Development of stereoscopic control system for the CANGAROO-III telescopes

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Abstract

Stereoscopic observation by the CANGAROO-III imaging Cherenkov telescopes will be performed by operating four telescopes simultaneously with various operation modes. High quality control system of such multi-telescopes to achieve various types of observation demands has been constructed and tested.

1. Introduction

The CANGAROO-III project consists of four imaging Cherenkov telescopes. The first telescope has been in operation since April, 2000, in Woomera, South Australia [4]. Stereoscopic observations using 2 telescopes started from December, 2002 [1]. The third and the fourth telescopes will be completed very soon.

We have been controlled the first telescope by using a driving control PC. In order to perform the stereoscopic observation by multi-telescopes, we developed a stereoscopic control system by implementing well-made former operation system for the operation of the first telescope. Details of the stereoscopic control system for the CANGAROO-III telescopes are described in this paper.

2. Telescope System

The first CANGAROO telescope (T1) is controlled by a driving control PC through a remote control unit called as an Antenna Control Unit (ACU). Data communication between the driving control PC and the ACU is done over RS-232C. The second telescope (T2) is operated by the same type of ACU, the third (T3) and the fourth (T4) will be the same.

The telescope motion range is limited by software from -270° to 270° in azimuth and from 0° to 90° in elevation. If the angle of the telescope exceeds the software limit, a hardware limiter will work to stop the moving of the telescope for safety. The maximum rotation speeds are set to 0.5 deg/sec for T1 and 1.0 deg/sec for T2 in spite of the direction of azimuth and elevation. We can, therefore, start stereoscopic observation at any celestial position at most 12 minutes after the operation command.

Linux operating system with the real-time extension (KURT [2]) is running on the driving control PC's and is synchronized to a GPS receiver by the Network Time Protocol (NTP) software. The driving control software is written in C language for communication with hardware. The driving control PC's communicate with respective telescopes at a transmission cycle of 100 ms. When they receive actual encoder counts and the status from the telescopes, they check the direction and the status, and send such information to the data acquisition (DAQ) system [3] every 1 sec over 100 Mbit/s Ethernet. Thus the directions that telescopes are pointing are recorded together with other observation data.

3. Design Concept of the Telescope Control System

Our concepts of designing the control system of the telescopes are fundamentally how to control all of the telescopes flexibly, efficiently and safely by responding to various demands for the observation. In order to perform them, we

designed to share charges for each PC. We put driving control PC's for respective telescopes by their sides. A central control PC supervise the driving control PC's (Fig. 1.).
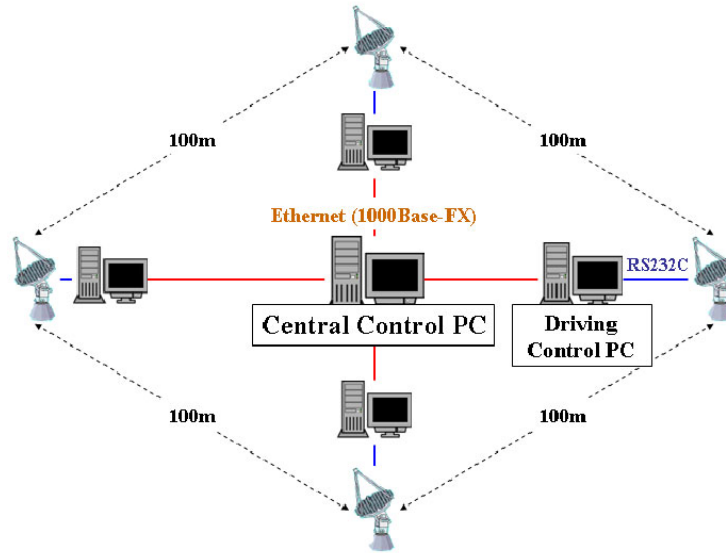

Fig. 1. Basic idea of the multi-telescope control system for the CANGAROO-III project.

We made telescope simulators which generates the same signals as the real telescopes so that we can develop the control softwares in the laboratory (Fig. 2.). The driving control PC's are interconnected to the central control PC over custom communication protocol of TCP/IP, and are always ready to receive remote instructions from the central control PC. The central control PC receive the status of each telescope every 1 sec from the driving control PC's. Therefore it is possible to cope with faults very quickly.
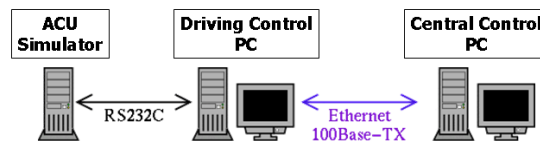

Fig. 2. Schematic image of the environment for development.

All telescopes are steered by the central control PC, and they don't interfere with each other. If the central control PC stops accidentally, each telescope can continue to track the observation object, and if one of the driving control PC's stops, other telescopes can do it.

4. Easy and Useful Operation Method

To make the observation easy for every shift people, we prepared an automatic operation system. In the beginning of the observation on the night, we create data of an observation schedule. This schedule data is created by a Graphical User Interface (GUI), easily, quickly, exactly for any targets. A control process on the driving control PC interprets the schedule data, and control the telescope along with the schedule. Moreover, the central control PC has the GUI which was made of the GIMP Toolkit (GTK) language. GTK is essentially the Application Programmers Interface (API) based on the object oriented programming. The GUI can make it easy to supervise the controls of the telescopes and to monitor their status.

5. Summary

We have developed a stereoscopic control system for the CANGAROO-III project. This system is composed by PC's with free operating system Linux. We can operate all of the telescopes by only one PC easily using GUI. Control roles are distributed to each PC to avoid accidental failure. This system has been installed for our recent observation, which has shown good performance as we designed.

6. Acknowledgements

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