Information Sciences

Improved Compression of Wavelet-Transformed Images
Code parameters are selected adaptively to achieve high compression performance.

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A recently developed data-compression method is an adaptive technique for coding quantized wavelet-transformed data, nominally as part of a complete image-data compressor. Unlike some other approaches, this method admits a simple implementation and does not rely on the use of large code tables.

A common data compression approach, particularly for images, is to perform a wavelet transform on the input data, and then losslessly compress a quantized version of the wavelet-transformed data. Under this compression approach, it is common for the quantized data to include long sequences, or "runs," of zeros.

The new coding method uses prefix-free codes for the nonnegative integers as part of an adaptive algorithm for compressing the quantized wavelet-transformed data by run-length coding. In the form of run-length coding used here, the data sequence to be encoded is parsed into strings consisting of some number (possibly 0) of zeros, followed by a nonzero value. The nonzero value and the length of the run of zeros are encoded. For a data stream that contains a sufficiently high frequency of zeros,

this method is known to be more effective than using a single variable length code to encode each symbol. The specific prefix-free codes used are from two classes of variable-length codes: a class known as Golomb codes, and a class known as exponential-Golomb codes. The codes within each class are indexed by a single integer parameter.

The present method uses exponential-Golomb codes for the lengths of the runs of zeros, and Golomb codes for the nonzero values. The code parameters within each code class are determined adaptively on the fly as compression proceeds, on the basis of statistics from previously encoded values. In particular, a simple adaptive method has been devised to select the parameter identifying the particular exponential-Golomb code to use. The method tracks the average number of bits used to encode recent runlengths, and takes the difference between this average length and the code parameter. When this difference falls outside a fixed range, the code parameter is updated (increased or decreased). The Golomb code parameter is selected based on the average magnitude of recently encoded nonzero samples.

The coding method requires no floating-point operations, and more readily adapts to local statistics than other methods. The method can also accommodate arbitrarily large input values and arbitrarily long runs of zeros. In practice, this means that changes in the dynamic range or size of the input data set would not require a change to the compressor.

The algorithm has been tested in computational experiments on test images. A comparison with a previously developed algorithm that uses large code tables (generated via Huffman coding on training data) suggests that the data-compression effectiveness of the present algorithm is comparable to the best performance achievable by the previously developed algorithm.

This work was done by Aaron Kiely and Matthew Klimesh 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 Karina Edmonds of the California Institute of Technology at (818) 393-2827. Refer to NPO-40490.

NASA Interactive Forms Type Interface — NIFTI
A flexible database query, update, modify, and delete tool provides an easy interface to Oracle forms.

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A flexible database query, update, modify, and delete tool was developed that provides an easy interface to Oracle forms. This tool — the NASA interactive forms type interface, or NIFTI — features on-the-fly forms creation, forms sharing among users, the capability to query the database from user-entered criteria on forms, traversal of query results, an ability to generate tab-delimited reports, viewing and downloading of reports to the user's workstation, and a hypertext-based help system. NIFTI is a very powerful *ad hoc* query tool that was developed using C++,

X-Windows by a Motif application framework. A unique tool, NIFTI's capabilities appear in no other known commercial-off-the-shelf (COTS) tool, because NIFTI, which can be launched from the user's desktop, is a simple yet very powerful tool with a highly intuitive, easy-to-use graphical user interface (GUI) that will expedite the creation of database query/update forms. NIFTI, therefore, can be used in NASA's International Space Station (ISS) as well as within government and industry — indeed by all users of the widely disseminated Oracle base. And it will provide sig-

nificant cost savings in the areas of user training and scalability while advancing the art over current COTS browsers.

No COTS browser performs all the functions NIFTI does, and NIFTI is easier to use. NIFTI's cost savings are very significant considering the very large database with which it is used and the large user community with varying data requirements it will support. Its ease of use means that personnel unfamiliar with databases (e.g., managers, supervisors, clerks, and others) can develop their own personal reports. For NASA, a tool such