

Generating Guitar Scores from a MIDI Source

By

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December 13, 1997

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Outline of the Talk

- Introduction
- Related Work
- Software System Design
- Implementation
- Experimental Results
 - User Interface
 - Performance
- Conclusion

Introduction

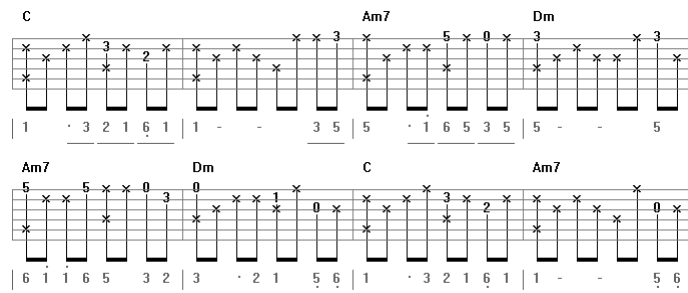
- **Most applications were developed to assist music professionals to create synthetical music.**
- **Amateur players need instrument-specific scores.**
- **Idea:** use computers to generate these scores from digital music sources.
- **Problem:** how to generate chords from music melody automatically?
- **Result:**
 - **A complete application that automatically generates six-line scores for guitars from a MIDI file.**
 - **An intuitive graphical user interface that allows customized scores (on chord selections or fingering styles).**

Related Work

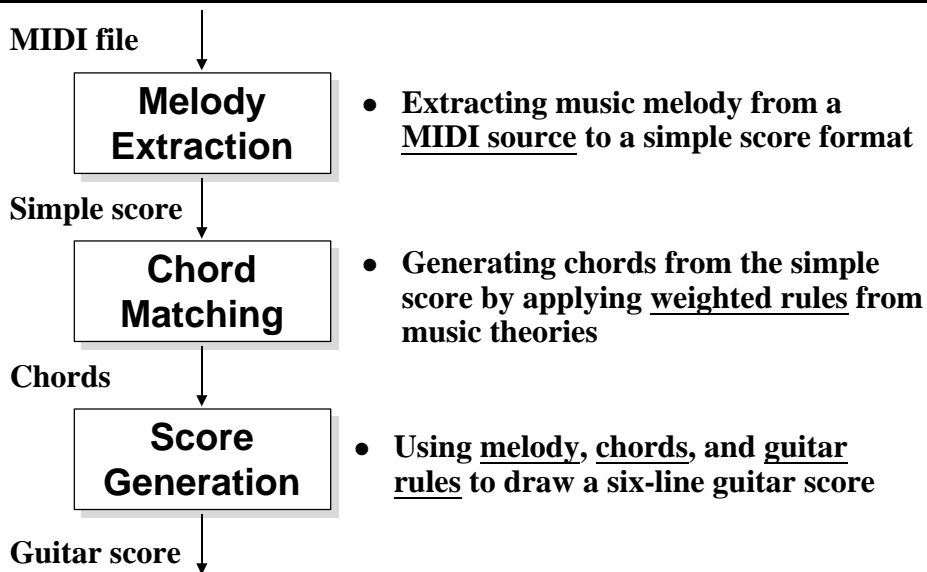
- **Researches in Computer Music**
 - **Computer-assisted music composition**
 - **Computer-assisted music analysis**
- **Primary users of the produced software**
 - **Music production:** professional music composer
 - **Music education:** students of music department
- **Computer-assisted course on theory learning:**
notes and rests, intervals, time signatures, key signatures, chords, staff writing, etc.
- **Computer-assisted course on music analysis:**
voice crossing, harmonics intervals, traid, etc.
- **Commercial Software**
 - **CakeWalk, Encore, etc.**

What We Have Developed

- A complete software package that generates guitar scores
 - Automatic guitar scoring from MIDI files
 - Customizable on chord selections and fingering styles
 - Playing the generated six-line scores in real time
 - Producing nice hardcopy of the guitar scores



System Description



Step 1: Melody Extraction

- **Choose a main channel for processing.**
- **Find the “Note Off” and “Note On” (8nh & 9nh) and use their running status to calculate the duration of each melody note.**
- **Use the FFh meta-events in channel messages to set up**
 - **tempo (51): 60**
 - **time signature (58): 4/4**
 - **key signature (59): C.**
- **Output melody in a simple score format**

Step 2: Chord Matching

- **No unique way to map notes into chords**
 - **Chord progression rules in harmonics**
 - **No quantitative definition for chord matching**
 - **A black art of music professionals**
- **Criteria for finding best-fit chords:**
 - **Melody matching**
 - **Chord progression**
 - **Lowest note**

Determining Sampling Frequency

- Based on the occurrences of different note periods.
- **Example:**
 - Sampling accuracy is up to an eighth note (e.g. T1213121) for a guitar playing a song in four-four time (4/4).
 - If 1/16 notes are two times more than 1/8 notes, choose half of a measure as a sampling period.

CMaj7

C Em C

A Measure

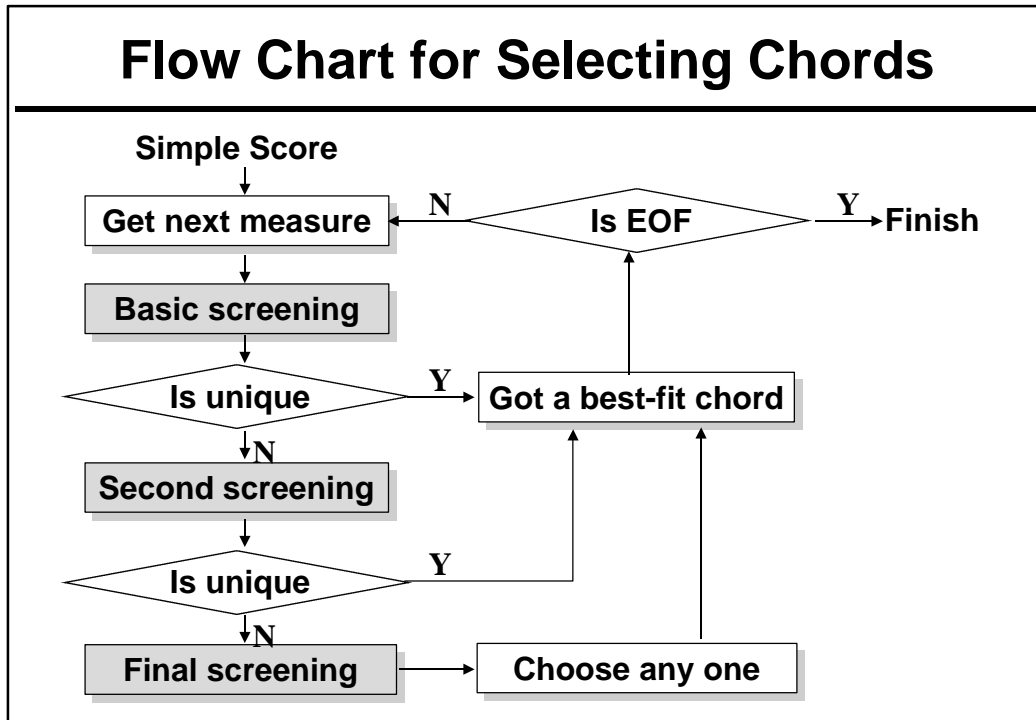
Half A Measure

Sampling Frequency

Chord matching: Sub-steps

- **Setting up weighted rules:**
 - Choose the best-fit chord set by evaluating each possible chord with weighted guidelines from the chord progression theories.
 - Weights in arbitrary units are given to guidelines according to their importance in practice.
- **Processing sub-steps:**
 - **Basic Screening:** melody matching
 - **Second Screening:** chord progression
 - **Final Screening:** lowest note

Flow Chart for Selecting Chords



Chord Matching: Basic Screening

- **Determining candidate chords**
 - finding all candidate chords whose constituent notes match any of the melody notes in a sampling period.
- **Dominant note** - the longest note
 - giving more weight to the chords containing the dominant note
- **Sharp and flat notes**
 - discarding chords that contain sharp and flat notes if the melody does not have any of them

Chord Matching: Second Screening

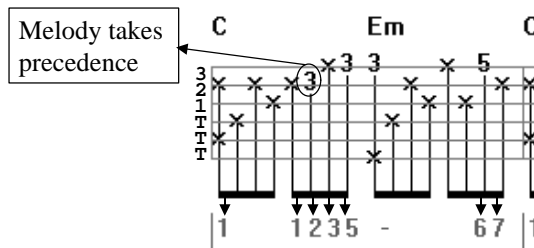
- **Chord progression theory**
 - a fifth downward, a third downward, and a second upward
- **Common rules**
 - For example, Golden Chords
 - I → III, VI → IV, etc.
- **Resolving dissonance**
 - For example, Dominant7 Chords
 - I₇ → IV, II₇ → V, VI₇ → II, etc.

Chord Matching: Final Screening

- **Finding the lowest note**
 - The lowest note is the most obvious sound in a chord.
 - Give two extra units of weight to the chords containing the lowest melody note in a sampling period
- **Final choice**
 - If there are still multiple choices at the end of applying these rules, the choice is arbitrary.

Step 3: Guitar Score Generation (1)

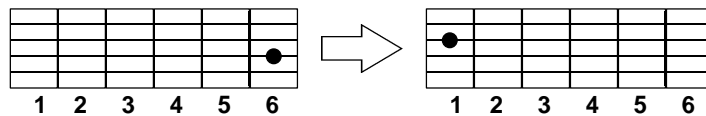
- **General Rules:** for a chosen fingering style
 - Raise melody notes by an octave.
 - Incorporate the raised melody notes into the chosen fingering style whenever possible.
 - Melody notes take precedence if there is a conflict.



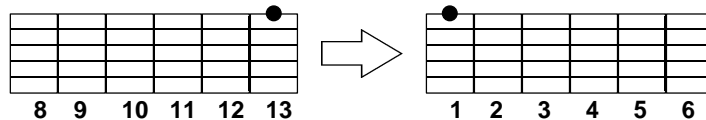
Fingering Style: TT213121 TT213121

Step 3: Guitar Score Generation (2)

- **Follow common guitar practice:** use the lowest five cells whenever possible.
 - Use the next string of higher pitch.



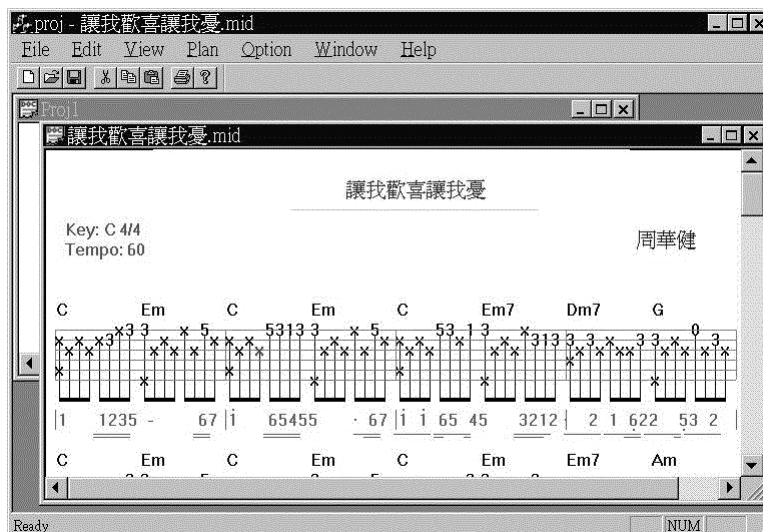
- **Lower melody notes by an octave.**



The Software Program

- **Implemented in Visual C++ for 32-bit Windows Environments.**
- **Features:**
 - **Multiple Document Interface**
 - **Customizable chord selection for each sampling period**
 - **Customizable fingering styles for each measure**
 - **Changeable tempo and key**
 - **Real-time playing instruction**
 - **Nice hardcopy**

Graphical User Interface

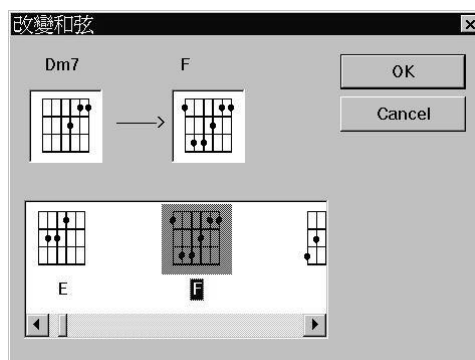


<http://www.cs.nccu.edu.tw/pub/li/packages/genchord.zip>

User Interface Allowing Customized Score

**Varying Fingering Style
for a range of measures**

**Modifying a Chord
for a specific measure**



System Performance

Example #	1	2	3
File Size (Bytes)	22605	13800	19300
Num. of Measures	59	78	42
Sampling Freq. (chords/measure)	2	1	1
Basic Screening	63 (54%)	41 (53%)	22 (52%)
Second Screening	13 (11%)	13 (17%)	6 (14%)
Final Screening	42 (35%)	24 (30%)	14 (33%)
Average Num. of Chords Left	2.85	3.50	2.04
Running Times(sec.)	0.38	0.27	0.16

Conclusion

- **We have designed and implemented a complete software package capable of generating guitar scores from a MIDI file automatically.**
- **We hope that this software can be beneficial to all amateur music players as well as the professions.**
- **Future Extensions:**
 - **Integrated sound-playing function**
 - **Input sources other than MIDI files**
 - **More objective measure of how chords match**
 - **Output other instrument-specific scores.**