



CFD Extraction Tool for TecPlot From DPLR Solutions

This invention is a TecPlot macro of a computer program in the TecPlot programming language that processes data from DPLR solutions in TecPlot format. DPLR (Data-Parallel Line Relaxation) is a NASA computational fluid dynamics (CFD) code, and TecPlot is a commercial CFD post-processing tool. The TecPlot data is in SI units (same as DPLR output). The invention converts the SI units into British units. The macro modifies the TecPlot data with unit conversions, and adds some extra calculations. After unit conversions, the macro cuts a slice, and adds vectors on the current plot for output format. The macro can also process surface solutions.

Existing solutions use manual conversion and superposition. The conversion is complicated because it must be applied to a range of inter-related scalars and vectors to describe a 2D or 3D flow field. It processes the CFD solution to create superposition/comparison of scalars and vectors.

The existing manual solution is cumbersome, open to errors, slow, and cannot be inserted into an automated process. This invention is quick and easy to use, and can be inserted into an automated data-processing algorithm.

This work was done by David Norman, Jr. of The Boeing Company for Johnson Space Center. For further information, contact the JSC Innovation Partnerships Office at (281) 483-3809. MSC-24982-1

RECOVIR Software for Identifying Viruses

Most single-stranded RNA (ssRNA) viruses mutate rapidly to generate a large number of strains with highly divergent capsid sequences. Determining the capsid residues or nucleotides that uniquely characterize these strains is critical in understanding the strain diversity of these viruses. RECOVIR (an acronym for “recognize viruses”) software predicts the strains of some ssRNA viruses from their limited sequence data. Novel phylogenetic-tree-based databases of protein or nucleic acid residues that uniquely characterize these virus strains are created. Strains of input virus sequences (partial or

complete) are predicted through residue-wise comparisons with the databases.

RECOVIR uses unique characterizing residues to identify automatically strains of partial or complete capsid sequences of picorna and caliciviruses, two of the most highly diverse ssRNA virus families. Partition-wise comparisons of the database residues with the corresponding residues of more than 300 complete and partial sequences of these viruses resulted in correct strain identification for all of these sequences.

This study shows the feasibility of creating databases of hitherto unknown residues uniquely characterizing the capsid sequences of two of the most highly divergent ssRNA virus families. These databases enable automated strain identification from partial or complete capsid sequences of these human and animal pathogens.

This work was done by Sugoto Chakravarty, George E. Fox, and Dianhui Zhu of the University of Houston for Johnson Space Center. For further information, contact the JSC Innovation Partnerships Office at (281) 483-3809. MSC-24358-1

Enhanced Contact Graph Routing (ECGR) MACHETE Simulation Model

Contact Graph Routing (CGR) for Delay/Disruption Tolerant Networking (DTN) space-based networks makes use of the predictable nature of node contacts to make real-time routing decisions given unpredictable traffic patterns. The contact graph will have been disseminated to all nodes before the start of route computation. CGR was designed for space-based networking environments where future contact plans are known or are independently computable (e.g., using known orbital dynamics). For each data item (known as a bundle in DTN), a node independently performs route selection by examining possible paths to the destination. Route computation could conceivably run thousands of times a second, so computational load is important.

This work refers to the simulation software model of Enhanced Contact Graph Routing (ECGR) for DTN Bundle Protocol in JPL’s MACHETE simulation tool. The simulation model was used for per-

formance analysis of CGR and led to several performance enhancements. The simulation model was used to demonstrate the improvements of ECGR over CGR as well as other routing methods in space network scenarios. ECGR moved to using earliest arrival time because it is a global monotonically increasing metric that guarantees the safety properties needed for the solution’s correctness since route re-computation occurs at each node to accommodate unpredicted changes (e.g., traffic pattern, link quality). Furthermore, using earliest arrival time enabled the use of the standard Dijkstra algorithm for path selection. The Dijkstra algorithm for path selection has a well-known inexpensive computational cost. These enhancements have been integrated into the open source CGR implementation. The ECGR model is also useful for route metric experimentation and comparisons with other DTN routing protocols particularly when combined with MACHETE’s space networking models and Delay Tolerant Link State Routing (DTLSR) model.

This work was done by John S. Segui, Esther H. Jennings, and Loren P. Clare of Caltech for NASA’s Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).

The software used in this innovation is available for commercial licensing. Please contact Dan Broderick at Daniel.F.Broderick@jpl.nasa.gov. Refer to NPO-47650.

Orbital Debris Engineering Model (ORDEM) v.3

A model of the manmade orbital debris environment is required by spacecraft designers, mission planners, and others in order to understand and mitigate the effects of the environment on their spacecraft or systems. A manmade environment is dynamic, and can be altered significantly by intent (e.g., the Chinese anti-satellite weapon test of January 2007) or accident (e.g., the collision of Iridium 33 and Cosmos 2251 spacecraft in February 2009).

Engineering models are used to portray the manmade debris environment in Earth orbit. The availability of new sensor and in situ data, the re-analysis of older data, and the development of new analytical and statistical techniques has enabled the construction of this more

comprehensive and sophisticated model. The primary output of this model is the flux [#debris/area/time] as a function of debris size and year. ORDEM may be operated in spacecraft mode or telescope mode. In the former case, an analyst defines an orbit for a spacecraft and “flies” the spacecraft through the orbital debris environment. In the latter case, an analyst defines a ground-based sensor (telescope or radar) in terms of latitude, azimuth, and elevation, and the model provides the number of orbital debris traversing the sensor’s field of view.

An upgraded graphical user interface (GUI) is integrated with the software. This upgraded GUI uses project-oriented organization and provides the user with graphical representations of numerous output data products. These range from the conventional flux as a function of debris size for chosen analysis orbits (or views), for example, to the more complex color-contoured two-dimensional (2D) directional flux diagrams in local spacecraft elevation and azimuth.

This work was done by Mark Matney of Johnson Space Center; Paula Krisko and Yu-

Lin Xu of Jacobs Technology; and Matthew Horstman of ERC. Further information is contained in a TSP (see page 1). MSC-25457-1

Scatter-Reducing Sounding Filtration Using a Genetic Algorithm and Mean Monthly Standard Deviation

Retrieval algorithms like that used by the Orbiting Carbon Observatory (OCO)-2 mission generate massive quantities of data of varying quality and reliability. A computationally efficient, simple method of labeling problematic datapoints or predicting soundings that will fail is required for basic operation, given that only 6% of the retrieved data may be operationally processed. This method automatically obtains a filter designed to reduce scatter based on a small number of input features.

Most machine-learning filter construction algorithms attempt to predict error in the CO₂ value. By using a surrogate goal of Mean Monthly STDEV, the goal is to reduce the retrieved CO₂ scatter rather than

solving the harder problem of reducing CO₂ error. This lends itself to improved interpretability and performance.

This software reduces the scatter of retrieved CO₂ values globally based on a minimum number of input features. It can be used as a prefilter to reduce the number of soundings requested, or as a post-filter to label data quality. The use of the MMS (Mean Monthly Standard deviation) provides a much cleaner, clearer filter than the standard ABS(CO₂-truth) metrics previously employed by competitor methods.

The software’s main strength lies in a clearer (i.e., fewer features required) filter that more efficiently reduces scatter in retrieved CO₂ rather than focusing on the more complex (and easily removed) bias issues.

This work was done by Lukas Mandrake 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 Dan Broderick at Daniel.F.Broderick@jpl.nasa.gov. Refer to NPO-48255.