The SCRAM Lite run time is of the order of one minute per day of mission time. The overall objective of the SCRAM Lite simulation is to process input profiles of equipment-rack, crew-metabolic, and other heat loads to determine flow rates, coolant supply temperatures, and available radiator heat-rejection capabilities. Analyses are performed for timelines of activities, orbital parameters, and attitudes for mission times ranging from a few hours to several months.

Optimization of Angular-Momentum Biases of Reaction Wheels

NASA's Jet Propulsion Laboratory, Pasadena, California

RBOT [RWA Bias Optimization Tool (wherein "RWA" signifies "Reaction Wheel Assembly")] is a computer program designed for computing angular-momentum biases for reaction wheels used for providing spacecraft pointing in various directions as required for scientific observations. RBOT is currently deployed to support the Cassini mission to prevent operation of reaction wheels at unsafely high speeds while minimizing time in undesirable low-speed range, where elasto-hydrodynamic lubrication films in bearings become ineffective, lead-ing to premature bearing failure. The problem is formulated as a constrained optimization problem in which maximum wheel speed limit is a hard constraint and a cost functional that increases as speed decreases below a low-speed threshold.

The optimization problem is solved using a parametric search routine known as the Nelder-Mead simplex algorithm. To increase computational efficiency for extended operation involving large quantity of data, the algorithm is designed to (1) use large time increments during intervals when spacecraft attitudes or rates of rotation are nearly stationary, (2) use sinusoidal-approximation sampling to model repeated long periods of Earth-point rolling maneuvers to reduce computational loads, and (3) utilize an efficient equation to obtain wheel-rate profiles as functions of initial wheel biases based on conservation of angular momentum (in an inertial frame) using pre-computed terms.

Short- and Long-Term Propagation of Spacecraft Orbits

NASA's Jet Propulsion Laboratory, Pasadena, California

The Planetary Observer Planning Software (POPS) comprises four computer programs for use in designing orbits of spacecraft about planets. These programs are the Planetary Observer High Precision Orbit Propagator (POHOP), the Planetary Observer Long-Term Orbit Predictor (POLOP), the Planetary Observer Post Processor (POPP), and the Planetary Observer Plotting (POPLOT) program.

POHOP and POLOP integrate the equations of motion to propagate an initial set of classical orbit elements to a future epoch. POHOP models short-term (one revolution) orbital motion; POLOP averages out the short-term behavior but requires far less processing time than do older programs that perform long-term orbit propagations.

POPP postprocesses the spacecraft ephemeris created by POHOP or POLOP (or optionally can use a less-accurate internal ephemeris) to search for trajectory-related geometric events including, for example, rising or setting of a spacecraft as observed from a ground site. For each such event, POPP puts out such user-specified data as the time, elevation, and azimuth.

POPLOT is a graphics program that plots data generated by POPP. POPLOT can plot orbit ground tracks on a world map and can produce a variety of summaries and generic ordinate-vs.-abscissa plots of any POPP data.

Monte Carlo Simulation To Estimate Likelihood of Direct Lightning Strikes

John F. Kennedy Space Center, Florida

A software tool has been designed to quantify the lightning exposure at launch sites of the stack at the pads under different configurations. In order to predict lightning strikes to generic structures, this model uses leaders whose origins (in the x–y plane) are obtained from a 2D random, normal distribution. The striking distance is a function of the stroke peak current, which is obtained from a random state machine that extracts the stroke peak current from a log-normal distribution. The height in which the leaders are originated is fixed and chosen to be several "strike dis-