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Lossless Audio Compression using Psychoacoustic Model and Wavelet Transform

Othman O. Khalifa, Sering Habib Harding and Aisha-Hassan A. Hasim

International Islamic University malaysia
KULLIYYAH OF ENGINEERING
khalifa@iiu.edu.my

ABSTRACT

The compression of audio signals refers to the reduction of the bandwidth required to transmit or store a digitized audio signal. . It has become one of the basic technologies of the multimedia age. The change in the telecommunication infrastructure, in recent years, from circuit switched to packet switched systems has also reflected on the way that speech and audio signals are carried in present systems. In many applications, such as the design of multimedia workstations and high quality audio transmission and storage, the goal is to achieve transparent coding of audio and speech signals at the lowest possible data rates. In other words, bandwidth cost money, therefore, the transmission and storage of information becomes costly. However, if we can use less data, both transmission and storage become cheaper. Further reduction in bit rate is an attractive proposition in applications like remote broadcast lines, studio links, satellite transmission of high quality audio and voice over internet applications. This paper presents a technique to incorporate psychoacoustic models into an adaptive wavelet transform scheme to achieve perceptually transparent compression of high quality. Simulation results show that the wavelet based compression software designed reaches a signal to noise ratio of 34.5 db at a compression ratio of 1.88 using the Daubechies 10 wavelet. The performance of the wavelet scheme in terms of compression scores and signal quality is incomparable with other good techniques such as MP3 codecs: however the implemented scheme performs reasonably well with an average fidelity and with much less computational burden.

Keywords: Audio Compression, Psychoacoustic model, Wavelet Transform

1. INTRODUCTION

The growth of the computer industry has invariably led to the demand for quality audio data. Compared to most digital data types, the data rates associated with uncompressed digital audio are substantial. For example, if we want send high-quality uncompressed audio data over a modem, it would take each second's worth of audio about 30 seconds to transmit. This means that the data would be gradually received, stored away and the resulting file played at the correct rate to hear the sound. However, if real-time audio is to be sent over a modem link, data compression must be used.

In a digital system, the bit rate is the product of the sampling rate and the number of bits in each sample. The difference between the information rate of a signal and its bit rate is known as the redundancy. Compression systems are designed to eliminate this redundancy. These systems rely on the fact that information, by its very nature is not random but exhibits order and patterning. According to Shannon's information theory, "any signal, which is totally predictable, carries no information" [4].

Therefore, if the order and pattern can be extracted, the essence of the information can often be represented and transmitted using less data than would be required for the original signal [5].

1.1 AUDIO COMPRESSION TECHNIQUES

A. Lossless Compression

Lossless compression works by removing the redundant information present in an audio signal. This would be the ideal compression technique as there is no cost to using it other than the cost of the compression and decompression process. However, lossless compression suffers from two