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## ➤ Real-Time Principal-Component Analysis

A recently written computer program implements dominant-element-based gradient descent and dynamic initial learning rate (DOGEDYN), which was described in “Method of Real-Time Principal-Component Analysis” (NPO-40034) *NASA Tech Briefs*, Vol. 29, No. 1 (January 2005), page 59. To recapitulate: DOGEDYN is a method of sequential principal-component analysis (PCA) suitable for such applications as data compression and extraction of features from sets of data. In DOGEDYN, input data are represented as a sequence of vectors acquired at sampling times. The learning algorithm in DOGEDYN involves sequential extraction of principal vectors by means of a gradient descent in which only the dominant element is used at each iteration. Each iteration includes updating of elements of a weight matrix by amounts proportional to a dynamic initial learning rate chosen to increase the rate of convergence by compensating for the energy lost through the previous extraction of principal components. In comparison with a prior method of gra-

dient-descent-based sequential PCA, DOGEDYN involves less computation and offers a greater rate of learning convergence. The sequential DOGEDYN computations require less memory than would parallel computations for the same purpose. The DOGEDYN software can be executed on a personal computer.

*This program was written by Vu Duong and Tuan Duong 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 Karina Edmonds of the California Institute of Technology at (818) 393-2827. Refer to NPO-40056.*

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## ➤ Fuzzy/Neural Software Estimates Costs of Rocket-Engine Tests

The Highly Accurate Cost Estimating Model (HACEM) is a software system for estimating the costs of testing rocket engines and components at Stennis Space Center. HACEM is built on a foundation of adaptive-network-based fuzzy inference systems (ANFIS) — a hybrid software concept that combines the adaptive

capabilities of neural networks with the ease of development and additional benefits of fuzzy-logic-based systems. In ANFIS, fuzzy inference systems are trained by use of neural networks. HACEM includes selectable subsystems that utilize various numbers and types of inputs, various numbers of fuzzy membership functions, and various input-preprocessing techniques. The inputs to HACEM are parameters of specific tests or series of tests. These parameters include test type (component or engine test), number and duration of tests, and thrust level(s) (in the case of engine tests). The ANFIS in HACEM are trained by use of sets of these parameters, along with costs of past tests. Thereafter, the user feeds HACEM a simple input text file that contains the parameters of a planned test or series of tests, the user selects the desired HACEM subsystem, and the subsystem processes the parameters into an estimate of cost(s).

*This program was written by Freddie Douglas of Stennis Space Center and Edit Kaminsky Bourgeois of the University of New Orleans.*

*Inquiries concerning rights for the commercial use of this invention should be addressed to the Intellectual Property Manager, Stennis Space Center, (228) 688-1929. Refer to SSC-00194.*