

Closed-loop control of Filter Wheel for 70 cm GROWTH telescope

The GROWTH (Global Relay of Observatories Watching Transients Happen) –India telescope at Hanle in Ladakh is India's first effort towards a fully robotic telescope. It is also the first one dedicated for a rapid follow-up of transient events in the universe. Mounted in between the CCD camera and the output port of the GROWTH telescope is a filter wheel which houses 6 filters whose centers are located on the same pitch circle. These filters are rotated into position in a specified sequence by a stepper motor coupled to the filter wheel shaft. A closed-loop control system has been designed to rotate the filter wheel and ensure that the correct filter is positioned before the camera in the required sequence, in line with stringent performance requirements. This system is realized with a 16-bit dsPIC33F microcontroller. The Quadrature Encoder Interface module is used to interface with an optical encoder attached to the filter wheel shaft. The Output compare module on the microcontroller has been used to generate the pulses to the stepper motor driver which will be used to move the stepper motor. The stepper motor rotation is ramped by varying the frequency of the pulses from pre-defined maximum to minimum frequencies to reduce the inertial effects of the filter wheel. An algorithm has been designed to calculate the shortest distance between any two filters and rotate the motor accordingly in either direction. As a marked improvement from the previous system, an interrupt system has been designed to ensure that the encoder values and desired position match with a very high accuracy. The electronic components have been carefully chosen keeping in mind the low temperatures of the observation floor of the telescope at Hanle. A GUI has been designed to allow the user to select the required filter, after which, the filter wheel is rotated to the position within 6 arcseconds of the position in a maximum of 25 seconds.

In this talk, I will present the key improvements made to the existing system and the methods used.