

---

# Playing Air Guitar by Electrical Muscle Stimulation

**Shan-Yuan Teng**

National Taiwan University  
No. 1, Sec. 4, Roosevelt Rd.,  
Taipei, Taiwan  
tanyuan@cmlab.csie.ntu.edu.tw

**Jo-Hsi Tang**

National Taiwan University  
No. 1, Sec. 4, Roosevelt Rd.,  
Taipei, Taiwan  
jhtang@cmlab.csie.ntu.edu.tw

**Yi-Chi Liao**

National Taiwan University  
No. 1, Sec. 4, Roosevelt Rd.,  
Taipei, Taiwan  
yichi@cmlab.csie.ntu.edu.tw

**Rong-Hao Liang**

National Taiwan University  
No. 1, Sec. 4, Roosevelt Rd.,  
Taipei, Taiwan  
rhliang@ntu.edu.tw

**Bing-Yu Chen**

National Taiwan University  
No. 1, Sec. 4, Roosevelt Rd.,  
Taipei, Taiwan  
robin@ntu.edu.tw

**Abstract**

Playing air guitar is an enjoyable way to feel the music; however, it takes some skills to be capable of. We propose “EMS Air Guitar,” an air guitar assistant using electrical muscle stimulation (EMS), which impulses the user’s arm to generate the strumming motion on the right time. We found that EMS can be an effective tool to make the air guitar easier to learn and to play.

**Author Keywords**

EMS, Proprioceptive interaction, Musical performance

**ACM Classification Keywords**

H.5 Information interfaces and presentation: [HCI]

**Introduction**

Playing an air guitar is an enjoyable experience, in which performers express the music through their body. Though it seems easy at first sight, not everyone can play it well. An air guitarist needs to master several skills, such as body coordination, sense of groove, and imaginations to deliver delightful performances.

Following previous works [1,2], we propose “EMS Air Guitar,” an air guitar assistant using EMS to impulse user’s arm to generate the strumming motion on the right time. This approach further enhances the immersion of listening to the music. A player first

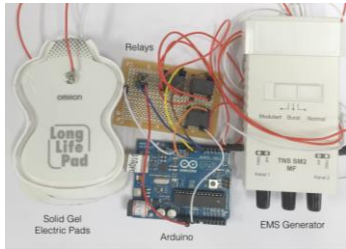


Figure 1: The components of our prototype.

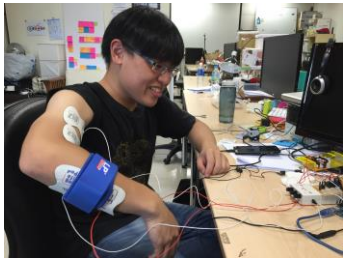


Figure 2: One participant performing air guitar with our EMS prototype.

chooses a piece of music in our system and wear on our prototype. Then, the music will be translated into pulses to the player's arm and wrist automatically.

### Implementation

As shown in Figure 1, our prototype includes: 1) a battery-powered (9V) two-channel EMS generator (TNS SM 2 MF) which produces a pulse waveform with a frequency of 25Hz and a pulse width of 290 $\mu$ s, 2) an Arduino Uno used for controlling the EMS generator through two relays, and 3) four solid gel electrical pads that would be attached on the human skin to transmit the pulses. We also translated a selected song with folk-rock strumming patterns into electrical patterns, which could be displayed using our prototypes.

### User Study

In the evaluation study (Figure 2), enjoyable level and comfortable level of two conditions were examined, where the two conditions were "playing air guitar with our EMS support" and "playing air guitar without any support,".

Six participants were recruited (3 females, age 22~23). Two participants have no previous experience on playing guitar, three participants are novices, and one participant is a skillful guitar player. All of them had no prior experience using EMS.

Before study, a calibration was conducted for each participant to obtain the suitable voltage that ensured visible muscle movement yet pain-free. For each condition, we played the same song with speaker, which took about 40 seconds, while the participants were told to play air guitar freely. After the study, the participants filled in a questionnaire comprised of 5-

level Likert scale questions with a short post-study interview.

The results showed that it's more enjoyable when playing with EMS air guitar (Mdn=4.5 of 5, IQR=1) than no-EMS condition (Mdn=3 of 5, IQR=1.5). Also, it's more comfortable when playing with EMS air guitar (Mdn=3.5 of 5, IQR=1) than without EMS (Mdn=2.5 of 5, IQR=1.75).

Most participants claimed that our prototype enriches the experience of feeling to music, and playing air-guitar with EMS is easy to understand and control. Some participants with guitar-playing experience further suggested that enabling more complicated motions with EMS might provide more exciting experience.

### Conclusion

We propose EMS Air Guitar which is an effective and enjoyable solution for users without instrument-playing experiences to learn and play expressive air guitar. Future work considers enabling more challenging and rich guitar motions.

### References

1. Emi Tamaki, Takashi Miyaki, and Jun Rekimoto. 2011. PossessedHand: techniques for controlling human hands using electrical muscles stimuli. In *Proc. ACM CHI '11*. DOI=<http://dx.doi.org/10.1145/1978942.1979018>
2. Pedro Lopes and Patrick Baudisch. 2013. Muscle-propelled force feedback: bringing force feedback to mobile devices. In *Proc ACM CHI '13*. DOI=<http://dx.doi.org/10.1145/2470654.2481355>