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Author: Dr. Hae-Dong Kim
Korea Aerospace Research Institute (KARI), Korea, Republic of

Prof. Hyochoong Bang
Korea Advanced Institute of Science and Technology (KAIST), Korea, Republic of

OPTIMAL DESIGN OF A REPEAT GROUND TRACK ORBIT WITH MULTI-OBJECTIVES FOR A LOCAL AREA TARGET

Abstract

Introduction: In Korea, the KOMPSAT-5 (KOrea Multi-Purpose SATellite-5) is scheduled to be launched until the end of this year. The main purpose of KOMPSAT-5 is to observe the local target area (i.e., Korean Peninsula) using a SAR (Synthetic Aperture Radar) system. However, 1 day RGT orbit is not satisfied to observe over the target area within 24 hours due to the incidence angle of SAR system. Thus, to find the mission orbit to satisfy the described mission requirements based on the traditional approach, enumerated methods which search the whole domain by evaluating the mean of the ART (Average Revisit Time) in according with semi-major axis and inclination should be adopted. And the region of interest is a local area with a complex geometry. Thus, a quality coverage analysis software package should be used. Indeed, it might be impossible to find the solution in case that the multi-objectives such as resolution vs. ART or field of view vs. ART are given as mission requirements.

Methodology: In this study, a genetic algorithm is modified to deal with the multi-objectives in this problem. The mean of average revisit time is the average value of the sum of ART over whole grid in Korean peninsula. For this, the grid of 5 km x 5 km is generated. The multi-purpose of mission design goal in this study is to maximize a resolution of SAR system and minimize a mean of ARTs over the local area target. A penalty strategy using a weighting factor is used to tune the multi-objectives. A COTS software such as STK/COV is applied to evaluate the fitness function.

Discussion: The performance of a genetic algorithm depends on the combination of methods and parameters of a genetic algorithm. Thus, a preliminary effort to tune GA parameters is presented and discussed through a simulation study. To deal with multi-objectives, a penalty strategy using weighting factors is used. Case study is performed and investigated in order to evaluate the effect of the penalty strategy.

Results: This paper describes a new approach to design a repeat ground track orbit for a local area target to meet the multiple mission requirements. The performance of a genetic algorithm according to the GA parameters and methods is investigated and presented. Through a simulation study, a proposed approach is successfully demonstrated and a possibility of applying to the complex mission design process has been shown.