CCD Data Acquisition Systems at Lick and Keck Observatories

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This paper will describe and compare two distinct but related CCD data acquisition systems (DAS) currently under development at Lick and Keck Observatories. Although these two systems have a number of major architectural differences, they share a considerable amount of common hardware and software. Both of these new systems build on a large body of proven software that is the foundation of the existing CCD DAS currently in use at Lick Observatory. Both will provide support for reading up to four on-chip amplifiers per CCD and/or reading out mosaics of CCD chips. In addition, they will provide the capability for interactive, real-time adjustment of CCD waveforms for engineering purposes.

Each of these two systems is composed of three major subsystems:

1. an instrument computer and its software
2. a data capture computer and its software
3. a CCD/dewar controller and its software

The instrument computer is a Unix workstation, and the functions it provides include user interfaces, the interactive real-time display of CCD images, and the recording of image and FITS header data to disk and/or tape. The data capture computer is responsible for the packaging and high-speed transfer of the CCD pixel data stream into a bulk RAM, and the subsequent transfer of this data to the instrument computer. The CCD/dewar controller generates the waveforms for clocking the CCD, digitizes the pixel data, and transmits it via high-speed link to the data capture computer. It is also responsible for monitoring and controlling the dewar temperature and cryogen levels.

A significant portion of both systems is based on hardware and software developed by Robert Leach of the Astronomy Department of San Diego State University. In both systems, the CCD/dewar controller will employ Leach-designed timing, analog, and utility boards. The timing and utility boards make use of Motorola DSP 56001 digital signal processors for high-speed waveform generation and data capture. In addition, the Lick system will employ the Leach-designed DSP-based DMA controller in its data capture computer.

Given the number of different types of processors and high-speed data links employed in both systems, a major emphasis of this paper will be on the various forms of inter-processor communications utilized for data transfer and distributed process synchronization.