

Form 3

論 文 要 旨

Abstract

論 文 題 目

音楽のシンボリックドメイン：アルゴリズムと応用に関する研究

Title

Studies on the Symbolic Domain of Music: Algorithms and Applications

Music – the language of the world. Since the invention of computers, music industry changed a lot. Computers now can synthesize music, edit music, and even compose music. The individual musical pieces are analyzed for pitches, tempo information, melodies, genre classification, etc. Musical pieces in huge databases are used for music recognition, analyzed for similarity, and music recommendation systems are being developed.

Music can be represented in computers using two different domains – the audio wave and symbolic domains. Music transcription systems are being developed to convert the individual pieces from the wave domain to the symbolic domain.

MIDI files are widely used to represent music in symbolic domain. They contain performance information about the individual notes of the musical piece. This makes them very convenient files for extracting various musical elements.

This thesis focuses on the MIDI files and describes many mechanisms for extracting musical information from them and a mechanism to write this information in the MIDI file, as long as applications of different character on these files.

This thesis describes a mechanism for estimating the tonality, modulations and functional harmonies of a piano piece in classical music based on theory of tonal music and pitch salience. This mechanism is unique in its ability to divide MIDI file into phrases where each phrase represents one harmony. Another mechanism for estimating the dynamics or loudness for a piano piece in MIDI based on the physical properties of acoustic pianos, and implementations of digital pianos is described. Melody line extracting in classical music is another mechanism described here based on the optimal path concept.

The thesis also describes many applications on MIDI files, namely, a MIDI visualizer based on the music content, and a steganography application for MIDI, and an application to embed watermark into the MIDI file.

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### 学位(博士)論文審査及び最終試験の終了報告書

学位(博士)の申請に対し、学位論文の審査及び最終試験を終了したので、下記の通り報告します。

記

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成績評価	学位論文	<input checked="" type="radio"/> 合格 <input type="radio"/> 不合格	最終試験 <input checked="" type="radio"/> 合格 <input type="radio"/> 不合格
論文題目	Studies on the Symbolic Domain of Music: Algorithms and Applications (音楽のシンボリックドメイン：アルゴリズムと応用に関する研究)		
審査要旨 (2000字以内)			
<p>This thesis focuses on the MIDI files and describes many mechanisms for extracting musical information from them and a mechanism to write this information in the MIDI file, as well as applications of different characters in these files.</p> <p>Since the invention of computers, music industry changed a lot. Computers now can synthesize music, edit music, and even compose music. The individual musical pieces are analyzed for pitches, tempo information, melodies, genre classification, and so forth. Musical pieces in huge databases are used for music recognition,</p>			

analyzed for similarity, and music recommendation systems are being developed.

Music can be represented in computers using two different domains – the audio wave and symbolic domains. Music transcription systems are being developed to convert the individual pieces from the wave domain to the symbolic domain.

MIDI files are widely used to represent music in symbolic domain. They contain performance information about the individual notes of the musical piece. This makes them very convenient files for extracting various musical elements.

This thesis describes:

(1) a mechanism for estimating the tonality, modulations and functional harmonies of a piano piece in classical music based on theory of tonal music and pitch salience. This mechanism is unique in its ability to divide MIDI file into phrases where each phrase represents one harmony.

(2) Another mechanism for estimating the dynamics or loudness for a piano piece in MIDI based on the physical properties of acoustic pianos, and implementations of digital pianos is described.

(3) Melody line extracting in classical music is another mechanism described here based on the optimal path concept.

The thesis also describes:

(4) many applications of MIDI files, namely, a MIDI visualizer based on the music content, and considers harmony, basses, chords and rhythm.

(5) Another application is steganography of MIDI which uses three different methods to embed data into the MIDI file. Up to 10 percent of the file size can be used for stegano messages.

(6) Another application is to embed watermarks into the MIDI file. The methods of embedment will make the music inaudible and robust and based on modulating the time and velocity on individual notes. Simulated attacks demonstrated high robustness and better transparency than existing methods.

(7) The thesis also describes MIDI tool C++ classes which were developed to analyze MIDI files, and an application “MIDI filters” was realized using these classes.

以上のように、本研究は、工学的に価値のある新しい成果を得ているため、提出された学位論文は博士の学位論文に値するものとして学位論文の審査を合格とする。また、論文発表会における発表ならびに質疑応答の結果、申請者は専門分野および関連分野の十分な知識ならびに本学大学院博士後期課程修了者として十分な研究能力を有していることが確認できたので最終試験も合格とする。