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Author: Dr. Fabrizio Piergentili
University of Rome "La Sapienza", Italy

Prof. Fabio Santoni
University of Rome "La Sapienza", Italy

A TELESCOPE MOUNT SUITABLE FOR SPACE SURVEILLANCE

Abstract

The Space Surveillance of high Earth orbital regimes has been accomplished using optical instruments. The slow angular motion of objects orbiting in these regions permits to achieve high sensitivity, measuring objects with sizes down to ten centimetres in Geosynchronous region.

The recent developments in telescope and CCD technologies make them suitable also to detect and measure fast moving low Earth or even re-entering space objects. In particular, recently developed systems allow to obtain at the same time large field of views and high sensitivity.

Optical systems are characterized by their high accuracy in angular measurements, whereas radar by range and range rate. Combining these information a very accurate orbit determination is possible. The knowledge of orbital parameters is of great importance in the assessment of collision risk between orbiting objects as well as in the identification of the impact region on the Earth for re-entering massive objects. Therefore, it is highly desirable for a space surveillance system to deploy optical instrument capable to observe fast moving space objects. These kinds of systems require a robust and precise high-speed tracking mount. In particular the combination of high pointing accuracy and fast angular movement requires a high level of automation and synchronization levels of the mount rotation axes.

In this paper the design of a one meter class telescope mount, suitable for LEO and re-entering object tracking is presented.

The telescope mount design has been completed and a first prototype is at the moment under manufacturing thanks to the collaboration between the Systems Laboratory of University of Rome "La Sapienza" with the company Roboptics, in the framework of a program funded by the Lazio Region.

The requirements of the core parts of the mount, including bearings, encoders and driving motors are analysed and identified solutions discussed with particular reference to mount pointing and tracking accuracy.

Finite element models have been used for the static and dynamical analysis of the fork structure leading to an optimized structure based on a trade off between mount weight and stiffness in terms of deflections and vibration frequencies.

The mount tracking system design has been validated through numerical simulation, to test the control laws and the effectiveness of the actuators and sensors chosen. To this purpose a number of trajectories of different orbiting objects have been simulated in order to evaluate the mount tracking error both in terms of position and velocity.