it is compared with those column vectors already in the reduced data matrix to ensure that only one copy of that vector ends up in the reduced data matrix. In the second stage, one orders the column vectors of the original data matrix by their Euclidean norms and then selects a subset of the vectors according to a spacing criterion. All column vectors selected in this way are compared to those vectors selected during the first stage. Only those column vectors that were not already included in the reduced data matrix during the first stage are added to the reduced data matrix.

Practical sets of data tend to be so large that excessive computer memory would be necessary for a single pass of the two-stage VOF procedure over all the data. In such a case, the VOF procedure can be applied recursively to successive subsets of the original data that are small enough to fit in the available memory. The figure presents plots from an example of a two-pass application of the VOF technique to some space-shuttle engine vibration data.

This work was done by Randall L. Bickford of Expert Microsystems, Inc., and James P. Herzog of Argonne National Laboratory for **Marshall Space Flight Center**. *This technology is immediately available using the SureSense™ Signal Validation System software produced by Expert Microsystems, Inc. For more information, contact the company at (916) 989-2018 or at expert@expmicrosys.com.*

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Remote Sensing and Information Technology for Large Farms

Timely data on spatial and temporal variations in fields help farmers manage crops.

Stennis Space Center, Mississippi

A method of applying remote sensing (RS) and information-management technology to help large farms produce at maximum efficiency is undergoing development. The novelty of the method does not lie in the concept of "precision agriculture," which involves variation of seeding, of application of chemicals, and of irrigation according to the spatially and temporally local variations in the growth stages and health of crops and in the chemical and physical conditions of soils. The novelty also does not lie in the use of RS data registered with other data in a geographic information system (GIS) to guide the use of precise agricultural techniques. Instead, the novelty lies in a systematic approach to overcoming obstacles that, heretofore, have impeded the timely distribution of reliable, relevant, and sufficient GIS data to support day-to-day, acre-to-acre decisions concerning the application of precise agricultural techniques to increase production and decrease cost.

The development and promotion of the method are inspired in part by a vision of equipping farm machinery to accept GIS (including RS) data and using the data for automated or semiautomated implementation of precise agricultural techniques. Primary examples of relevant GIS data include information on plant stress, soil moisture, and effects of applied chemicals, all derived by automated computational analysis of measurements taken by one or more airborne spectroradiometers.

Proper management and timeliness of the large amount of GIS information are of paramount concern in agriculture. Information on stresses and changes in crops is especially perishable and important to farmers. The need for timeliness and management of information is satisfied by use of computing hardware and software capable of (1) rapid geo-rectification and other processing of RS data, (2) packaging the output data in the form of GIS plots, and (3) making the data available to farmers and other subscribers by Internet password access. It is a goal of this development program to make RS data available no later than the data after an aerial survey. In addition, data from prior surveys are kept in the data base. Farmers can, for example, use current and prior data to analyze changes.

This work was done by John E. Williams of Global Positioning Solutions, Inc., and Jimmie A. Ramsay of DataStar, Inc. for **Stennis Space Center**.

In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to:

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