When Counterpoint Meets Chinese Folk Melodies

Nan Jiang†, Sheng Jin†, Zhiyao Duan†, Changshui Zhang†
† Institute for Artificial Intelligence, Tsinghua University (THUAI),
State Key Lab of Intelligent Technologies and Systems,
Beijing National Research Center for Information Science and Technology (BNRist),
Department of Automation, Tsinghua University, Beijing, China
‡ Department of Electrical and Computer Engineering, University of Rochester

Introduction

Human-machine collaborative duet improvisation.
✓ Chinese folk melody style
✓ Counterpoint interaction between parts

Task: Incorporating Western counterpoint interactions into Chinese folk melodies for online Human-machine collaborative duet improvisation.

- Chinese folk melody: typically presented in a monophonic form or with accompaniments that are less melodic.
- Counterpoint: mediation of two or more musical voices into a meaningful and pleasing whole.

Challenges

- Out-of-domain data (Chinese folk duets are scarce)
- Monophonic Chinese folk melodies + Bach chorales
- Counterpoint pattern is coupled with western-music style pattern
- Extract counterpoint interaction pattern & eliminate western-music style

Our Solutions

- Reinforcement Learning → Design task-specific reward functions
- Measure counterpoint interaction using mutual information

FolkDuet

Framework of FolkDuet: a Generator and two Rewarders, i.e. Inter-Rewarder and Style-Rewarder. The Generator is trained using reinforcement learning with these two rewards.

- Inter-Rewarder: measures the degree of interaction between human and machine parts through a mutual information informed measure.

- Style-Rewarder: Inverse Reinforcement learning (IRL): learns to infer a reward function underlying the observed expert behavior.

- Style-Rewarder is alternatively updated using the maximum entropy inverse reinforcement learning. Its learning objective is to infer the reward function that underlies the demonstrated expert behavior, i.e. the Chinese folk melodies.

Architectures

- Generator
- Style-Rewarder
- Inter-Rewarder

Results

Generated Duets

Can interaction reward reflect counterpoint interaction?

We compare the interaction reward of the original Bach’s duets (raw), duets of two randomly shuffled parts (shuffle), duets with random notes in the machine part (M-random), duets with random notes in the human part (H-random), duets of parallel human and machine parts (parallel), and duets of duplicate parts (duplicate). It shows that this interaction reward achieves the highest score on the original duets.

Objective Evaluation

Subjective Evaluation

Subjective listening tests show that FolkDuet obtains higher scores than the MLE baseline, from three perspectives, i.e. the harmonic appealingness of the duets, the melodic appealingness and the prominence of the Chinese folk style of the generated duets.