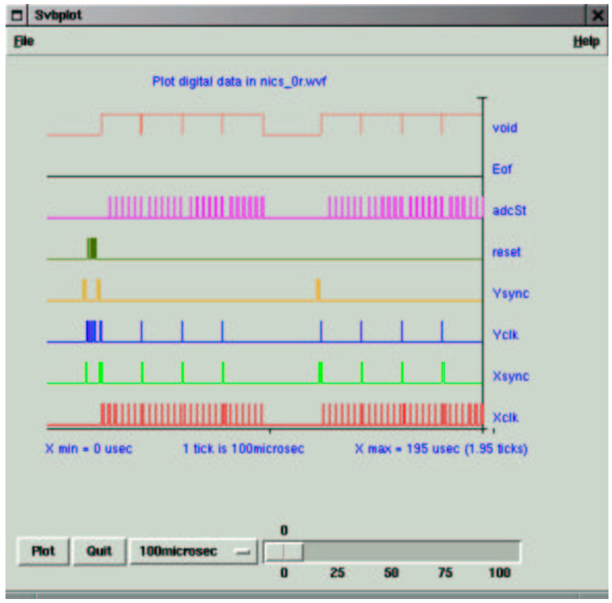

Fig. 1. An example of Fasti waveform as seen by the development software.

– to design the few custom parts as concepts, not around a particular electronic device, so that they could be implemented by components from different manufacturers, or by devices developed in the future.
– to be as flexible as possible on waveform generation. This part has proved to be flexible enough to drive both DRO and CCD detector.

3. Fasti structure

Fasti is designed in modules, with clear-cut boundaries. Its main parts are:

- The Waveform Generator
  The flexible waveform generator is a custom part of which we had already built the prototype. It is based on a specialized micro-controller, where the waveform definition is realized by means of a program in a pseudo assembler language, greatly simplifying the definition of new waveforms. We had already developed all the support software for waveforms design and testing. This part, named SVB, can generate not only the standard waveforms to read the full array, but also arbitrary sub-array scan patterns. It can be reprogrammed in seconds, and hold up to four different clocking schemes, which can be selected on a per integration basis. The SVB is implemented in programmable chips, but, being *a conceptual design*, can be easily transferred to newer devices.
- The Global Controller
  Inside Fasti there is a central controller for start-up, general housekeeping, global control of operations (start integrations for example), data collection, formatting and buffering, or for data pre-processing when needed. In the present design all this is realized with a disk-less embedded computer, using an Intel or Alpha family CPU and few commercial boards. The parallel digital acquisition board and the fast Ethernet interface are hosted here.
- The Serial Bus
  All the low speed communication inside Fasti are routed through a *serial bus*.

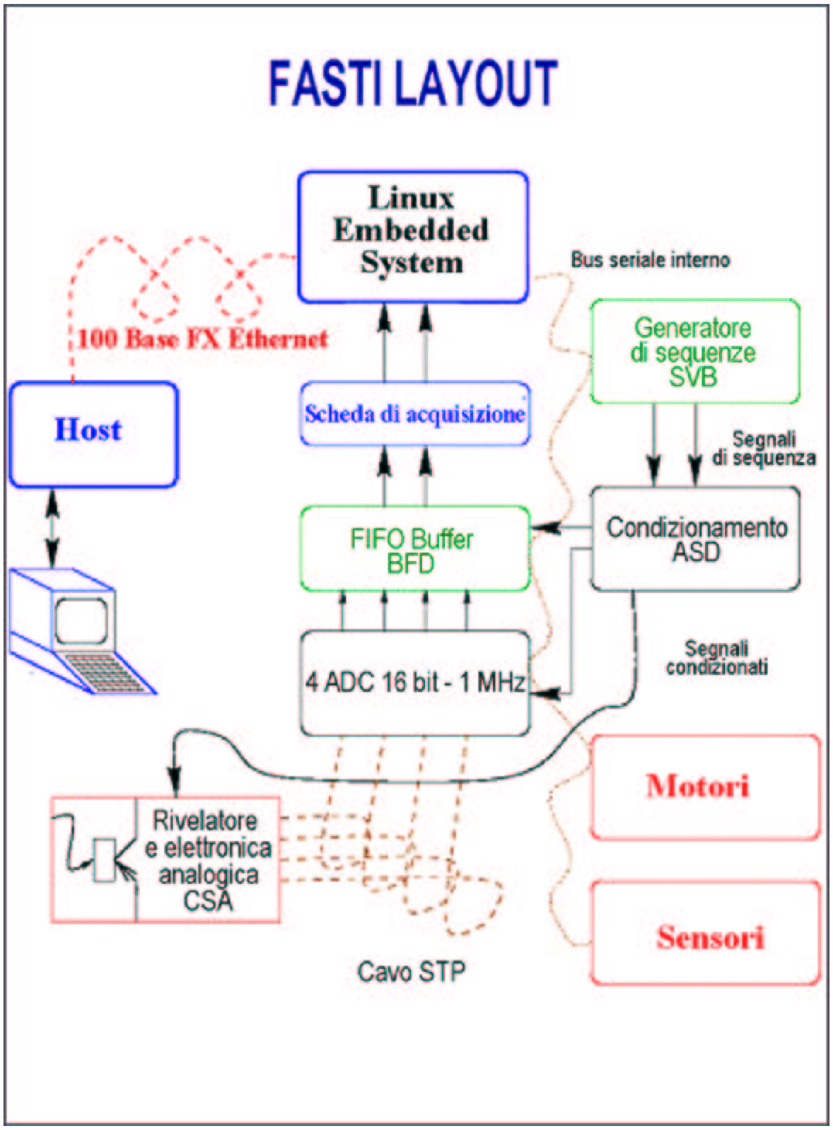

Fig. 2. An Artist's view of Fasti-IR structure.

This approach gives us the possibility to use a simple and widely accepted standard for communications, and to use all commercially available parts. The bus chosen is the old RS232, but routed on Ethernet. This choice bring together the ubiquity and the ease of use of RS232 and the flexibility and addressability of Ethernet.

- The Conversion Subsystem
  This part has to be custom developed. This section mainly consists of a small number (4 for NICMOS3 and Hawaii) of analog to digital converters and some glue logic. We will use high quality 16-

bits converters for Nics[1] version, and very fast low resolution (8 or 12 bits) converters for Adaptive Optics version.
- The Analog Interfaces
  This part consists mainly of the bias levels generation, of digital clocks level shifting and of detector output conditioning. For Infrared version this part inherits the NICS[1] design, and for L^3CCD uses a Marconi commercial board.

4. Project Status

At the date of this paper three of the four boards for Nics[1] version have been designed and are in fabrication or testing. The fourth (the buffer board) is in its final design phase, ad are expected to be completed in a month. The system is designed to be able to work (even at lower capabilities) so we expect to be able to get first acquisition before spring 2002.

In our present schedule, the complete system will be read before summer.

For the L^3CCD version, a collaboration with Bologna University have been started, and we are already actively collaborating. The expected laboratory version is expected for the summer.

[1] Nics is the Infrared Camera Spectrometer developed by arcetri Infrared Group for the TNG (Baffa et al. 2001; Lisi et al. 1999)

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