

program uses standard Unisys library routines for reading files that have standard structures and for editing and printing output. The program can run in a batch or an interactive mode.

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### Parachute Drag Model

DTV-SIM is a computer program that implements a mathematical model of the flight dynamics of a missile-shaped drop test vehicle (DTV) equipped with a multistage parachute system that includes two simultaneously deployed drogue parachutes and three main parachutes deployed subsequently and simultaneously by use of pilot parachutes. DTV-SIM was written to support air-drop tests of the DTV/parachute system, which serves a simplified prototype of a proposed crew capsule/parachute landing system.

The DTV-SIM model is of a point-mass trajectory-integrator type and includes detailed submodels of the staged deployment of, inflation of, and aerodynamic drag on, the parachutes. The model simulates (1) the forces on the parachutes and

the DTV and (2) the motion of the DTV/parachute system from release until landing. Before a planned test, DTV-SIM is used to predict the flight of the DTV/parachute system in order to develop a flight envelope for the test. After the test, DTV-SIM is used to reconstruct the flight on the basis of data acquired during the test and, while so doing, to optimize parameters in the parachute-inflation simulation submodels.

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### Evolutionary Scheduler for the Deep Space Network

A computer program assists human schedulers in satisfying, to the maximum extent possible, competing demands from multiple spacecraft missions for utilization of the transmitting/receiving Earth stations of NASA's Deep Space Network. The program embodies a concept of optimal scheduling to attain multiple objectives in the presence of multiple constraints. Optimization of schedules is performed through a selection-and-reproduction process inspired by a biological evolution process. A

genome (a representation of design parameters in a genetic algorithm) is encoded such that a subset of the scheduling constraints (e.g., the times when a given spacecraft lies within the field of view of a given antenna) are automatically satisfied. Several fitness functions are formulated to emphasize different aspects of the scheduling problem, and multi-fitness functions are optimized simultaneously by use of multi-objective optimization algorithms.

The output of the program consists of a population of Pareto-optimal schedules that demonstrate the compromises made in solving the scheduling problem and provide insight into a conflict resolution process. These schedules are used by human schedulers to choose the simplest paths to resolution of conflicts as items on schedules are changed and as new items are added to schedules.

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*This software is available for commercial licensing. Please contact Daniel Broderick of the California Institute of Technology at danielb@caltech.edu. Refer to NPO-44821.*