TECHNOLOGY 2004'
Riper Abstract

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Gov't Agency/Lab The Subject Technology **Was Developed By/For:** JPL

Contract No. (ii **applicable):**

Paper **Title:** Subband Coding Methods for Seismic Data Compression

category: Computer Software

Description (use **additional sheet** if **necessary):**

This paper presents a study 01 seismic data compression techniques and a compression algorithm based on subband coding that can meet prescribed fidelity requirements, i.e. the waveform will be reproduced with the necessary accuracy to allow for correct interpretation and subsequent analysis of the data. The compression algorithm includes three stages: a decorrelation stage based on subband coding, a quantization stage that introduces a controlled amount of distortion to allow for high compression ratios, and a lossless entropy coding stage based on a simple but efficient arithmetic coding method. Compression/distortion performance results are presented for several filter ban ks and increasing number of levels of decomposition, On a widely used data base 01 seismic waveforms. Subband coding methods, closely related to wavelet methods, are particularly suited to the decorrelation of highly non-stationary processes such as seismic events, and can provide controlled resolution independently in the time and frequency domains. Adaptivity to the non-stationary behavior of the waveform is achieved by dividing the data into separate blocks which are encoded separately with an adaptive arithmetic encoder. This is done with high efficiency due to the low overhead introduced by the arithmetic encoder in specifying its parameters. The compression method described in this paper is amenable to progressive transmission, where successive refinements of the data can be requested by the user. This allows seismologists to first examine a coarse version of waveforms with minimal usage of the channel and then decide where refinements are required.

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Paper Abstract

Subband Coding Methods for Seismic Data Compression

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A typical seismic analysis scenario involves collection of data by an array of seismometers, transmission over a channel offering limited data rate, and storage of data for analysis. Seismic data analysis is performed for monitoring earthquakes and for planetary exploration as in the planned study of seismic events on Mars. Data compression algorithms are required to cope with the transmission of vast amounts of data over severely constrained channels.

This paper presents a study of seismic data compression techniques and a compression algorithm based on subband coding that can meet prescribed fidelity requirements, i.e. the waveform will be reproduced with the necessary accuracy to allow for correct interpretation and subsequent analysis of the data. The distortions incurred by the methods here described are currently being evaluated by several seismologists involved in seismic data analysis. The compression algorithm includes three stages: a decorrelation stage based on subband coding, a quantization stage that introduces a controlled amount of distortion to allow for high compression ratios, and a lossless entropy coding stage based on a simple but efficient arithmetic coding method. Compression/distortion performance results are presented for several filter banks and increasing number of levels of decomposition, on a widely used data base of seismic waveforms. Comparisons are made with other proposed methods based on block transforms such as the Discrete Cosine Transform (DCT), the Walsh-Hadamard Transform (WHT), and the Karhunen-Loeve Transform (KLT), as well as with linear predictive methods. Subband coding methods, closely related to wavelet methods, are particularly suited to the decorrelation of highly non-stationary processes such as seismic events, and can provide controlled resolution independently in the time and frequency domains. Adaptivity to the non-stationary behavior of the waveform is achieved by dividing the data into separate blocks which are encoded separately with an adaptive arithmetic encoder. This is done with high efficiency due to the low overhead introduced by the arithmetic encoder in specifying its parameters. Subband coding can also be useful

[1]The research described in this abstract was carried out at the Jet Propulsion Laboratory, California Institute of Technology, under contract with the National Aeronautics and Space Administration.

to control the effect of background noise while preserving with high accuracy the information contained in seismic events. The compression method described in this paper is amenable to progressive transmission, where successive refinements of the data can be requested by the user. 'Ibis allows seismologists to first examine a coarse version of waveforms with minimal usage of the channel and then decide where refinements are required.

In general, given a fixed transmission rate, lossy compression algorithms applied to high accuracy instruments deliver higher scientific content than lossless compression methods applied to lower accuracy instruments.