Interactive, Repair-Based Planning and Scheduling for Shuttle Payload Operations

G. Rabideau, S. Chien,
T. Mann, C. Eggemeyer
Jet Propulsion Laboratory
4800 Oak Grove Drive
Pasadena, CA 91109-8099
{gregg.rabideau, steve.chien,
tobias.mann, curt.eggemeyer}
@jpl.nasa.gov

J. Willis, S. Siewert
University of Colorado
Colorado Space Grant College
Campus Box 520
Boulder, CO 80309
{jwillis, siewerts}
@rodin.colorado.edu

P. Stone
Carnegie Mellon University
Computer Science Department
Pittsburgh, PA 15213-3891
pstone@cs.cmu.edu

Abstract—This paper describes the DATA-CHASER Automated Planner/Scheduler (DCAPS) system for automatically generating low-level command sequences from high-level user goals. DCAPS uses Artificial Intelligence (AI)-based search techniques and an iterative repair framework in which the system selectively resolves conflicts with the resource and temporal constraints of the DATA-CHASER shuttle payload activities.

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1. INTRODUCTION

Command sequence generation for spacecraft operations can be a laborious process requiring a great deal of specialized knowledge. Command sets can be large, with each command performing a low-level task. There may be many interactions between the commands due to the use of resources. In addition, due to power and weight limitations, the resources available on-board spacecraft tend to be scarce. Because of this complexity, tools to assist in planning and scheduling spacecraft activities are critical to reducing the cost and effort of mission operations.

This paper describes a general system that uses Artificial Intelligence Planning and Scheduling technology to automatically generate command sequences for the DATA-CHASER shuttle payload operations. The DATA-CHASER Automated Planner/Scheduler (DCAPS) architecture presented supports direct, interactive commanding, rescheduling and repair, resource allocation, and constraint maintenance.

The DCAPS search algorithm was developed based on the "iterative repair" technique used in [1]. Basically, this technique iteratively selects a schedule conflict and performs some action in an attempt to resolve the conflict. Using a repair algorithm, DCAPS is naturally well-adapted for human interaction. Therefore, the scheduler can be used as a tool to assist payload command sequencing. With the use of this tool, sequencing becomes simple enough to be accomplished by nonspacecraft and sequencing experts, such as the mission scientists. This allows the scientist to become directly involved in the command sequencing process. Following any changes in spacecraft state or user-defined goals, the repair algorithm allows simple rescheduling that avoids disrupting the original schedule as much as possible. Finally, the highly restrictive payload resources and constraints are consistently monitored and conflicts avoided automatically.

The DCAPS system is being developed for operation of the DATA-CHASER shuttle payload, which is being managed by students and faculty of the University of Colorado at