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LEO EARTH OBSERVATION SMALL SATELLITES CONSTELLATION BASED ON REVISIT OPTIMIZATION

Abstract

Climate issues have always been an international topic of concern. There are many constellation projects that have been built for meteorological observation in the world. The minisat constellation has low cost and low risk, and is a research hotspot in the aerospace field. It is of great significance and practical value to study and design small satellite constellations operating in low orbits to enrich and compensate for expensive large geostationary orbit satellites, and to form meteorological and earth observation constellations with global/regional coverage capabilities.

This paper first introduces two typical low earth orbits ,Sun-synchronous orbit and recursive orbit.On the basis of above , a improved recursive orbit based on re-visit cycle is analyzed.Secondly , in order to evaluate the performance of the minisat constellation , an approach of grid point simulation model is adopted and then a simulation software is developed. Then , the improved cursive orbit is used , with six mini satellites distributed on one orbit plane or three orbit planes. Both constellation designs satisfy the requirement of re-visit cycle no more than one day, and then other performances are also compared and analyzed.

Having evaluated the performance of the two mentioned constellations , the constellation model optimization problem is proposed on the basis of the analysis above.A simplified type of Genetic algorithm,which can shorten the computing timing, is adopted to solve the optimization problem.The number of satellites in the constellation is determined to be 24 or more, and the main configuration is the Walker configuration. The number of orbit planes of the constellation and the orbit elements of satellites are used as variables and calculation parameters.Taking the coverage performance parameters of the first-generation constellation as boundary conditions, and shortening the revisit cycle as the optimization goal.Then the constellation models with the best comprehensive coverage performance are selected from the samples with the shortest re-visit cycle, through the previously established coverage performance calculation model.

Key words: Meteorological Observation Constellation ; Re-visit Cycle ; Constellation Optimization ; Genetic Algorithm