

A low cost portable multipurpose satellite tracking system for Sri Lanka

R S T Kodikara and K P S C Jayaratne

Department of Physics, University of Colombo, Colombo 3

The position of a satellite cannot be determined by simple Kepler's laws alone given by the six orbital elements. Any satellite, including geostationary would change its position with time due to orbital perturbations caused by several other factors such as: the influence of other attracting bodies like sun and moon, the nonspherical nature of the earth, atmospheric drag, solar radiation pressure and the satellite's own manoeuvres. As such, satellite tracking systems are very expensive devices.

This paper describes an attempt made to construct a prototype low cost portable satellite tracking system for Sri Lanka which can be used for various purposes like tracking geostationary and fast orbiting satellites in communication/data transmission, military purposes, to track and forecast the point of impact of falling satellites or space derbies.

The structure of the controller was built in a workshop using metal frames and hardened wood. Driver section of the tracker was constructed using two stepper motors (12 V, 1.5 A Denshi unipolar) in a manner that could rotate the controller in vertical and horizontal planes. These motors rotate 1.8 degrees per step and have 200 steps per revolution. The motors were driven through UCN5804 stepper motor drivers. The minimum angle of rotation achieved in this system was 0.05 degrees. An additional encoder system was used to monitor the rotation ensuring the high accuracy. The software program embedded with the tracking system was written using the programming language Borland Delphi 7. To point the system automatically towards a satellite, the software requires two types of data sets: the position of the satellite and the position of the earth station or the antenna. The programme then calculates the magnitude of angles that controller should rotate. Then it sends appropriate pulse signals to motor driver circuits through the parallel port of the computer. The system can be powered either by 230 V ac mains or a 12 V car battery. This system was successfully used to track the INTELSAT 904 telecommunication satellite. To verify that the satellite is always remaining in line of site with antenna, a telescope with cross-wires at the eyepiece fitted to the tracking system was used to observe the satellite (optical tracking) and the image of the satellite was visible inside the telescope. In this manner the system can also be used as a pilot device when directing a large dish antenna or a telescope to a space object. The weight of the tracking system is 4.5 kg excluding the tripod and the cost involved in construction was about Rs. 15000.00.