

Audio Signal Compression using DCT and LPC Techniques

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Abstract—Audio compression is designed to reduce the transmission bandwidth requirement of digital audio streams and storage size of audio files. Audio compression has become one of the basic technologies of the multimedia age to achieve transparent coding of audio and speech signals at the lowest possible data rates. This paper presents a comparative analysis of audio signal compression using transformation techniques like discrete cosine transform and linear prediction coding. Performance measures like compression ratio, signal to noise ratio (SNR), peak signal to noise ratio (PSNR) and mean square error (MSE) etc are calculated for analysis.

Key words— Discrete Cosine Transform (DCT), linear prediction coding (LPC), compression ratio (CR), SNR, PSNR, MSE.

I. INTRODUCTION

In digital signal processing data compression involves encoding the information using fewer bits than the original representation. Compression reduces the usage of resources like storage space and transmission capacity. Audio Compression is a process of lessening the dynamic range between the loudest and quietest parts of an audio signal. This is done by boosting the quieter signals and attenuating the louder signals. Audio compression basically consists of two parts. The first part, called encoding, transforms the digital audio data (.WAV file) into a highly compressed form called bit stream. However, the second part, called decoding takes the bit stream and re-expands it to a WAV file[1].

Compression Types

There are mainly two types of compression techniques: Lossless Compression and Lossy Compression techniques. Lossless data compression algorithms allow exact reconstruction of original

data from the compressed data. Lossy compression techniques does not allow perfect reconstruction of data but offers good compression ratio values relative to the lossless compression techniques.

B. General Audio Compression Architecture

The most common characteristic of audio signals is the existence of redundant information between adjacent samples. Compression tries to remove this redundancy and makes the data de-correlated. Typical audio compression system contains three basic modules to accomplish audio compression. First, an appropriate transform is applied. Second, the produced transform coefficients are quantized to reduce the redundant information; here, the quantized data hold errors but should be insignificant[1]. Third, the quantized values are coded using packed codes; this encoding stage changes the format of quantized coefficients values using one of the suitable variable length coding technique.



Fig1: General block diagram

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Digital Signal Processing with Examples in MATLAB Samuel D. Stearns, Donald R. Hush, 2016-04-19 Based on fundamental principles from mathematics linear systems and signal analysis digital signal processing DSP algorithms are useful for extracting information from signals collected all around us Combined with today's powerful computing capabilities they can be used in a wide range of application areas including engineering communication *Analysis of the MPEG-1 Layer III (MP3) Algorithm using MATLAB* Andreas Spanias, Jayaraman Thiagarajan, 2022-05-31 The MPEG 1 Layer III MP3 algorithm is one of the most successful audio formats for consumer audio storage and for transfer and playback of music on digital audio players The MP3 compression standard along with the AAC Advanced Audio Coding algorithm are associated with the most successful music players of the last decade This book describes the fundamentals and the MATLAB implementation details of the MP3 algorithm Several of the tedious processes in MP3 are supported by demonstrations using MATLAB software The book presents the theoretical concepts and algorithms used in the MP3 standard The implementation details and simulations with MATLAB complement the theoretical principles The extensive list of references enables the reader to perform a more detailed study on specific aspects of the algorithm and gain exposure to advancements in perceptual coding Table of Contents Introduction Analysis Subband Filter Bank Psychoacoustic Model II MDCT Bit Allocation Quantization and Coding Decoder **Digital Signal Processing** Li Tan, Jean Jiang, 2013-01-21 Digital Signal Processing Second Edition enables electrical engineers and technicians in the fields of biomedical computer and electronics engineering to master the essential fundamentals of DSP principles and practice Many instructive worked examples are used to illustrate the material and the use of mathematics is minimized for easier grasp of concepts As such this title is also useful to undergraduates in electrical engineering and as a reference for science students and practicing engineers The book goes beyond DSP theory to show implementation of algorithms in hardware and software Additional topics covered include adaptive filtering with noise reduction and echo cancellations speech compression signal sampling digital filter realizations filter design multimedia applications over sampling etc More advanced topics are also covered such as adaptive filters speech compression such as PCM u law ADPCM and multi rate DSP and over sampling ADC New to this edition MATLAB projects dealing with practical applications added throughout the book New chapter chapter 13 covering sub band coding and wavelet transforms methods that have become popular in the DSP field New applications included in many chapters including applications of DFT to seismic signals electrocardiography data and vibration signals All real time C programs revised for the TMS320C6713 DSK Covers DSP principles with emphasis on communications and control applications Chapter objectives worked examples and end of chapter exercises aid the reader in grasping key concepts and solving related problems Website with MATLAB programs for simulation and C programs for real time DSP **DSP for MATLAB and LabVIEW: Fundamentals of discrete frequency transforms** Forester W. Isen, 2008 The entire series consists of four

volumes that collectively cover basic digital signal processing in a practical and accessible manner but which nonetheless include all essential foundation mathematics As the series title implies the scripts of which there are more than 200 described in the text and supplied in code form available via the internet at <http://www.morganclaypool.com/page/isen> will run on both MATLAB and LabVIEW The text for all volumes contains many examples and many useful computational scripts augmented by demonstration scripts and LabVIEW Virtual Instruments VIs that can be run to illustrate various signal processing concepts graphically on the user's computer screen

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Digital Signal Processing with Matlab Examples, Volume 2 Jose Maria Giron-Sierra, 2016-12-02 This is the second volume in a trilogy on modern Signal Processing The three books provide a concise exposition of signal processing topics and a guide to support individual practical exploration based on MATLAB programs This second book focuses on recent developments in response to the demands of new digital technologies It is divided into two parts the first part includes four chapters on the decomposition and recovery of signals with special emphasis on images In turn the second part includes three chapters and addresses important data based actions such as adaptive filtering experimental modeling and classification

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Starting Digital Signal Processing in Telecommunication Engineering

Tomasz P. Zieliński, 2021-01-29 This hands on laboratory driven textbook helps readers understand principles of digital signal processing DSP and basics of software based digital communication particularly software defined networks SDN and software defined radio SDR In the book only the most important concepts are presented Each book chapter is an introduction to computer laboratory and is accompanied by complete laboratory exercises and ready to go Matlab programs with figures and comments available at the book webpage and running also in GNU Octave 5.2 with free software packages showing all or most details of relevant algorithms Students are tasked to understand programs modify them and apply presented concepts to recorded real RF signal or simulated received signals with modelled transmission condition and hardware imperfections Teaching is done by showing examples and their modifications to different real world telecommunication like applications The book consists of three parts introduction to DSP spectral analysis and digital filtering introduction to DSP advanced

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Multimedia Signals and Systems Mrinal Kr. Mandal, 2012-12-06 Multimedia Signals and Systems is primarily a technical introductory level multimedia textbook including problems examples and MATLAB codes It will be a stepping stone for readers who want to research in audio processing image and video processing and data compression This book will also be useful to readers who are carrying out research and development in systems areas such as television engineering and storage media Anyone who seeks to learn the core multimedia signal processing techniques and systems will need Multimedia Signals and Systems There are many chapters that are generic in nature and provide key concepts of multimedia systems to technical as well as non technical persons There are also several chapters that provide a mathematical analytical framework for basic multimedia signal processing The readers are expected to have some prior knowledge about discrete signals and systems such as Fourier transform and digital filters However a brief review of these theories is provided Additional material for this book including several MATLAB codes along with a few test data samples e g audio image and video may be downloaded from <http://extras.springer.com>

Introduction to Audio Analysis Theodoros Giannakopoulos, Aggelos Pikrakis, 2014-02-15 Introduction to Audio Analysis serves as a standalone introduction to audio analysis providing theoretical background to many state of the art techniques It covers the essential theory necessary to develop audio engineering applications but also uses programming techniques notably MATLAB to take a more applied approach to the topic Basic theory and reproducible experiments are combined to demonstrate theoretical concepts from a practical point of view and provide a solid foundation in the field of audio analysis Audio feature extraction audio classification audio segmentation and music information retrieval are all addressed in detail along with material on basic audio processing and frequency domain representations and filtering Throughout the text reproducible MATLAB examples are accompanied by theoretical descriptions illustrating how concepts and equations can be applied to the development of audio analysis systems and components A blend of reproducible MATLAB code and essential theory provides enable the reader to delve into the world of audio signals and develop real world audio applications in various domains Practical

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