Software

Dynamically Alterable Arrays of Polymorphic Data Types

An application library package was developed that represents data packets for Deep Space Network (DSN) message packets as dynamically alterable arrays composed of arbitrary polymorphic data types. The software was to address a limitation of the present state of the practice for having an array directly composed of a single monomorphic data type. This is a severe limitation when one is dealing with science data in that the types of objects one is dealing with are typically not known in advance and, therefore, are dynamic in nature. The unique feature of this approach is that it enables one to define at run-time the dynamic shape of the matrix with the ability to store polymorphic data types in each of its indices. Existing languages such as C and C++ have the restriction that the shape of the array must be known in advance and each of its elements be a monomorphic data type that is strictly defined at compile-time. This program can be executed on a variety of platforms. It can be distributed in either source code or binary code form. It must be run in conjunction with any one of a number of Lisp compilers that are available commercially or as shareware.

This program was written by Mark James of Caltech for **NASA's Jet Propulsion Laboratory**. *FFurther information is contained in a TSP (see page 1).*

This software is available for commercial licensing. Please contact Karina Edmonds of the California Institute of Technology at (626) 395-2322. Refer to NPO-42071.

Identifying Trends in Deep Space Network Monitor Data

A computer program has been developed that analyzes Deep Space Network monitor data, looking for changes of trends in critical parameters. This program represents a significant improvement over the previous practice of manually plotting data and visually inspecting the resulting graphs to identify trends. This program uses proven numerical techniques to identify trends. When a statistically significant trend is detected, then it is characterized by means of a symbol that can be used by pre-existing model-based reasoning software. The program can perform any of the following functions:

- Given an expectation that data in a given list should exhibit an upward, downward, constant, or unknown trend, it can determine whether the data do or do not follow such a trend.
- Given a list of data, it can identify which of the aforementioned trends the data follow.
- Given two lists of data, it can determine whether or not both follow the same trend.

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Predicting Lifetime of a Thermomechanically Loaded Component

NASALIFE is a computer program for predicting the lifetime, as affected by low cycle fatigue (LCF) and creep rupture, of a structural component subject to temporally varying, multiaxial thermomechanical loads. The component could be, for example, part of an aircraft turbine engine. Empirical data from LCF tests, creep rupture tests, and static tensile tests are used as references for predicting the number of missions the component can withstand under a given thermomechanical loading condition.

The user prepares an input file containing the creep-rupture and cyclic-fatigue information, temperature-dependent material properties, and mission loading and control flags. The creep rupture information can be entered in tabular form as stress versus life or by means of parameters of the Larson-Miller equation. The program uses the Walker mean-stress model to adjust predicted life for ranges of the ratio between the maximum and minimum stresses. Data representing complex load cycles are reduced by the rainflow counting method. Miner's rule is utilized to combine the damage at different load levels. Finally, the program determines the total damage due to creep and combines it with the fatigue damage due to the cyclic loading and predicts the approximate number of missions a component can endure before failing.

This work was done by Pappu L. N. Murthy of **Glenn Research Center**, *John Z. Gyekenyesi of N&R Engineering and Management Services Corp., Subodh Mital of the University of Toledo, and David N. Brewer of the U. S. Army Aviation Systems Command. Further information is contained in a TSP (see page 1).*

Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Glenn Research Center, Innovative Partnerships Office, Attn: Steve Fedor, Mail Stop 4–8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-18081.

Partial Automation of Requirements Tracing

Requirements Tracing on Target (RETRO) is software for after-the-fact tracing of textual requirements to support independent verification and validation of software. RETRO applies one of three user-selectable information-retrieval techniques: (1) term frequency/inverse document frequency (TF/IDF) vector retrieval, (2) TF/IDF vector retrieval with simple thesaurus, or (3) keyword extraction. One component of RETRO is the graphical user interface (GUI) for use in initiating a requirements-tracing project (a pair of artifacts to be traced to each other, such as a requirements spec and a design spec). Once the artifacts have been specified and the IR technique chosen, another component constructs a representation of the artifact elements and stores it on disk.

Next, the IR technique is used to produce a first list of candidate links (potential matches between the two artifact levels). This list, encoded in Extensible Markup Language (XML), is optionally processed by a "filtering" component designed to make the list somewhat smaller without sacrificing accuracy. Through the