AN OVERVIEW OF THE SUSI CONTROL SYSTEM

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Abstract. The SUSI control system is a distributed real-time system currently consisting of 17 processors. A custom real-time operating system and network protocols ensure synchronous operation of servo loops across multiple processors.

Key words: SUSI–optical interferometer–control system–real-time–operating system–network protocol

1. Introduction

Ground-based stellar interferometers such as the Sydney University Stellar Interferometer (SUSI) (Davis *et al.* 1992) are inherently complicated astronomical instruments requiring a sophisticated control system if observations are to be made efficiently. In SUSI almost all observing functions are under the control of an elaborate distributed real-time system consisting of custom electronic interfaces, commercially-available computers and custom applications running on a mix of standard and custom operating systems.

2. Hardware interfaces

Electronic interfaces include microstepping controllers for stepper motors in the siderostats and path compensator, pulse-counting interfaces for photomultipliers in the tilt detectors and visibility detectors, digital-to- analog converters for PZT-actuated tilt correctors and a video signal peak tracker in the star acquisition system.

3. Computers and operating systems

The computer system is divided into a fast, hard real-time section and a slow, soft real-time section. In the fast section repetitive tasks are scheduled with periods ranging from 1ms up to 2s. Soft real-time computers include a Sun 386i workstation running UNIX and 3 IBM-compatible 386 PCs running MS-DOS. In the hard real-time section two versions of a hard real-time operating system written by ourselves are used: OS-0 on eleven Australian-made 68000 AV68K single board computers (SBCs) and OS-1 on two Motorola 68010 MVME333-2 SBCs. Figure 1 is a block diagram of the system.

4. Networking

Hard real-time interprocessor communication is via RS-232 at 9600 baud using a custom Register Transfer Protocol (RTP). Links between soft real-time computers use NFS protocols over Ethernet. The hard and soft sections are connected via RTP over RS-232. RTP within the hard real-time section provides error detection,

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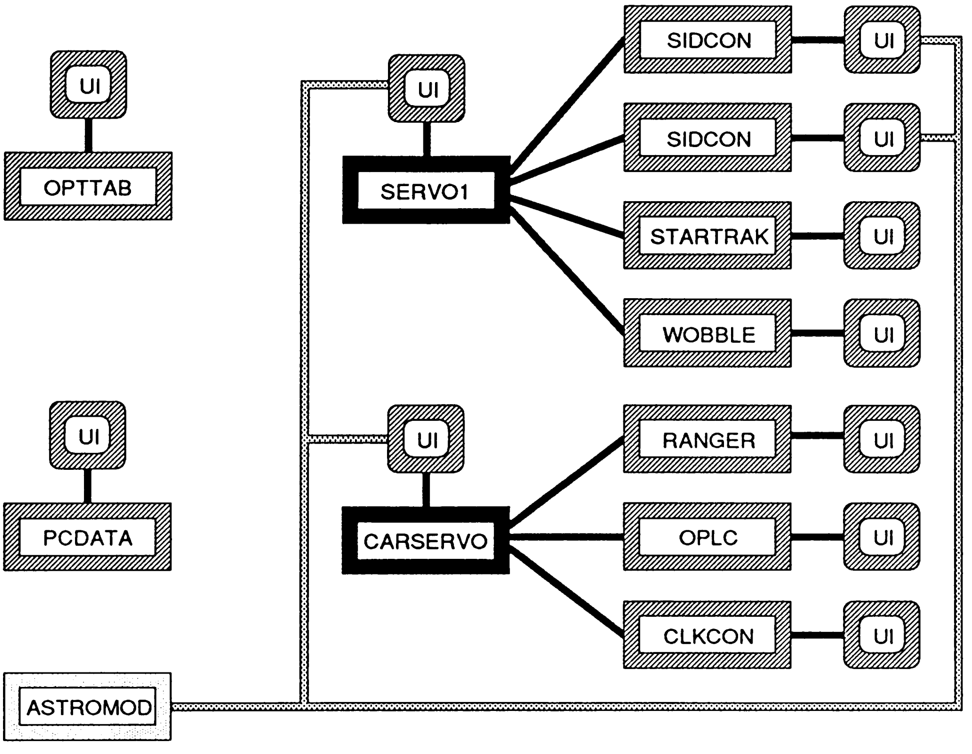
correction and data transmission within a guaranteed time interval by using short messages up to four bytes in length.

Fig. 1. The diagram shows the structure of the SUSI control system in its current observing configuration. Hatched rectangles represent AV68K SBCs, while black rectangles represent MVME333-2 SBCs. The function of each SBC is specified in Table I. ASTROMOD is a background process running on the SUN workstation. The rounded rectangles are user interface programs either running on dedicated PCs under MSDOS or MS Windows or multitasked with other such programs under SunView on the workstation. Each black line corresponds to a bidirectional RTP link over RS-232C. Shaded lines represent the broadcast of astrometric information over Ethernet using NFS protocols.



5. Timebase

A clock network synchronises most of the hard real-time computers at the instruction level and the electronic interfaces at hardware level so that the sampling epoch of most signals is known to within a few nanoseconds of the system's atomic time standard.

6. Software

All software is written in C with version control provided by SCCS on the Sun workstation. Code for the 68000-based computers is created by a Hitech cross-compiler which runs in an MS-DOS environment either on a PC or on the workstation. Microsoft C is used for PC programs, and cc and gcc for UNIX software.

TABLE I
Key to SUSI single board computers.

SBC	function
SIDCON	Controls a siderostat's azimuth and elevation stepping motors and the periscope mirrors which switch light into the evacuated pipe.
STARTRAK	Uses an image intensifier, CCD camera and a video signal peak tracker to acquire stars.
WOBBLE	Uses photon-counting quadrant detectors to detect and correct wave-front tilt using PZT mirrors.
SERVO1	Guides the siderostats using information from either the video acquisition system or the tilt correcting mirrors and the astrometric model.
RANGER	Controls two infra-red laser metrology systems which measure the position of the path compensator.
OPLC	Controls the stepping motors and PZT mirrors on the path compensator.
CLKCON	Reads time information from a Rohde and Schwartz atomic clock, disciplines a secondary Hewlett Packard quartz frequency standard and generates clock signals.
CARSERVO	Controls the path compensator using information from the laser metrology system and the astrometric model.
OPTTAB	Controls shutters, periscopes and apertures on the optical table.
PCDATA	Integrates photon counts in the signal channels and calculates correlation.

7. User interface

The main user interface (SUSIUI) is a textual one based on the standard UNIX screen management package, "curses", which provides a uniform user-interface across UNIX and MS-DOS. A graphical interface developed using Microsoft Windows is provided for the star acquisition system. In current operation each hard real-time SBC has its own user interface program.

8. Future development

Future plans include a centralised user interface and VMEbus links to additional Motorola SBCs and an Ethernet link between the hard and soft real-time systems.

References

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