



## Computer Program Recognizes Patterns in Time-Series Data

NASA's Jet Propulsion Laboratory, Pasadena, California

A computer program recognizes selected patterns in time-series data like digitized samples of seismic or electro-physiological signals. The program implements an artificial neural network (ANN) and a set of  $N$  clocks for the purpose of determining whether  $N$  or more instances of a certain waveform,  $W$ , occur within a given time interval,  $T$ . The ANN must be trained to recognize  $W$  in the incoming stream of data. The first time the ANN recognizes  $W$ , it sets clock 1 to count down from  $T$  to

zero; the second time it recognizes  $W$ , it sets clock 2 to count down from  $T$  to zero, and so forth through the  $N$ th instance. On the  $N + 1$ st instance, the cycle is repeated, starting with clock 1. If any clock has not reached zero when it is reset, then  $N$  instances of  $W$  have been detected within time  $T$ , and the program so indicates. The program can readily be encoded in a field-programmable gate array or an application-specific integrated circuit that could be used, for example, to detect

electroencephalographic or electrocardiographic waveforms indicative of epileptic seizures or heart attacks, respectively.

*This program was written by Charles Hand 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-30636.*

## Program for User-Friendly Management of Input and Output Data Sets

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A computer program manages large, hierarchical sets of input and output (I/O) parameters (typically, sequences of alphanumeric data) involved in computational simulations in a variety of technological disciplines. This program represents sets of parameters as structures coded in object-oriented but otherwise standard American National Standards Institute C language. Each structure contains a group of I/O parameters that "make sense" as a unit in the simulation program with which this program is used. The addition of options and/or elements to sets of parameters amounts to the addition of

new elements to data structures. By association of child data generated in response to a particular user input, a hierarchical ordering of input parameters can be achieved. Associated with child data structures are the creation and description mechanisms within the parent data structures. Child data structures can spawn further child data structures. In this program, the creation and representation of a sequence of data structures is effected by one line of code that looks for children of a sequence of structures until there are no more children to be found. A linked list of structures is created dy-

namically and is completely represented in the data structures themselves. Such hierarchical data presentation can guide users through otherwise complex setup procedures and it can be integrated within a variety of graphical representations.

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

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## Noncoherent Tracking of a Source of a Data-Modulated Signal

Properties of the modulation would be exploited to determine direction-dependent phase differences.

Lyndon B. Johnson Space Center, Houston, Texas

A proposed tracking receiver system containing three suitably positioned antenna elements and special signal-processing equipment would determine the direction of incidence of a microwave signal containing spread-spectrum digital data modulation. If the system were

to contain two sets of antenna elements separated by a known baseline, it could determine the location of the transmitter as the intersection of the lines of incidence on the two antennas. Such systems could be used for diverse purposes in outer space and on Earth, including

tracking astronauts and small robotic spacecraft working outside a spacecraft or space station, and locating cellular telephones from which distress calls have been made. The principle of operation does not require the transmission of a special identifying or distress signal