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SOFTWARE AND ELECTRONIC DEVELOPMENTS FOR TUG - T60 ROBOTIC TELESCOPE

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RESUMEN

Un telescopio robótico es un telescopio que puede realizar observaciones sin intervención humana en persona. Su comportamiento base es automático y controlado por ordenador. Los telescopios robóticos suelen funcionar bajo el control de un planificador, que provee control de alto nivel seleccionando objetivos astronómicos para observar. El telescopio robótico T60 del observatorio nacional de TUBITAK[2] (TUG) es controlado por el software código abierto OCAAS, anteriormente llamado TALON. Este estudio introduce las mejoras sobre el software TALON, y nuevos diseños electrónicos y mecánicos. Las mejoras de diseño y software han sido implementadas en el sistema de control del telescopio T60 y probadas en el sistema real exitosamente.

ABSTRACT

A robotic telescope is a telescope that can make observations without hands-on human control. Its low level behavior is automatic and computer-controlled. Robotic telescopes usually run under the control of a scheduler, which provides high-level control by selecting astronomical targets for observation. TUBITAK[2] National Observatory (TUG) T60 Robotic Telescope is controlled by open source OCAAS software, formally named TALON. This study introduces the improvements on TALON software, new electronic and mechanic designs. The designs and software improvements were implemented in the T60 telescope control software and tested on the real system successfully.

Key Words: telescopes — instrumentation: miscellaneous

1. INTRODUCTION

T60 is controlled by TALON formerly called OCAAS software based on open source GNU/C unix platform. The telescope can be operated on robotic mode and the observations are made as object oriented. The corresponding technical specifications are on the Table 1. T60 robotic telescope is able to survey the dynamic catalogs such as edb, response for the GRB alerts and make long-time observation projects.

2. T60 SOFTWARE / HARDWARE ARCHITECTURE

2.1. *Software Architecture*

Telescope control software, TALON provides the users to control the telescope both manual mode (by GUI) and robotic mode (batch mode). The users are able to prepare the observations by using the TALON tools such as mksch, telsched. TALON software architecture based on the daemons which are able to execute all the processes simultaneously.

TABLE 1

T60 TECHNICAL SPECIFICATIONS

Model	OMI RC06
Optical Class	Ritchey-Chrétien
Aperture	600 mm
Focal Length	6000 mm
Focal Ratio	f/10
Resolving Capacity	0.19"
Image Scale	34"/mm
Filter Wheel	12
Dome	ASH-DOME, model R
	14′6" 100 sec/rev

TALON has two main daemon, telrun and telescoped. The telrun daemon is responsible for operating the schedule on robotic mode by sending appropriate command to telescope daemon (telescoped). The telescoped is responsible for the control of the dome, focus, filter wheel and the telescope axes by sending the low level commands to the motion controllers.

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2.2. *Hardware Architecture*

The servo motors are used in order to control the RA, Dec axes, focus and filter. The single phase AC motor is used in order to control the dome. All motors are closed-loop controlled by using the motor drivers and the motion controller cards. Every motion controller card is independent and programmed for the distinct processes.

3. T60 SOFTWARE AND ELECTRONIC DEVELOPMENTS

The first design of the T60 dome was open-loop controlled and mostly controlled manually. The opening and closing processes have been done time dependently. TALON sent the *open* or *close* command to motion control card and wait for a while, then it assumed that dome had opened or closed. In any case of failure on one of those processes, the dome got stuck and observation failed because of no information of the feedback from dome. In order to solve the problem, the closed-loop control has been implemented by designing a new electronic card and low level software in order to get information of the feedback.

The meteo station sends the weather information such as wind, humidity etc. to TALON. In case of the extreme weather conditions, alert was sent to TALON from the meteo station. The telescoped daemon checks whether alert flag is on or not. If it is on, the daemon stops the motions of all modules of the telescope (dome, filter, focus, RA-Dec axes) and closes the dome immediately. After that any commands is not accepted for dome, even *stop*. In case of the alert, *dome_close* function in telescoped returned to *negative value* to inform telrun about alert. Meanwhile, *Chck_Weather* function in telrun sent the *stop* command to telescoped because of the *negative value*. The *second stop* got telescoped returned the *second negative value* and it occurred in every millisecond like loop. That was *the bug* and got the log file expanded. The software was fixed by providing that telescoped got *stop* command from telrun once when the alert occurred.

Telsched is a tool to make all night schedule from the individual schedules which are prepared by the observers. In the old version of TALON, the problem was that the individual schedule were not sorted in full night. The solution was to prepare two schedule files for one night, one for until 24:00, the other for until dawn. The *crontab* procedure ran to swap the schedule files while TALON was running in robotic mode. The improved solution is that "Julian Date Sort" function is written in GNU/C and added in the telsched module.

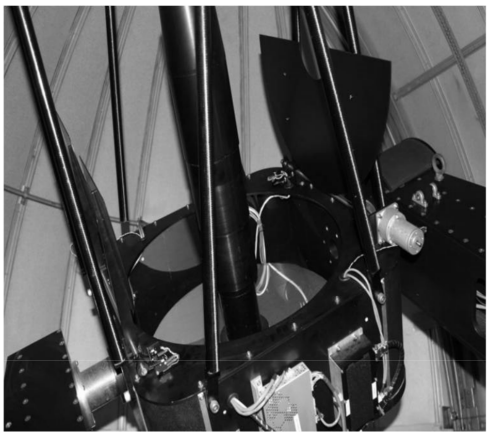

Fig. 1. The view of the mirror cover.

The mechanic, electronic and software components of mirror cover were designed by TUG engineers in Figure 1. For the new design, the new drop down list is implemented to the TALON GUI in order to control the telescope in manually. The main challenge was to make it work in robotic. In order to achieve that, the new algorithm is implemented to adopt the mirror cover in existing system by taking into account the extreme situation such as the weather alert. In case of weather alert or closing at the dawn, the closing sequence should be mirror cover and dome shutter respectively. While opening case, vice versa. The motion control card which is used for mirror cover is used for tracking as well, so the process for the mirror cover should be finished exactly, before the observation starts. Otherwise, the tracking and mirror cover processes are conflicted and the system will get stuck. The new attribute in *shared memory* for the dome state is checked firstly; if dome opened clearly, then the open command is sent to motion control card for the mirror cover in recursive functions.

4. CONCLUSION

Developments and improvements that have been achieved so far on T60 robotic telescope make it more stable for the robotic mode, and encourages us for further improvements and future challenges. As future project, it is thought that a new autonomous GRB software can be employed to implement T60 telescope software so that the telescope can be used in observing GRBs and astroids.

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