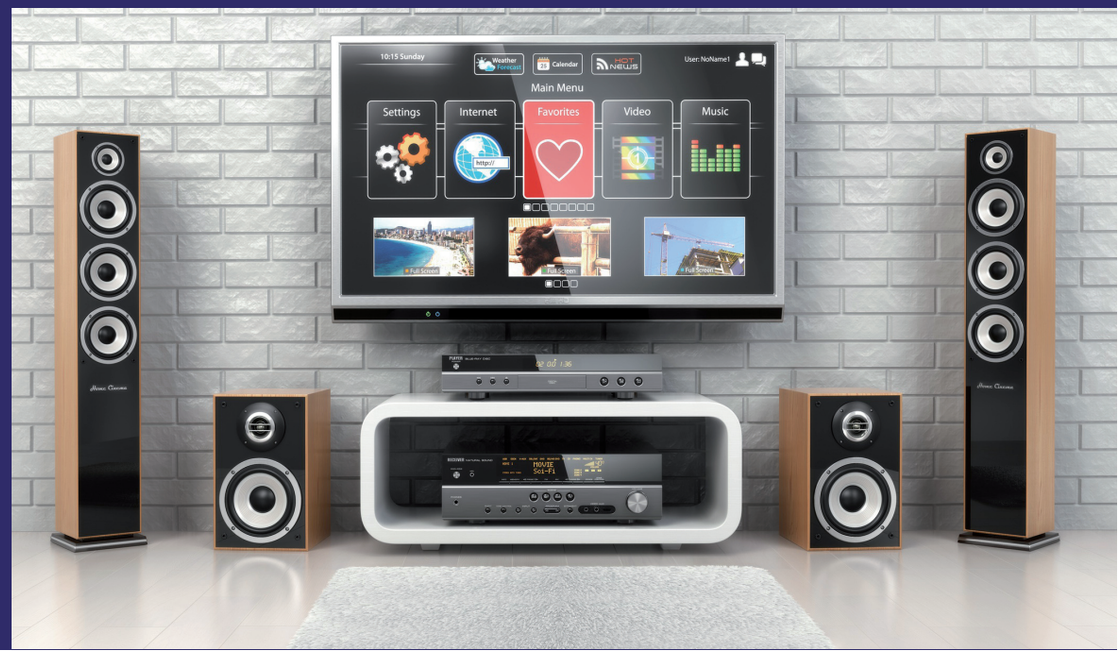
Nowadays, many methods and algorithms have been proposed to improve the compression performance on multichannel audio. This book focuses on performance evaluation of various algorithms on multichannel audio compression. First, we identified and investigated current state-of-the-art audio compression algorithms, both lossless and lossy compression, which can handle mono, stereo, 5.1, and 7.1 multichannel audio. Out of various algorithms available, AC3, AAC, and Ogg have been selected as lossy compression algorithms, while FLAC and MPEG-4 ALS have been chosen as lossless compression algorithms. Two performance measure were used in the experiments, i.e. compression ratio and encoding time. The results showed that among three lossy audio compression algorithms, AC3 has the fastest encoding time while Ogg Vorbis has the highest compression ratio. Furthermore, between FLAC and MPEG-4 ALS, FLAC has faster encoding time and MPEG-4 ALS has higher compression ratio. Overall, in terms of encoding time and compression ratio, it has been found that FLAC is the fastest coder while Ogg Vorbis has the highest compression ratio among five encoders evaluated.

@Siti Aisyah Abdul Rashid obtained her BEng in Communication Engineering from IIUM in 2016. @Teddy Surya Gunawan received his PhD degree from UNSW in 2007 and is currently an Associate Professor at IIUM. @Mira Kartiwi obtained her PhD from UOW in 2009 and is currently an Associate Professor at IIUM.

978-620-2-01220-1

Multichannel Audio Compression



Siti Aisyah Abdul Rashid
Teddy Surya Gunawan
Mira Kartiwi

Multichannel Audio Compression

Performance Evaluation of Various Algorithms

LAP LAMBERT Academic Publishing

Abdul Rashid, Gunawan, Kartiwi

Siti Aisyah Abdul Rashid
Teddy Surya Gunawan
Mira Kartiwi

Multichannel Audio Compression

Siti Aisyah Abdul Rashid
Teddy Surya Gunawan
Mira Kartiwi

Multichannel Audio Compression

Performance Evaluation of Various Algorithms

LAP LAMBERT Academic Publishing

Imprint
Any brand names and product names mentioned in this book are subject to trademark, brand or patent protection and are trademarks or registered trademarks of their respective holders. The use of brand names, product names, common names, trade names, product descriptions etc. even without a particular marking in this work is in no way to be construed to mean that such names may be regarded as unrestricted in respect of trademark and brand protection legislation and could thus be used by anyone.

Cover image: www.ingimage.com

Publisher:
LAP LAMBERT Academic Publishing
is a trademark of
International Book Market Service Ltd., member of OmniScriptum Publishing Group
17 Meldrum Street, Beau Bassin 71504, Mauritius

Printed at: see last page
ISBN: 978-620-2-01220-1

Zugl. / Approved by: Kuala Lumpur, IIUM, 2017

ABSTRACT

Multichannel audio or surround sound compression is rather more challenging to compress compare to mono and stereo audio. Nowadays, many methods and algorithms have been proposed to improve the compression performance on multichannel audio. This book focuses on performance evaluation of various algorithms on multichannel audio compression. First, we identified and investigated current state-of-the-art audio compression algorithms, both lossless and lossy compression, which can handle mono, stereo, 5.1, and 7.1 multichannel audio. Out of various algorithms available, AC3, AAC, and Ogg have been selected as lossy compression algorithms, while FLAC and MPEG-4 ALS have been chosen as lossless compression algorithms. Two performance measure were used in the experiments, i.e. compression ratio and encoding time. The results showed that among three lossy audio compression algorithms, AC3 has the fastest encoding time while Ogg Vorbis has the highest compression ratio. Furthermore, between FLAC and MPEG-4 ALS, FLAC has faster encoding time and MPEG-4 ALS has higher compression ratio. Overall, in terms of encoding time and compression ratio, it has been found that FLAC is the fastest coder while Ogg Vorbis has the highest compression ratio among five encoders evaluated.

Keywords: Multichannel Audio, lossless compression, lossy compression, encoding time, compression ratio

ACKNOWLEDGMENTS

The authors would like to express their gratitude to the Malaysian Ministry of Higher Education (MOHE), which has provided funding for the research through the Fundamental Research Grant Scheme, FRGS15-194-0435.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1

INTRODUCTION

1.1 AUDIO COMPRESSION ALGORITHMS

The audio coding proficiency developments as well as their resultant standard have certainly improved the productivity in audio world. Basically, audio compression can be defined as a way to reduce the size of the audio file. The compression is implied by a codec. Codec is a program that uses unique algorithm to shrink the size of data. The important of compression include keeping space and decreasing transmission period. Begin from the monophonic, multichannel audio compression technology further to stereophonic, quadraphonic, 5.1 channels, 7.1 channels and more.

There are two kinds of audio compression algorithm those are lossy and lossless that will be further explain in next topic. For short, lossy audio compression is known by their well-designed system to shrinks file sizes. Advanced Audio Coding (AAC), MPEG-1 Layer III (MP3), Dolby AC-3, Opus, OGG Vorbis and Windows Media Audio Lossy (WMA lossy) are the examples of prevalent foremost lossy audio coding system. AAC can be considered as the most influential multichannel audio coding algorithm. This is due to its ability to support audio channels up to 48 channels and contribute lossless audio for 5.1 channels at sampling rates 320 kbits/s. Meanwhile, AC-3 provides high audio quality at 384kbit/s.

Meanwhile, the most well-known codec in lossless algorithm are Free Lossless Audio Codec (FLAC), Apple Lossless Audio Codec (ALAC), Waveform Audio File (WAV), MPEG-4 Audio lossless, True Audio (TTA), and more. Each of the codec, have the own domain and advantage to encode and decode the audio. Literally, lossless methods do not have any loss information and provide an exact replica of the original signal.

1.2 PROBLEM STATEMENT

As the improvement of audio history developed from mono to stereo audio and then stereo to multichannel audio, more improvement to audio codec is needed to provide high quality audio performance. There is a strong demand in encoding tools in both lossless and lossy algorithm compression in order to give efficient compression ratio and smallest time encoding.

As we know, the previous methods of multi-channel compression mostly focuses on single-channel audio (mono) and the signal coding rate is fairly high. Specifically, in this book, several audio codec will be evaluated on various audio files to study state-of-the art coding of multichannel audio, mono audio and stereo audio. The multi-channel audio compressions algorithms evaluated are AAC, AC3, OGG Vorbis, and MPEG-4 ALS. Matlab will be used to automate the process of encoding and decoding, as well as performance measure in terms of compression ratio and encoding/decoding time.

1.3 OBJECTIVES

The objectives of this book are listed as follows:

- To investigate various algorithms, including lossy and lossless compression, on mono audio, stereo audio, 5.1 and 7.1 multichannel audio signals.
- To evaluate the performance of lossy and lossless audio compression algorithms in terms of encoding time and compression ratio.

1.4 METHODOLOGY

To achieve the objectives stated previously, we conducted several activities as follows:

1. Literature review on the various topics of multichannel audio compression, surround sound and encoding method. Of the various algorithms found, we classify into two main methods which are

lossy and lossless compression, in which we further selected some algorithms for our benchmarking.

2. Determine and analyze information on various codec techniques and methods for multichannel, mono and stereo audio compression.
3. Understanding on current state of the art of multichannel audio compression.
4. Evaluation on the performance of various algorithms in terms of the encoding/decoding time and compression ratio.

1.5 BOOK ORGANIZATION

This book consists of five main chapters starting with Chapter 1 that focus on the introductory part. This chapter also includes the problem statement, objectives, methodology and scope of this research work. Chapter 2 describes the literature review and theoretical background of the multichannel, mono and stereo audio signals as well as various related audio compression algorithms. Chapter 3 presents the experimental setup and implementation. This chapter explains each method on how to encode audio to AAC, OGG Vorbis and AC3 format (lossy compression) as well as FLAC and MPEG-4 ALS audio format (lossless compression). Chapter 4 discusses the experimental result of the encoding simulation of AAC, AC3, OGG Vorbis, FLAC and MPEG-4 ALS using binary on Matlab. Chapter 5 concludes all the findings of this book and also the future work related to this book.