Abstract

Introduction

Hypothesis

The question of if we can or can not universally and acurately identify acoustic music without the use of learning-based AI

Exploration of waveforms

Demonstration of the physical form of music notes (frequencies), as well as the structure and effects of chords on the waveform

Exploration of algorithms

Exploring the options in terms of existing mathematical algorithms (FFT, IFFT, wavelet).

Listing their pros and cons.

Experimentation on single notes

hypothesis: single notes can be identified from any instrument

steps:

implement chosen algorithm

repeat:

acquire instrument

observe waveform

record behaviour

define acceptance margin / accuracy rate

results:

proof or denial of plausability (based on prerequisite research, most likely proof)

accuracy data of instruments (how in-tune they are) leading to note clustering intervals

Experimentation on rithm

hypothesis: rithm can be identified based on the waveform

steps:

implement new layer of software

repeat:

acquire instrument

observe waveform

record behaviour

tweak software

define acceptance margin / accuracy rate

results:

proof or denial of plausability (based on prerequisite research, 75% sure of proof)

method for identification of rithm and time-based human readable output

Experimentation on chords

hypothesis: complex chords can be decoded and individual notes identified

steps:

implement new layer of software

repeat:

acquire instrument

observe waveform

record behaviour

tweak software

define acceptance margin / accuracy rate

results:

proof or denial of plausability (based on prerequisite research, result is unpredictable)

in case of a positive result: method for filtering played notes from instrument resonation notes

Resolution on accuracy / plausability

Based experiment results, determine the verdict of the hypothesis

Possible usecases

Based on overall result.

Prediction of possibilities based on positive result:

better playable storage format for acoustic musis

possible ouput of sheet music

Predictions based on any result:

confirmation of input audio against predetermined sequence (rithm games with real instriments)

References

[1] The Fast Fourier Transform - Ulrich Oberst - University of Innsbruck - January 2007

<https://www.researchgate.net/publication/220259110_The_Fast_Fourier_Transform>

[2] Bearing vibration detection and analysis using enhanced fast Fourier transform algorithm -

Hsiung-Cheng Lin, Yu-Chen Ye, Bo-Jyun Huang - October 2016

<https://journals.sagepub.com/doi/full/10.1177/1687814016675080>

[3] Audio Analysis using the Discrete Wavelet Transform - George Tzanetakis, Georg Essl, Perry Cook

<https://soundlab.cs.princeton.edu/publications/2001_amta_aadwt.pdf>

[4] Simultaneous Estimation of Chords and Musical Context From Audio - Matthias Mauch; Simon Dixon

<https://ieeexplore.ieee.org/document/5256327>

[5] Vibration parameter estimation methods for ultrasonic measurement systems - Kshetrimayum Milan Singh, Parasuraman Sumathi - July 2015

<https://ietresearch.onlinelibrary.wiley.com/doi/10.1049/iet-smt.2014.0176>

[6] Continuous wavelet transform for non-stationary vibration detection with phase-OTDR - Zengguang Qin, Liang Chen, and Xiaoyi Bao

<https://www.osapublishing.org/oe/fulltext.cfm?uri=oe-20-18-20459&id=240860>

[7] Application of Wavelet Transform and its Advantages Compared to Fourier Transform - M. Sifuzzaman, M.R. Islam and M.Z. Ali - September 27, 2009

<http://inet.vidyasagar.ac.in:8080/jspui/bitstream/123456789/779/2/Art11.pdf>

[8] Separation of adjacent interharmonics using maximum energy retrieving algorithm - Hsiung Cheng Lin - March 2016

<https://ietresearch.onlinelibrary.wiley.com/doi/10.1049/iet-smt.2015.0115>

[9] A Graphical Model for Recognizing Sung Melodies - Christopher Raphael

<https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.137.1147&rep=rep1&type=pdf>

[10] AUTOMATED SYNCHRONIZATION OF SCANNED SHEET MUSIC WITH AUDIO RECORDINGS - Frank Kurth, Meinard M̈uller, Christian Fremerey, Yoon-ha Chang, and Michael Clause

<https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.205.8799&rep=rep1&type=pdf>

[11] MIREX AUDIO CHORD DETECTION - Maksim Khadkevich, Maurizio Omologo

<https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.334.8317&rep=rep1&type=pdf>

[12] Large-Scale Study of Chord Estimation Algorithms Based on Chroma Representation and HMM -Helene Papadopoulos; Geoffroy Peeters

<https://ieeexplore.ieee.org/document/4275055>

[13] Simultaneous estimation of chord progression and downbeats from an audio file - Helene Papadopoulos; Geoffroy Peeters

<https://ieeexplore.ieee.org/document/4517561>

[14] Influences of Signal Processing, Tone Profiles, and Chord Progressions on a Model for Estimating the Musical Key from Audio - Katy Noland; Mark Sandler

<https://ieeexplore.ieee.org/document/6791997>

[15] Pitch Perception and Measurement - Roger Shepard

<https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.208.2386&rep=rep1&type=pdf>