Technische Universität Berlin

Fakultät I - Geisteswissenschaften
Fachgebiet Audiokommunikation
Audiokommunikation und -technologie M.Sc.

Self-Organizing Maps for Sound Corpus Organization

Master's Thesis

Vorgelegt von: Jonas Margraf
Matrikelnummer: 372625
E-Mail: jonasmargraf@me.com

Erstgutachter: Prof. Dr. Stefan Weinzierl
Zweitgutachter: Dr. Diemo Schwarz
Datum: February 7, 2019

Eidesstattliche Erklärung

Hiermit erkläre ich, dass ich die vorliegende Arbeit selbstständig und eigenhändig sowie ohne unerlaubte fremde Hilfe und ausschließlich unter Verwendung der aufgeführten Quellen und Hilfsmittel angefertigt habe.
Berlin, den February 7, 2019

.....
Jonas Margraf

Abstract An english abstract.

Zusammenfassung Die Zusammenfassung auch auf Deutsch.

Acknowledgements

This is where the thank yous go.

Contents

1 Introduction

This is the Introduction. Here's a citation about Self-Organizing Maps (SOMs)(Kohonen, 1990).

1.1 Motivation and Problem Description

1.2 Aims and Objectives

1.3 Previous Work

2 Background

This is the Background section.

2.1 Audio Feature Extraction

Make sure to quote Lerch (2012), Rawlinson et al. (2015), Rawlinson et al. (2019a), Mathieu et al. (2010) Mathieu et al. (2019).

2.1.1 Fundamentals

2.1.2 Audio Pre-Processing

2.1.3 Time-Domain Features

2.1.3.1 Root Mean Square (RMS) measures the power of a signal (Lerch, 2012, p.73f). It describes sound intensity and is sometimes used as a simple measure for loudness (Rawlinson et al., 2019b) that does not take the nonlinearity of human hearing into account (Fletcher and Munson, 1933). It is calculated for an audio frame x consisting of n samples such that

$$v_{RMS} = \sqrt{\frac{\sum_{i=1}^{n} x(i)^2}{n}}. \tag{1}$$

2.1.3.2 Zero-Crossing Rate (ZCR)

2.1.4 Frequency-Domain Features

2.1.4.1 Spectral Centroid

2.1.4.2 Spectral Flatness

2.1.4.3 Spectral Kurtosis

2.1.4.4 Spectral Skewness

2.1.4.5 Spectral Slope

2.1.4.6 Spectral Spread

2.1.4.7 Spectral Rolloff

2.1.5 Perceptual Features

2.1.5.1 Loudness

2.2 Self-Organzing Map

Something about SOMs and also neurons have IDs.

3 Implementation

This is the Implementation.

3.1 Groundwork: CataRT Extension

3.2 SOM Browser

4 Evaluation

This is the Evaluation.

4.1 Measuring SOM-Induced Quantization

4.2 Online Sound Similarity Survey

4.3 Semistructured User Interviews

5 Results

This is the Results section.

6 Discussion

This is the Discussion.

6.1 Outlook

7 References

Bauer, H.-U.; Ralf Der; and Michael Herrmann (1996): "Controlling the magnification factor of self-organizing feature maps." In: *Neural computation*, **8**(4), pp. 757–771.

DeSieno, Duane (1988): "Adding a conscience to competitive learning." In: *IEEE international conference on neural networks*, vol. 1. Institute of Electrical and Electronics Engineers New York, pp. 117–124.

Fasciani, Stefano (2016): "TSAM: a tool for analyzing, modeling, and mapping the timbre of sound synthesizers." In: .

Fiebrink, Rebecca and Baptiste Caramiaux (2016): "The machine learning algorithm as creative musical tool." In: *Handbook of Algorithmic Music*.

Fletcher, Harvey and Wilden A Munson (1933): "Loudness, its definition, measurement and calculation." In: *Bell System Technical Journal*, **12**(4), pp. 377–430.

Fried, Ohad; Zeyu Jin; Reid Oda; and Adam Finkelstein (2014): "AudioQuilt: 2D Arrangements of Audio Samples using Metric Learning and Kernelized Sorting." In: *NIME*. pp. 281–286.

Gillet, Olivier and Gaël Richard (2006): "ENST-Drums: an extensive audio-visual database for drum signals processing." In: *ISMIR*. pp. 156–159.

Goto, Masataka; Hiroki Hashiguchi; Takuichi Nishimura; and Ryuichi Oka (2002): "RWC Music Database: Popular, Classical and Jazz Music Databases." In: *ISMIR*, vol. 2. pp. 287–288.

Kohonen, Teuvo (1990): "The self-organizing map." In: *Proceedings of the IEEE*, **78**(9), pp. 1464–1480.

Kohonen, Teuvo (1997): "Exploration of very large databases by self-organizing maps." In: *Proceedings of International Conference on Neural Networks (ICNN'97)*, vol. 1. IEEE, pp. PL1–PL6.

Lazar, Jonathan; Jinjuan Heidi Feng; and Harry Hochheiser (2017): *Research methods in human-computer interaction*. Morgan Kaufmann.

Lerch, Alexander (2012): *An introduction to audio content analysis: Applications in signal processing and music informatics*. Wiley-IEEE Press.

Lykartsis, Athanasios (2014): *Evaluation of accent-based rhythmic descriptors for genre classification of musical signals.* Master's thesis, Master's thesis, Audio Communication Group, Technische Universität Berlin ....

Mathieu, Benoit; Slim Essid; Thomas Fillon; Jacques Prado; and Gaël Richard (2010): "YAAFE, an Easy to Use and Efficient Audio Feature Extraction Software." In: *ISMIR*. pp. 441–446.

Mathieu, Benoit; Slim Essid; Thomas Fillon; Jacques Prado; and Gaël Richard (2019): "Yaafe - audio features extraction." URL `http://yaafe.sourceforge.net/`.

Mayring, Philipp (2010): "Qualitative Inhaltsanalyse." In: *Handbuch qualitative Forschung in der Psychologie*. Springer, pp. 601–613.

Merenyi, Erzsbet; Abha Jain; and Thomas Villmann (2007): "Explicit magnification control of self-organizing maps for "forbidden" data." In: *IEEE Transactions on Neural Networks*, **18**(3), pp. 786–797.

Moffat, David; David Ronan; Joshua D Reiss; et al. (2015): "An evaluation of audio feature extraction toolboxes." In: .

Rawlinson, Hugh; Nevo Segal; and Jakub Fiala (2015): "Meyda: an audio feature extraction library for the web audio api." In: *The 1st Web Audio Conference (WAC). Paris, Fr.*

Rawlinson, Hugh; Nevo Segal; and Jakub Fiala (2019a): "Meyda: Audio feature extraction for JavaScript." URL `https://github.com/meyda/meyda`.

Rawlinson, Hugh; Nevo Segal; and Jakub Fiala (2019b): "Meyda: Audio feature extraction for JavaScript." URL `https://meyda.js.org/audio-features`.

Scholler, Simon and Hendrik Purwins (2010): "Sparse coding for drum sound classification and its use as a similarity measure." In: *Proceedings of 3rd international workshop on Machine learning and music*. ACM, pp. 9–12.

Shier, Jordie; Kirk McNally; and George Tzanetakis (2017): "Analysis of Drum Machine Kick and Snare Sounds." In: *Audio Engineering Society Convention 143*. Audio Engineering Society.

Vagias, Wade M (2006): "Likert-type Scale Response Anchors. Clemson International Institute for Tourism." In: *& Research Development, Department of Parks, Recreation and Tourism Management, Clemson University.*

Vesanto, Juha; Johan Himberg; Esa Alhoniemi; and Juha Parhankangas (2000): "SOM toolbox for Matlab 5." In: *Helsinki University of Technology, Finland*, p. 109.

Villmann, Thomas and Jens Christian Claussen (2006): "Magnification control in self-organizing maps and neural gas." In: *Neural Computation*, **18**(2), pp. 446–469.

Appendices

A LaTeX Sources

The LaTeX sources for this work can be found in XXX.

B Thesis Bibliography

The references used in this work can be found in XXX.

Glossary

ID A name or number that identifies an object.

Acronyms

SOM Self-Organizing Map.

List of Figures

List of Listings

List of Tables

Digital Resource

This page holds a data disk.