The Fasti Project

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Abstract.
Fasti is a controller architecture originally developed for fast infrared astronomical array detectors, and intended to be powerful and extendible. 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. In the framework of LBT project, a L^3CCD version is in development.

More info can be found in http://www.arcetri.astro.it/irlab/fasti .

1. Fasti general description

Fasti is an innovative design for infrared and fast optical detectors and is mainly implemented as software. All circuit logic is build using programmable chips, the sequence generator is a specialized microprocessor build in a PGA (Programmable Gate Array), all the system is controlled by a Linux embedded controller, the waveforms are described by an ad hoc assembler.

Fasti is meant to be a light electronic system, and is designed to be modular, flexible, extendible and to avoid obsolescence as much as possible. It is divided in modules with clear-cut boundaries. Fasti is seen as a network device, giving very few constraints to the controlling architecture. Fasti can hold up to four completely different waveforms, so is capable to control the detector in radically different operation modes.

The first uses of Fasti will be the replacement of the Nics (Nics is the Infrared Camera Spectrometer developed by Arcetri Infrared Group for the TNG, the Italian National Telescope Galileo, see Baffa et al., 2001) electronics and and the fast LBT (Large Binocular Telescope) wavefront sensor optical detectors control (cfr. Esposito, et al., 2002, Foppiani et al., 2002).

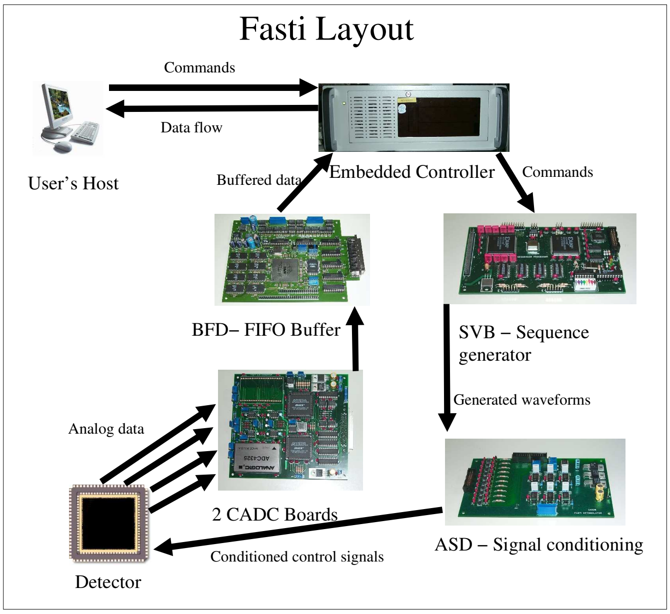

Figure 1. Fasti general structure. Boards images are relative to Nics version

2. Fasti components

Fasti is designed as modules, its structure can be seen in Figure 1. Fasti building blocks are:

- The embedded computer system, acting as a global controller.
- The internal serial bus for general setup and control.
- The parallel input interface (now a commercial board).
- SVB - the flexible waveform generator.
- CADC - the analog signals conditioning and conversion board.
- BDF - the FIFO and multiplexer board.
- ASD - the digital signal conditioning board.

We describe briefly the main modules.

2.1. 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 built 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.

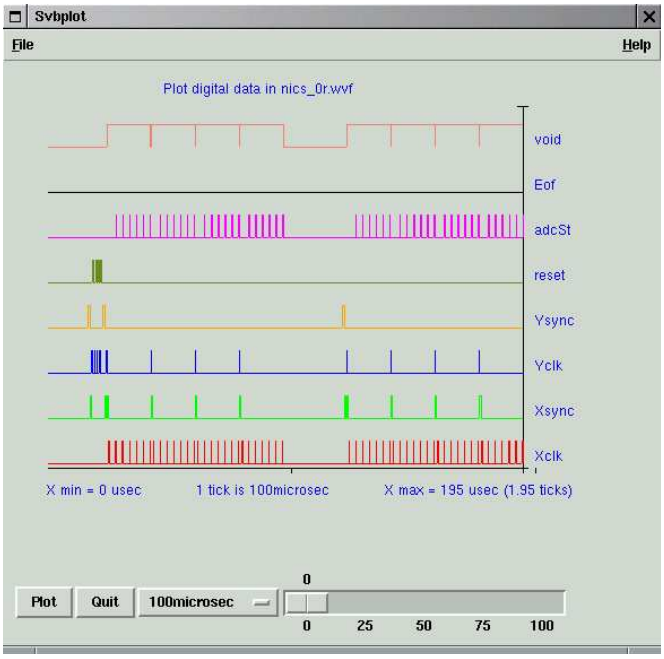

Figure 2. Plotsv output of a simplified Hawaii IR detector clock sequence

2.2. The Global Controller

Inside Fasti there is a central controller for startup, general housekeeping, global control of operations (start integrations for example), data collection, formatting and buffering, or for data preprocessing when needed. In the present design all this is realized with a diskless 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.

2.3. The Conversion Subsystem

This part has been 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 the Nics version, and very fast, lower resolution (12 or 14 bits), converters for the Adaptive Optics version.

2.4. 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 design, and for L^{3}CCD uses a Marconi commercial board.

3. Fasti ancillary software

Fasti has some support software to ease its use and integration in a particular application.

- Svbasm. To develop specific waveform, we designed an ad hoc assembler, and we wrote a cross assembler program. It has integer and floating point capabilities and has been written using the GNU bison parser generator.
- Emusvb. To check the correctness of waveform assembled, we wrote a software emulator of the sequence generator board. It is implemented as a *state machine*, and is enough accurate to reproduce the internal checksum of the board during waveforms output.
- Plotsvb. To graphically verify the waveforms generate, we developed a specialized interactive plotting program which emulates the output of a logic analyzer. It is written in perl_tk and permits plotting and panning of the multiple waveforms generated. An example can be seen in Figure 2
- Ftest. To test single components of Fasti, or to execute low lever operations, we developed a text menu application which give both a fine grain control on the machine and the ability to execute higher level task as a series of integrations.

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