

# 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.

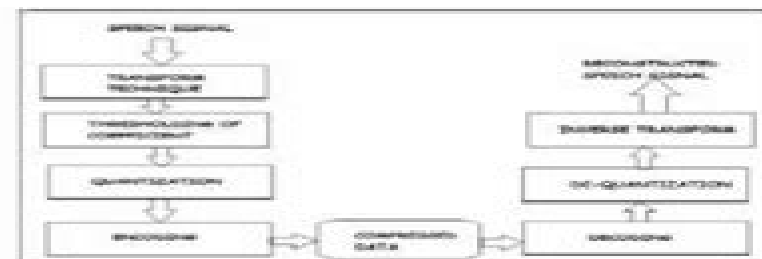


Fig1: General block diagram

# Matlab Code For Dct In Audio Signal

**Li Tan, Jean Jiang**



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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 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 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 **Digital Signal Processing** EduGorilla Prep Experts, 2024-07-25 EduGorilla Publication is a trusted name in the education sector committed to empowering learners with high quality study materials and resources Specializing in competitive exams and academic support EduGorilla provides comprehensive and well structured content tailored to meet the needs of students across various streams and levels **MATLAB for Engineers** Karel Perutka, 2011-10-13 The book presents several approaches in the key

areas of practice for which the MATLAB software package was used Topics covered include applications for Motors Power systems Robots Vehicles The rapid development of technology impacts all areas Authors of the book chapters who are experts in their field present interesting solutions of their work The book will familiarize the readers with the solutions and enable the readers to enlarge them by their own research It will be of great interest to control and electrical engineers and students in the fields of research the book covers

**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

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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 approach to signal processing. The first book to focus on audio analysis from a signal processing perspective demonstrating practical implementation alongside theoretical concepts. Bridge the gap between theory and practice. The authors demonstrate how to apply equations to real life code examples and resources giving you the technical skills to develop real world applications. Library of MATLAB code. The book is accompanied by a well documented library of MATLAB functions and reproducible experiments.      *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 topics: multi rate adaptive model based and multimedia speech audio video signal analysis and processing; and introduction to software defined modern telecommunication systems: SDR technology, analog and digital modulations, single and multi carrier systems, channel estimation and correction as well as synchronization issues. Many real signals are processed in the book in the first part mainly speech and audio while in the second part mainly RF recordings taken from RTL SDR USB stick and ADALM PLUTO module for example captured IQ data of VOR avionics signal, classical FM radio with RDS, digital DAB, DAB

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**Communication Systems Principles Using MATLAB** John W. Leis,2018-07-31 Discover the basic telecommunications systems principles in an accessible learn by doing format Communication Systems Principles Using MATLAB covers a variety of systems principles in telecommunications in an accessible format without the need to master a large body of theory The text puts the focus on topics such as radio and wireless modulation reception and transmission wired networks and fiber optic communications The book also explores packet networks and TCP IP as well as digital source and channel coding and the fundamentals of data encryption Since MATLAB is widely used by telecommunications engineers it was chosen as the vehicle to demonstrate many of the basic ideas with code examples presented in every chapter The text addresses digital communications with coverage of packet switched networks Many fundamental concepts such as routing via shortest path are introduced with simple and concrete examples The treatment of advanced telecommunications topics extends to OFDM for wireless modulation and public key exchange algorithms for data encryption Throughout the book the author puts the emphasis on understanding rather than memorization The text also Includes many useful take home skills that can be honed while studying each aspect of telecommunications Offers a coding and experimentation approach with many real world examples provided Gives information on the underlying theory in order to better understand conceptual developments Suggests a valuable learn by doing approach to the topic Written for students of telecommunications engineering Communication Systems Principles Using MATLAB is the hands on resource for mastering the basic concepts of

telecommunications in a learn by doing format      **Digital Signal Compression** William A. Pearlman, Amir Said, 2011-10-27 Provides clear and easily understandable coverage of the fundamental concepts and coding methods whilst retaining technical depth and rigor      **Digital Signal Processing and Applications with the C6713 and C6416 DSK** Rulph Chassaing, 2004-12-20 This book is a tutorial on digital techniques for waveform generation digital filters and digital signal processing tools and techniques The typical chapter begins with some theoretical material followed by working examples and experiments using the TMS320C6713 based DSPStarter Kit DSK The C6713 DSK is TI s newest signal processor based on the C6x processor replacing the C6711 DSK      Music Emotion Recognition Yi-Hsuan Yang, Homer H. Chen, 2011-02-22 Providing a complete review of existing work in music emotion developed in psychology and engineering Music Emotion Recognition explains how to account for the subjective nature of emotion perception in the development of automatic music emotion recognition MER systems Among the first publications dedicated to automatic MER it begins with a comprehensive introduction to the essential aspects of MER including background key techniques and applications This ground breaking reference examines emotion from a dimensional perspective It defines emotions in music as points in a 2D plane in terms of two of the most fundamental emotion dimensions according to psychologists valence and arousal The authors present a computational framework that generalizes emotion recognition from the categorical domain to real valued 2D space They also Introduce novel emotion based music retrieval and organization methods Describe a ranking base emotion annotation and model training method Present methods that integrate information extracted from lyrics chord sequence and genre metadata for improved accuracy Consider an emotion based music retrieval system that is particularly useful for mobile devices The book details techniques for addressing the issues related to the ambiguity and granularity of emotion description heavy cognitive load of emotion annotation subjectivity of emotion perception and the semantic gap between low level audio signal and high level emotion perception Complete with more than 360 useful references 12 example MATLAB codes and a listing of key abbreviations and acronyms this cutting edge guide supplies the technical understanding and tools needed to develop your own automatic MER system based on the automatic recognition model      Speech and Audio Processing Ian McLoughlin, 2016-07-21 An accessible introduction to speech and audio processing with numerous practical illustrations exercises and hands on MATLAB examples      *Natural Computing for Unsupervised Learning* Xiangtao Li, Ka-Chun Wong, 2018-10-31 This book highlights recent research advances in unsupervised learning using natural computing techniques such as artificial neural networks evolutionary algorithms swarm intelligence artificial immune systems artificial life quantum computing DNA computing and others The book also includes information on the use of natural computing techniques for unsupervised learning tasks It features several trending topics such as big data scalability wireless network analysis engineering optimization social media and complex network analytics It shows how these applications have triggered a number of new natural computing techniques to improve the performance of unsupervised learning methods With

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**Conference Record of the Thirty-Seventh Asilomar Conference on Signals, Systems & Computers, November 9-12, 2003, Pacific Grove, California** Michael B. Matthews, 2003



This book delves into Matlab Code For Dct In Audio Signal. Matlab Code For Dct In Audio Signal is a crucial topic that must be grasped by everyone, ranging from students and scholars to the general public. This book will furnish comprehensive and in-depth insights into Matlab Code For Dct In Audio Signal, encompassing both the fundamentals and more intricate discussions.

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