

Tools for Designing and Analyzing Structures

Structural Design and Analysis Toolset is a collection of approximately 26 Microsoft Excel spreadsheet programs, each of which performs calculations within a different subdiscipline of structural design and analysis. These programs present input and output data in user-friendly, menu-driven formats. Although these programs cannot solve complex cases like those treated by larger finite element codes, these programs do yield quick solutions to numerous common problems more rapidly than the finite element codes, thereby making it possible to quickly perform multiple preliminary analyses — e.g., to establish approximate limits prior to detailed analyses by the larger finite element codes. These programs perform different types of calculations, as follows:

1. determination of geometric properties for a variety of standard structural components;
2. analysis of static, vibrational, and thermal-gradient loads and deflections in certain structures (mostly beams and, in the case of thermal-gradients, mirrors);
3. kinetic energies of fans;
4. detailed analysis of stress and buckling in beams, plates, columns, and a variety of shell structures; and
5. temperature dependent properties of materials, including figures of merit that characterize strength, stiffness, and deformation response to thermal gradients.

This program was written by Paul L. Luz of Marshall Space Flight Center. For further information, contact Sammy Nabors, MSFC Commercialization Assistance Lead, at sammy.a.nabors@nasa.gov. Refer to MFS-31797.

Interactive Display of Scenes With Annotations

ThreeDView is a computer program that enables high-performance interactive display of real-world scenes with annotations. ThreeDView was developed primarily as a component of the Science Activity Planner (SAP) software, wherein it is to be used to display annotated images of terrain acquired by exploratory robots on Mars and possibly other remote

planets. The images can be generated from sets of multiple-texture image data in the Visible Scalable Terrain (ViSTa) format, which was described in “Format for Interchange and Display of 3D Terrain Data” (NPO-30600) *NASA Tech Briefs*, Vol. 28, No. 12 (December 2004), page 25. In ThreeDView, terrain data can be loaded rapidly, the geometric level of detail and texture resolution can be selected, false colors can be used to represent scientific data mapped onto terrain, and the user can select among navigation modes. ThreeDView consists largely of modular Java software components that can easily be reused and extended to produce new high-performance, application-specific software systems for displaying images of three-dimensional real-world scenes.

This program was written by Marsette Vona, Mark Powell, Paul Backes, Jeffrey Norris, and Robert Steinke 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 Don Hart of the California Institute of Technology at (818) 393-3425. Refer to NPO-30675.

Solving Common Mathematical Problems

Mathematical Solutions Toolset is a collection of five software programs that rapidly solve some common mathematical problems. The programs consist of a set of Microsoft Excel worksheets. The programs provide for entry of input data and display of output data in a user-friendly, menu-driven format, and for automatic execution once the input data has been entered. The programs perform the following calculations:

1. “Definite Integral Evaluator 1.0” calculates the definite integral of a user-specified function $y = f(x)$ between user-specified limits for the lower and upper bands. The program will also plot the function.
2. Solve for X in the matrix equation $AX = B$, where A is a 2×2 , 3×3 , or 6×6 matrix of constant coefficients, X is the matrix of unknown independent values, and B is the matrix of dependant values.
3. “Cubic Equation Solver” calculates the real and imaginary roots, x , of the cubic equation $x^3 + ax^2 + bx + c = 0$.

4. Given a pair of vectors specified in terms of their Cartesian components, the Vector Calculator program calculates their scalar product, their vector product, the unit vectors, and the angle between the vectors.
5. “Unit Conversions” will convert between the English and metric values of the most commonly used units for length, volume, velocity, mass, density, force, pressure, energy, power, temperature, and thermal energy.

This program was written by Paul L. Luz of Marshall Space Flight Center. For further information, contact Sammy Nabors, MSFC Commercialization Assistance Lead, at sammy.a.nabors@nasa.gov. Refer to MFS-31794.

Tools for Basic Statistical Analysis

Statistical Analysis Toolset is a collection of eight Microsoft Excel spreadsheet programs, each of which performs calculations pertaining to an aspect of statistical analysis. These programs present input and output data in user-friendly, menu-driven formats, with automatic execution. The following types of calculations are performed:

- Descriptive statistics are computed for a set of data $x(i)$ ($i = 1, 2, 3 \dots$) entered by the user.
- “Normal Distribution Estimates” will calculate the statistical value that corresponds to cumulative probability values, given a sample mean and standard deviation of the normal distribution.
- “Normal Distribution from two Data Points” will extend and generate a cumulative normal distribution for the user, given two data points and their associated probability values.
- Two programs perform two-way analysis of variance (ANOVA) with no replication or generalized ANOVA for two factors with four levels and three repetitions.
- “Linear Regression-ANOVA” will curve-fit data to the linear equation $y=f(x)$ and will do an ANOVA to check its significance.
- Two multiple regression programs will do statistical analysis on test data that includes more than one predictor and will perform curve-fitting of the data to either the equation $y = f(x_1, x_2)$ or $y = f(x_1, x_2, x_3, x_4)$.