Song Prompter: 歌詞とコードをスクロール表示するインタラクティブ演奏支援システム

Matthias Mauch† 藤原弘将† 後藤真孝†

我們提出 Song Prompter，一個互動演出助理，能以自動對齊文本和 MIDI 鼓的旋律線同步顯示歌詞和和弦，並支援歌曲節奏的曲速和音域變更。此外，Song Prompter 不僅支援不同音域的演奏，還能讓使用者在不同節奏和曲速的情況下同步進行練習和演奏。其設計理念是通過結合遊戲元素和現代音樂技術，為不同水準的音樂家提供一個互動演出助理。

1. Introduction

Song Prompter is a software system that acts as a performance assistant by showing horizontally scrolling lyrics and chords in a graphical user interface, together with an audio accompaniment consisting of bass and MIDI drums. Both alignment and accompaniment are automatically calculated from the original song recording. A song outline displays the song structure, including names and positions of sections for easy overview and navigation. Song Prompter enables users to sing and play live along the timeline of an original song, without having to memorize lyrics and chords or turning pages. Chord labels, and bass and audio playback can be transposed to a different key, and the playback speed can be changed.

† National Institute of Advanced Industrial Science and Technology (AIST)
Many usage scenarios are conceivable. For example, in a cover band rehearsal situation, a band member can propose a new song by his favourite artist, and the band can immediately start playing the song based on the lyrics, beats, and chord progression displayed in *Song Prompter*. When the band performs live, *Song Prompter* can literally act as an automatic prompter. In a more informal setting, it can be used when a party of friends want to sing together, and someone has brought along a guitar: *Song Prompter* is more convenient than song books because no pages need to be turned, and it prevents people from loosing track of the current song position (as often happens with static formats). Furthermore, since the text is scrolling, only a small portion of the lyrics need to be seen, and they can be displayed in a larger font than is possible in a static book format.

In Section 2 we will describe the *Song Prompter* interface in more details, and Section 3 explains the underlying music processing technology. We conclude with some initial experiences with the system and a look to the future in Section 4.

A demonstration of *Song Prompter* can be viewed online.

### 2. Interface

As can be seen in the screenshot (Figure 1) the user interface is divided into four parts, from top to bottom: the **status block** with the song title and detailed performance controls, the **song outline** providing global song information and navigation, the **song stream pane** containing the main display function of *Song Prompter*, and finally a set of easy access **transport control** buttons.

#### 2.1 Status Block

The status block (Figure 1) consists of two parts. On the left, the current song title is displayed, and on the right a panel allows to view and modify the playback parameters: bass on/off and bass volume, drums on/off and drum volume, playback of original recording on/off and volume, playback speed control, and key transpose control.

#### 2.2 Song Outline

The song outline enables a user to see the structure of the whole song including section titles, but also provides an efficient way of navigating this structure. The user can click/tap on a section to access it directly and playback position will be set to the beginning of the selected section. The time display has two functions: it displays the current elapsed song time both in digital form and in analog form by its position on the song outline, but also functions as a navigation device: the user can simply drag the time display to the desired position.

#### 2.3 Song Stream Pane

The song stream pane is the central display of *Song Prompter*, offering scrolling lyrics, chords, and beats synchronised to the timeline of the original recording of the song (see Figure 2). The display is designed so that lyrics and chords can easily be viewed at the same time, which is important for musicians both playing and singing. Diamond-shaped markers provide cues to where the beats are, larger markers mark the beginning of a bar (measure). The current song position is highlighted by pulsating beat marks, i.e. the beat marks enlarge at the current playback position. The playback position is additionally marked by a red triangle above the song stream pane. By dragging this triangle the display position can be adjusted to the left or right to suit the taste of the musician. Precise navigation in the song can be done by dragging the song stream pane directly.

To accommodate fast successions of lyrics without displaying overlapped words, the time line is stretched accordingly, similar to the variable lengths of bars (measures) in traditional sheet mu-
2.4 Transport Control

The large transport control buttons are located at the bottom of the display in order not to obstruct the view of the song stream pane when handling Song Prompter on a touch screen display. The buttons allow instant navigation to the previous or following song part as well as the traditional start/pause function.

3. Underlying Technology

Song Prompter is an interface to state-of-the-art music processing technology: lyrics-to-audio alignment and the automatic detection and re-synthesis of music from the original recording.

3.1 Lyrics-to-Audio Alignment

We use the automatic lyrics-to-audio alignment method proposed in\(^3\), which makes use of additional chord information. This is necessary when only a textual description of the lyrics and chords, and the audio waveform of the original recording are given (see Figure 4). Hence, no musical score input is needed. The method combines automatic parsing of the lyrics and chords, calculation of and chroma features\(^5\) and mel frequency cepstral coefficients (MFCCs) based on the segregated vocal signal\(^4\). The alignment method is an extension of 3) and uses hidden Markov models\(^8\), which is commonly used in speech recognition, but additionally models chords\(^6\). Once the alignment to the original audio has been performed, we know the position of every word and chord, but also every section of the song. This data is used in both the song outline and the song stream pane. The beat marks and larger bar marks complete the white song stream pane (see Figure). Their positions are obtained using either an established method\(^2\) or a novel, yet unpublished method.

3.2 Automatic Accompaniment Generation

Like in the case of lyrics-to-audio alignment, the accompaniment provided by Song Prompter is also automatically derived directly from an original audio recording. The drum accompaniment is realised as MIDI, based on the automatically extracted beat and bar times. The fundamental frequency and the amplitude of the partials in the bass line are estimated using PreFEst\(^4\), and are then re-synthesised during playback. The bass line can hence be transposed, sped up or slowed down. To achieve the same for the audio playback of the original recording, we use the implementation of granular synthesis provided in the Beads project\(^9\).

4. Discussion

Song Prompter is features on a unique combination of music processing methods and provides an interface to make them available to musicians. In our experience, the quality of the alignment is usually good enough to easily follow the song, and the flow in the song stream pane makes it easy for a musician to follow the song both in terms of lyrics

\(^{8}\) http://www.beadsproject.net/
and chords. For popular music, an additional synchronisation between a performer and the software does not seem strictly necessary because the tempo is usually meant to be stable, and it’s very easy to play along. However, in the future, we will investigate ways of robustly synchronising playback to the rhythm or harmony provided by the performer. Another possibility of improvement is to make the display more flexible: when vocals and the accompanying instrument (e.g. a guitar) are performed by two separate musicians, the vocalist usually does not require the chord flow in the song stream pane, and in the future we will add the option of separate lyrics and chord displays.

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References