

and pressure units. The control function algorithms use the monitor data to control the cooler power, vacuum solenoid, vacuum pump, and electrical warm-up heaters. The control algorithms are based on a rule-based system that activates the required device based on the

operating mode. The external interface is Web-based. It acts as a Web server, providing pages for monitor, control, and configuration. No client software from the external user is required.

*This work was done by Michael J. Britcliffe, Bruce L. Conroy, Paul E. Anderson, and*

*Ahmad Wilson of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).*

*This software is available for commercial licensing. Please contact Daniel Broderick of the California Institute of Technology at danielb@caltech.edu. Refer to NPO-47247.*

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## Common Bolted Joint Analysis Tool

*Lyndon B. Johnson Space Center, Houston, Texas*

Common Bolted Joint Analysis Tool (comBAT) is an Excel/VB-based bolted joint analysis/optimization program that lays out a systematic foundation for an inexperienced or seasoned analyst to determine fastener size, material, and assembly torque for a given design. Analysts are able to perform numerous "what-if" scenarios within minutes to arrive at an optimal solution. The program evaluates input design parameters, performs joint assembly checks, and steps through numerous calculations to arrive at several key margins of safety for each member in a joint. It also checks for joint gapping,

provides fatigue calculations, and generates joint diagrams for a visual reference. Optimum fastener size and material, as well as correct torque, can then be provided.

Analysis methodology, equations, and guidelines are provided throughout the solution sequence so that this program does not become a "black box" for the analyst. There are built-in databases that reduce the legwork required by the analyst. Each step is clearly identified and results are provided in number format, as well as color-coded spelled-out words to draw user attention.

The three key features of the software are robust technical content, innovative and user friendly I/O, and a large database. The program addresses every aspect of bolted joint analysis and proves to be an instructional tool at the same time. It saves analysis time, has intelligent messaging features, and catches operator errors in real time.

*This work was done by Kauser Imtiaz of The Boeing Co. for Johnson Space Center. For further information, contact the JSC Innovative Partnerships Office at (281) 483-3809. MSC-24836-1*

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## Draper Station Analysis Tool

*Lyndon B. Johnson Space Center, Houston, Texas*

Draper Station Analysis Tool (DSAT) is a computer program, built on commercially available software, for simulating and analyzing complex dynamic systems. Heretofore used in designing and verifying guidance, navigation, and control systems of the International Space Station, DSAT has a modular architecture that lends itself to modification for application to spacecraft or terrestrial systems. DSAT consists of user-interface, data-structures, simulation-generation, analysis, plotting, documentation, and help components. DSAT automates the construction of sim-

ulations and the process of analysis. DSAT provides a graphical user interface (GUI), plus a Web-enabled interface, similar to the GUI, that enables a remotely located user to gain access to the full capabilities of DSAT via the Internet and Web-browser software. Data structures are used to define the GUI, the Web-enabled interface, simulations, and analyses. Three data structures define the type of analysis to be performed: closed-loop simulation, frequency response, and/or stability margins. DSAT can be executed on almost any workstation, desktop, or laptop com-

puter. DSAT provides better than an order of magnitude improvement in cost, schedule, and risk assessment for simulation based design and verification of complex dynamic systems.

*This program was written by Nazareth Bedrossian, Jiann-Woei Jang, Edward McCants, Zachary Omohundro, Tom Ring, Jeremy Templeton, Jeremy Zoss, Jonathan Wallace, and Philip Ziegler of Charles Stark Draper Laboratory, Inc., for Johnson Space Center. For further information, contact the Johnson Commercial Technology Office at (281) 483-3809. MSC-23607-1*

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## Commercial Modular Aero-Propulsion System Simulation 40k

*John H. Glenn Research Center, Cleveland, Ohio*

The Commercial Modular Aero-Propulsion System Simulation 40k (C-MAPSS40k) software package is a non-linear dynamic simulation of a 40,000-pound ( $\approx 178$ -kN) thrust class commercial turbofan engine, written in the MATLAB/Simulink environment.

The model has been tuned to capture the behavior of flight test data, and is capable of running at any point in the flight envelope [up to 40,000 ft ( $\approx 12,200$  m) and Mach 0.8]. In addition to the open-loop engine, the simulation includes a controller whose ar-

chitecture is representative of that found in industry.

The simulation environment gives the user easy access to health, control, and engine parameters. C-MAPSS40k has a graphical user interface (GUI) to allow users to easily specify an arbitrarily com-