

MOTION FEEDBACK IN TRAINING WITH MUSICAL LOUDNESS CHANGE

RUIYUN WANG, SHIN TAKAHASHI University of Tsukuba, wang@iplab.cs.tsukuba.ac.jp

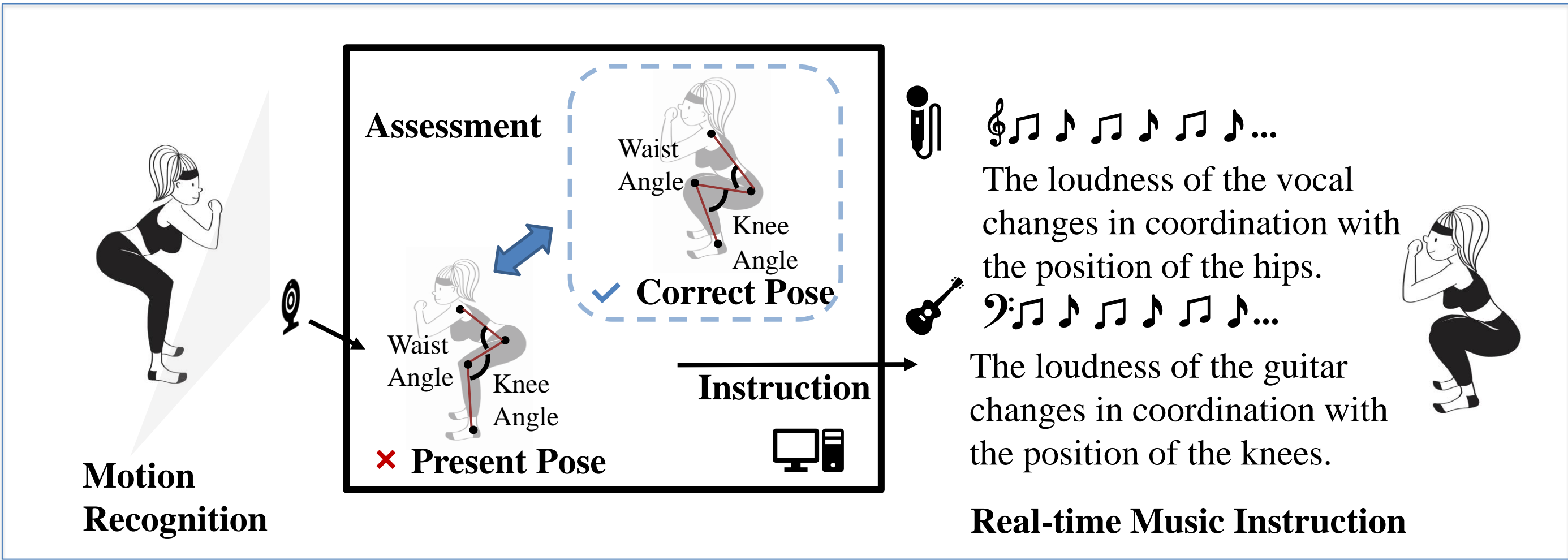


INTRODUCTION

Many sound interfaces have been proposed to support training. The sound interfaces using music always indicate the motion by a melody that corresponds to the user's movement.

In this study, we propose a feedback method to support training by music loudness. Specifically, the motion is indicated by the loudness change of each part (e.g., vocal, bass, drums, guitar) of the pop music. For example, a user doing squats can grasp the knee position by the loudness change of the guitar, which changes according to the knee angle. Meanwhile, the hip position could be grasped by the loudness change of the vocal.

A loudness perception experiment was performed to know how much the loudness change of vocal could be felt and investigate the possibility of training support by musical loudness.



Squatting Support by Musical Loudness

LOUDNESS PERCEPTION EXPERIMENT

In this experiment, we assume that the loudness changes by the partial body movements and analyze the loudness participants perceived while the vocal loudness is increased linearly.

Participants

We recruited 8 graduate students (4 males and 4 females) who are not majoring in music, aged 24 to 29 years.

Stimuli

We selected two pieces of pop music with relatively clear rhythms (loudness of the original music: -23LUFS). From each music, 15 segments of less than 15 seconds ({0-5, 5-10, 10-15} sec × 5 segments) were extracted. The loudness of the vocal in each segment was linearly increased from 0% to 149.8% (+3.5 dB) of the original music.

About the 30 experimental musical stimuli, 24 pieces ({0-5, 5-10, 10-15} sec × 8 segments) were used for the main experiment and 6 pieces({0-5, 5-10, 10-15} sec × 2 segments) were for practice.

Procedure

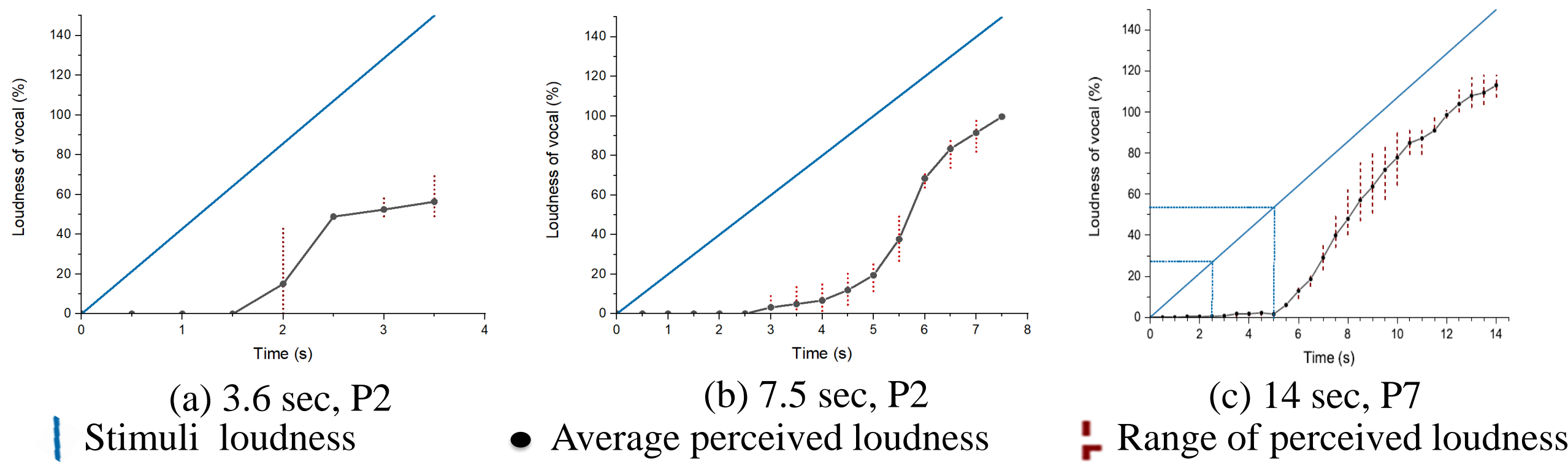
Before the experiment, the experimental music files (total listening time of two songs: about 7 minutes) were given to the participants. They were asked to listen to the music at least twice a day for four days or more.

The perception experiment was conducted after it was confirmed that the participants were familiar with the experimental music. The loudness was judged using cross-modality matching with a slider bar. The participants continuously adjusted the slider bar of the experimental software with a mouse to match the momentary loudness of the musical stimuli while it was being played.

The participants went through practice to get used to the experimental software before commencing with the main experiment.

Results

- I. When the duration of the musical stimulus was relatively short, it was difficult to perceive the vocal loudness correctly.
- II. The vocal was recognized after the loudness became more than 30% of the original song, and a linear change was felt after the loudness became more than 50% ($r>0.91$, $p<0.001$).



Example of perceived loudness

Duration of musical stimuli (sec)	Average perceived loudness
0-5 (Ave: 3.9)	67.8
5-10 (Ave: 8.0)	96.9
10-15 (Ave: 12.8)	106.3

Average perceived value at maximum loudness
(149.8% of the original)

Conclusion

In this study, we propose a feedback method for training support by changing the loudness of each part of the music with body movement.

Through the preliminary experiment, we investigated the loudness perception ability when vocal changes linearly. As a result, we found that users can feel the linear type loudness change of vocal when the duration of musical stimuli is relatively long.

FUTURE WORK

- Based on the results of the loudness perception experiment, implement the feedback to support the movement of a part of the body by the vocal loudness change.
- Investigate the loudness perception ability when the loudness of multiple parts of music change simultaneously.
- Examine the possibility of supporting the training that needs multiple parts of body movements by music loudness change.
- In the case that the loudness cannot be grasped clearly, the method of using words and music together will be considered.