Lossless, Multi-Spectral Data Compressor for Improved Compression for Pushbroom-Type Instruments

A modified data compression algorithm could be used on commercial satellites or other applications with multispectral imaging instruments.

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A low-complexity lossless algorithm for compression of multispectral data has been developed that takes into account pushbroom-type multispectral imagers' properties in order to make the file compression more effective. These types of imagers use a detector array to acquire data in spatial-spectral slices. Each detector element corresponds to a specific spectral band and cross-track position. Because the characteristics of detector elements generally vary somewhat from element to element, cross-track adjacent samples in a given spectral band are not as similar as they are in an instrument that uses the same detector for all samples in a given spectral band (e.g. in a whiskbroom-type instrument). Along-track adjacent samples will tend to be very similar.

Therefore, the fast lossless algorithm described in "Fast Lossless Compression of Multispectral-Image Data" (NPO-42517), *NASA Tech Briefs*, Vol. 30, No. 8 (August 2006), pages 26-28 was modified in two ways to increase the compression efficiency for these imagers. The first modification involves a local mean that was originally computed, for each sample, as the average sample value in a causal neighborhood of four adjacent samples within the spectral band. Local means are subtracted from sample values to produce the input quantities for the adaptive filtering algorithm. For data from pushbroom-type multispectral imagers, it is found that letting the local mean be equal to the previous sample in the same cross-track position (and in the same spectral band) gave significantly better results. Specifically, for all rows (along-track positions) except the first row in a segment, the local mean equals the previous sample in the same cross-track position. For the first row in a segment, no such sample is available, so the local mean equals the causal cross-track adjacent sample. In addition, the prediction neighborhood of the sample is changed. In the original algorithm, this neighborhood contains three samples from the same band as the given sample, and one sample from each of the three preceding spectral bands. Under this first modification, only the first three samples from the three preceding spectral bands are used.

For the second modification, crude calibration information is used as side information for the compressor. This modification exploits the observation that the variations in detector element characteristics are an inherent property of the detector, and there is little change in this variation over time. A key ingredient in this modification is a calibration array containing approximate, constant offsets for the detector elements. Each sample in a data set has the corresponding calibration value subtracted prior to starting compression, and the decompressor reverses this process after decompression. It is noted that the decompressor requires a copy of the calibration information. There are various ways in which the calibration array might be generated. In this instance, only a single calibration array was generated, but it appeared to work well with a large number of datasets from the same instrument.

When used with the first modification, the second modification primarily only affects how the first line of each segment is compressed. Nevertheless, the improvement for this line is significant enough to provide a noticeable, overall compression improvement.

This work was done by Matthew Klimesh of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). *NPO-45473*