Using Tabu Search Heuristic In Satellite Resources Scheduling Problem

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Abstract – **Resource Scheduling is a important technology to realize an automated control for operations in earth observing satellites with limited resources. This is a difficult constraint optimization problem. Satellite specific constraints, priorities of certain payload and special operations, as well as visibility conflicts are taken into consideration while generating the operations schedules in an optimum way.**
This paper proposes a tabu search heuristic for earth observation satellite resource scheduling problem, where as earth observing operations have to be scheduled on several resources while respecting time constraint and taking the priorities of the operations into account with the objective of scheduling as many operations as possible within their time windows. The computational results indicate that this approach is typically effective to generate a near optimal and feasible schedule for operations of the satellite. In addition, compared with genetic algorithm has better computation time.

Keywords – Tabu Search, Heuristic, Satellite Resources Scheduling Problem, Move Operation, Graph Coloring

I. INTRODUCTION

The mission of an earth observation satellite is taking photographs of specific areas to perform the user's requests. Currently, science activities on different satellites or even different instruments on the same satellite are scheduled independently of one another. As a given request can sometimes be satisfied by several satellites, the problem is not separable by satellites. Instead, planning must be performed simultaneously by all satellites, to help to improve the utility of the expensive resources, such as satellites. This problem consists of selecting and scheduling as many requests as possible to satisfy the maximal sum of priority subject to temporal constraints and resource constraints.

There has been plenty of research devoted to planning and scheduling a satellite by a variety of optimization techniques. Globus et.al. present initial results of a comparison of several evolutionary and other optimization techniques such as simulated annealing, genetic algorithm and so on. They found that simulated annealing is the best search technique [1]. Frank et.al. present a constraint-based approach to solve the earth observing satellite and proposes a stochastic heuristic search method for solving it [2]. Wolfe and Sorensen indicate the genetic algorithm is a lot slower but appears to create near-optimal schedules [3]. Agness et.al. show that this is a large and difficult combinational optimization problem which could be viewed as an instance of the valued constraint satisfaction problem framework [4]. Barbulescu et.al. in [5] compare local search methods against a genetic algorithm using data from the U.S Air Force Satellite Control Network, and show the genetic algorithm yields the best overall performance on larger , more difficult problems. Lin et.al. in [6] formulate the scheduling problem as an integer-programming problem and indicate that the approach is very effective to generate a near-optimal , feasible schedule for the imaging operations of the satellite. Wang group propose a hybrid ant colony optimization algorithm [7]. Zhang et.al present an ant colony optimization approach for the satellite control resource scheduling problem and indicate that their approach possesses strong competitive advantages in exploring the best global solution [8].

This paper considers the problem of scheduling resources of earth observation satellites as a graph coloring problem which could be solved by a new heuristic tabu search approach.

II. PROBLEM DEFINITION

Consider a set of satellites and a collection of jobs which should be done by the satellites with a predefined duration in a period of time in a day. The main purpose of the jobs in the observation satellites is taking images form specific areas. We define a task to be a basic operation of image acquisition over an area of the earth and each job contains only the basic task of imaging.

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