LOW-COMPLEXITY PROGRESSIVE IMAGE-TRANSMISSION SCHEMES FOR SPACE APPLICATIONS'

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Abstract

This paper describes the use of a combination of multi resolution image representation and data compression techniques to reduce transmission time and permit early recognition of images. Data compression removes the inherent redundancies in the image data to reduce the overall data volume. Multiresolution image representation allows efficient progressive transmission. Instead of building an image line-by-line, progressive transmission first sends a low-resolution approximate image that is progressively improved with further transmission. Progressive transmission allows the viewer the flexibility at any stage of the reconstruction to decide on whether or not further transmission is necessary. This saves transmission power and bandwidth, which translates into saving of complexity and cost.

We describe two integer-based progressive transmission schemes, which are both efficient in compression performance and speed and are simple to implement. These schemes are potentially viable to process images in real time using genera] purpose microprocessor or programmable digital signal processor. This allows greater flexibility, reduces design risk, and simplifies testing. This can result in great reduction of development cost. An integer-based non-progressive data compression scheme known as integer cosine transform (lCT) is now being developed for use in the Gaileo S-Band Mission.

The first is a mean-pyramid scheme. It represents the image data using an hierarchical data structure that averages over blocks of pixels (typically, 2x2 blocks from the previous layer). After the entire picture is averaged, the differences between the top and second layers are sent first, followed by the differences between the second and the third layers, and so on. The differences between adjacent layers, which tend to be small more often than large, can be encoded with fewer bits; this improves transmission efficiency. We have also developed techniques m reduce storage. This scheme has a simple encoder and a simple decoder, and can be used for both lossless and lossy compression. The sequence of progression of the image ``oilfield'' is shown in Figure 1.

The second multiresolution image compression scheme is called the integer subband coding (ISBC) scheme. Similar to the mean-pyramid scheme, the ISBC scheme iteratively transforms and decimates an image into layers of decreasing size and decreasing resolutions using a low-pass filter (LPF) and a high-pass filter (HPF). Filtering is done in both horizontal and veritcal directions. The image layers are transmitted in a coarse-to-fine fashion. Unlike other wavelet and subband coding schemes, the ISBC scheme has a very simple encoder (short, multiplication-free, add and shift operations only) and a more complicated decoder. This unbalanced architecture allows simple spacecraft implementation (encoder) and more computation-intensive ground implementation (decoder). "l'he ISBC scheme is used for lossy compression. The sequence of progression of the image ``Gaspra'' is shown in Figure 2.

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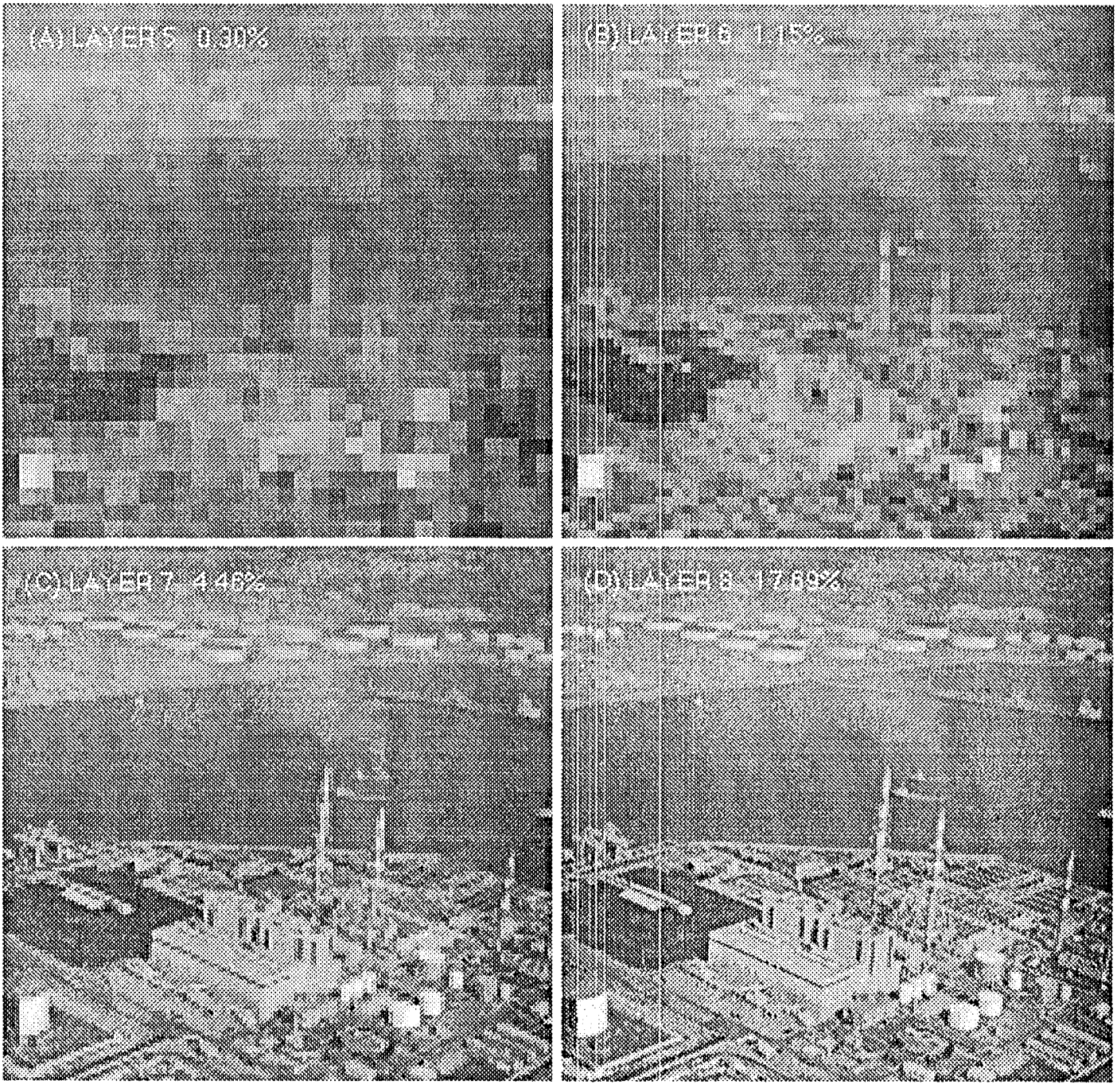
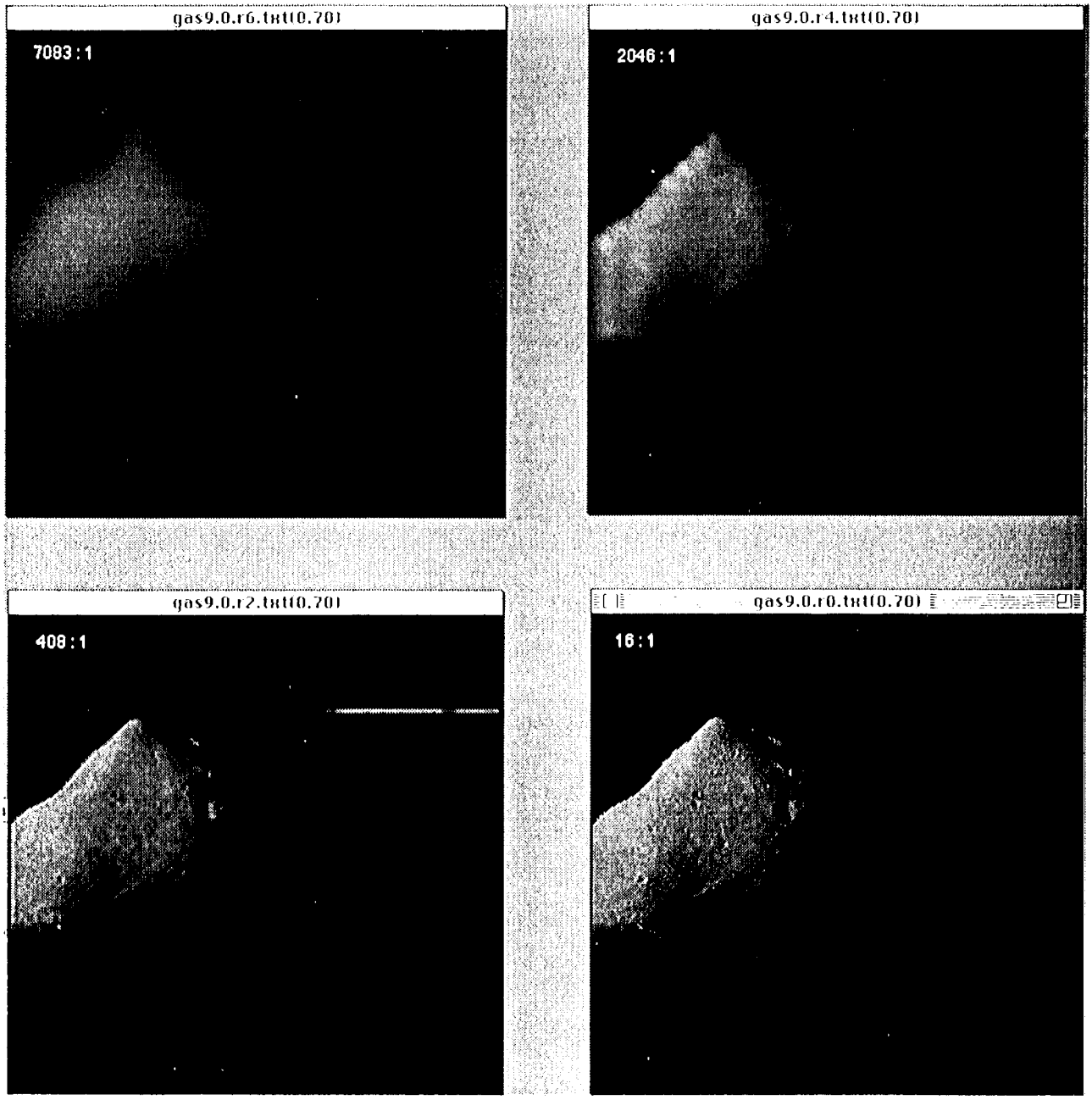
HIERARCHICAL **PROGRESSIVE** TRANSMISSION
IMAGE : OILFIELD

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