Sci-MIDI Toolbox

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Abstract

Sci-MIDI Toolbox provides a set of Scilab functions, which have versatile ways to analyze and compute MIDI files' data based in the Scilab computing environment. It contains extracting, computing and visualizing MIDI files' data which is relating to musical melodic notes and others information, besides basic manipulation, filtering, statistics and some algorithms that are often used involved in musical research. The development of the Toolbox is suitable for some research of music information retrieval, music emotion recognition and style classification and others using with MIDI data.

The aim of Sci-MIDI Toolbox is to provide the core representation and functions for manipulating and analyzing MIDI files in Scilab. Although MIDI data is not necessarily a good representation of music in general, it is also widespread among the research community as well as having wide users as music professionals, researchers and musicians, and it also suffices for many research questions dealing with concepts such as Music Information Retrieval, Melody Extraction, Query by humming, Music Cognition, and so on.

MIDI is a standardized protocol that allows electronic musical instruments to communicate with each other and with other storage devices. The musical data is encoded as symbols of events in MIDI. The event contains the information about the note number, time duration of the note to be played, pressure level of the key and information about the instrument that played the music. Although it is easy to get MIDI files, but it is a basic and fussy work to extract the information from binary files. So, the development of the Sci-MIDI Toolbox is to solve the difficulty.

The basic functions in Sci-MIDI Toolbox read and manipulate type 0 and type 1 MIDI files into Scilab. A MIDI file contains the most important information about onset time, MIDI channel, pitch, velocity and duration of each note. In the Toolbox, this information represent as a matrix which can be also created by a conversion function that reads into a MIDI file. Tick type information, tempo, key signature, meter signature, copyright notes, lyrics, track names, various types of controller data and changes in these across time are commonly included in MIDI files. Every type has a pair of functions including getting and setting. For example, there is a pair of functions like getTempo and setTempo for tempo.

In the Toolbox, there are some functions divided into several categories. Conversion functions read MIDI files into Scilab and export MIDI files from Scilab, whereas generation functions allow creating and playing note matrices from within Scilab, either by invoking an external MIDI player or synthesizing the note matrix and sending the resulting waveform to a soundcard using Scilab's own sound function. Various filter functions allow editing the musical material, including scaling, shifting, quantizing, transposing and time-windowing note matrices. Meta functions are designed to apply any function for a collection of note matrices. Plotting and statistical functions are also helpful in visualizing the structure of a note matrix either by displaying it using a piano roll notation or showing the distribution of certain types of events of a note matrix. These functions facilitate use of the remainder of function categories which could be called analytic functions such as key-finding, mete-

finding, segmentation and so on. Most of the functions in these categories involve cognitive models that are applied to a note matrix.

Next some main functions and manipulations are demonstrated:

Visualizing MIDI Data: Visualizing MIDI data functions display conventional piano roll notation. Two and three-dimensional plot the data using different colors can aid the interpretation of the data.

Melodic Contour: Melodic contour describes the overall shape of the melody. The contour representation of a melody is usually easier to remember than exact interval information and numerous music information retrieval systems use contour to find specific melodies from large music databases. The contour function can build a line representing a coarser melodic contour.

Key-Finding: the classic Krumhansl & Schmuckler key-finding algorithm is based on key profiles obtained from empirical work. The key profiles were obtained in a series of experiments, where listeners heard a context sequence, consisting of an incomplete major or minor scale or a chord cadence. In the Toolbox, some classic key-finding can be available.

Mete-Finding: another way of visualizing the possible meter of a note matrix is to display its note onset distribution in terms of the beat. Functions are used to plot the onset distribution of a MIDI file assuming a specific beat measure.

Melodic Segmentation: one of the fundamental processes in perceiving music is the segmentation of the auditory stream into smaller units, melodic phrases, motifs and such issues. Various computational approaches to segmentation have been taken.

Melodic Complexity: Occasionally, it is useful to know how complicated, difficult or entropy a melody is. There are many uses for a melodic complexity measure such as using it as an aid in classification of melodic material. One way of assessing melodic complexity is to focus on tonal and accent coherence, and to the amount of pitch skips and contour self-similarity the melody exhibits. And another measure is anchored in continuous measurement of note event distribution entropy.

Analyzing MIDI Collections: When loading all collecting songs saved in a Scilab matrix, we can investigate and calculate any property of the collection MIDI files with some functions.

Creating Sequences: The Toolbox may be used to create melodies and chord sequences that can, in turn, be saved as MIDI or synthesized audio files.

Key words: Scilab, MIDI Toolbox, functions, melody, note matrix