Books & Reports

Application of the Hilbert-Huang Transform to Financial Data

A paper discusses the application of the Hilbert-Huang transform (HHT) method to time-series financial-market data. The method was described, variously without and with the HHT name, in several prior *NASA Tech Briefs* articles and supporting documents. To recapitulate: The method is especially suitable for analyzing time-series data that represent nonstationary and nonlinear phenomena including physical phenomena and, in the present case, financial-market processes. The method involves the empirical mode decomposition (EMD), in which a complicated signal is decomposed into a finite number of functions, called "intrinsic mode functions" (IMFs), that admit well-behaved Hilbert transforms. The HHT consists of the combination of EMD and Hilbert spectral analysis. The local energies and the instantaneous frequencies derived from the IMFs through Hilbert transforms can be used to construct an energy-frequency-time distribution, denoted a Hilbert spectrum. The instant paper begins with a discussion of prior approaches to quantification of market volatility, summarizes the HHT method, then describes the application of the method in performing time-frequency analysis of mortgage-market data from the years 1972 through 2000. Filtering by use of the EMD is shown to be useful for quantifying market volatility.

This work was done by Norden Huang of **Goddard Space Flight Center**. *Further information is contained in a TSP (see page 1).*

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to the Patent Counsel, Goddard Space Flight Center, (301) 286-7351. Refer to GSC-14807-1.

Optimizing Parameters for Deep-Space Optical Communication

A paper discusses the optimization of the parameters of a high-rate, deep-space optical communication link that utilizes pulse-position modulation (PPM) and an error-correcting code (ECC). The parameters in question include the PPM order (number of pulse time slots in one symbol period), the ECC rate, and the uncoded symbol error rate. In simple terms, the optimization problem is to choose the combination of these parameters that maximizes the throughput data rate at a given bit-error-rate (BER), subject to several constraints, including limits on the average and peak power and possibly a limit on the uncoded symbol error rate. This is a complex, multidimensional optimization problem, the solution of which involves computation of channel capacities for various combinations of the parameters. The paper presents extensive theoretical analyses and numerical predictions that elucidate the many facets of the optimization problem. It shows how a nearly optimum solution can be obtained by choosing the optimum PPM order for the desired number of bits per slot and concatenating the PPM mapping with an error-correction code so that the decoded bits satisfy some BER threshold.

This work was done by Bruce Moison and Jon Hamkins of Caltech for **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP (see page 1).*
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Low-Shear Microencapsulation and Electrostatic Coating

A report presents additional information on the topic of a microencapsulation electrostatic processing system. Information in the report includes micrographs of some microcapsules, a set of diagrams that schematically depict the steps of an encapsulation process, and brief descriptions of (1) alternative versions of the pres- ent encapsulation processes, (2) advantages of the present microencapsulation processes over prior microencapsulation processes, and (3) unique and advantageous features of microcapsules produced by the present processes.

This work was done by Dennis R. Morrison of **Johnson Space Center** *and Benjamin Mosier of the Institute for Research, Inc.*

This invention has been patented by NASA (U.S. Patent No. 6,103,271). Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to the Patent Counsel, Johnson Space Center, (281) 483-0837. Refer to MSC-22938.