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AN AUTOMATIC TARGET ACQUISITION METHOD BASED ON QUASI-CROSS SEARCH PATTERN FOR LEO SATELLITES

Abstract

A majority of artificial satellites are placed in LEO, making one complete revolution around the Earth in about 90 minutes, and with high speed relative to the ground station. LEO satellites encounter atmospheric drag in the form of gases in the thermosphere or exosphere, which causes orbital decay and altitude loss, meanwhile atmospheric and ionospheric refraction also lead to deviation between target location and forecast track. Grand stations often use larger diameter antenna which has narrower beam width for a more precise orbit measurement, but it's very difficult to acquire target automatically when the satellite signal is outside the main lobe but in the scope of side lobes of receiving antennas.

This paper presents an automatic target acquisition method based on quasi-cross search pattern for LEO satellites. We identify target location through voltage curves of sum-signal and difference-signal which are formed by relative motion between satellite and grand station, and use quasi-cross search pattern to locate it. The method separates the procedure of acquisition into offline and online phases. In the off-line phase, we establish 3D model database consist of radiation pattern, which contains both sum channel and difference channel of receiving antennas. In the on-line phase, when satellite signal is in side lobes, first we have the antenna ceasing, then collect voltage curves of sum-signal and difference-signal cause by the moving target for a certain time. Second we seek feature points of the curves, such as "nulls", angles at which the radiation falls to zero, in the model database by quasi-cross search pattern. Finally we determine the relative position of the target, calculate azimuth and elevation correction angles, then operate the antenna tracking it.

This paper provides a detailed description of the design and the implementation of the automatic target acquisition method for LEO satellites. The method is implemented in software, in that way it can be easily adapted to the antennas in other grand stations. The method is proved to be reliable and is able to reduce target searching time and enhance the success rate of task.