



Computer-Assisted Orchestration and Texture Generation

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Introduction

- ◆ Timbre is one of the most important factors that composer would think of when composing, and orchestration plays an essential role when realizing a timbre instrumentally. Therefore, with the growth of artificial intelligent algorithms, developing a model to aid composers explore the possibilities of orchestration has drawn a lot of attentions of researchers in the field of music technology.
- ◆ Existing models of auto-orchestration highly relies on prior inputs. For instance, some require piano scores which contain pitch and rhythm information for all notes[1][2]; some demand a target sound as input and search through a huge database to find the most likely combination of notes for numbers of instruments[3].
- ◆ However, in real-world cases, another common approach of sound designing is to have a rough imagination of the sound in minds without notes and targets, but with some descriptions that matches the desire timbre. In other words, the orchestration result is generated given some specific conditions. Considering this case, I proposed a problem for orchestration score generation using generative neural networks constrained by some musical conditions, like the nature of musical instruments, the morphology of desired timbre, and the complexity of the texture. The NN will study from composed orchestra scores to learn musically reasonable ways of doing orchestration.

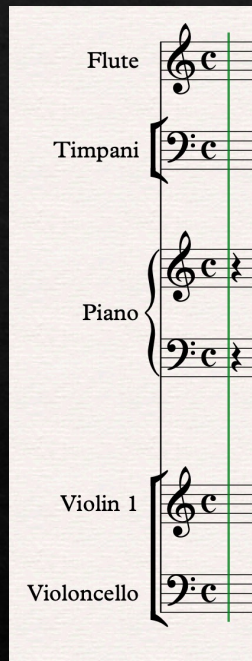
Problem statement

- ◆ Generate a musically reasonable score given the following constraints:
 - configuration(what instruments to use)
 - morphology
 - textural complexity

Use case

◆ Condition 1: Given a configuration + register + some parameters

◆ Instruments:



Flute

Timpani

Piano

Violin 1

Violoncello

◆ Register:

C, E, G

◆ Parameters:

Length: 1 measure

Dynamics: Forte

◆ Result 1:



Flute

Timpani

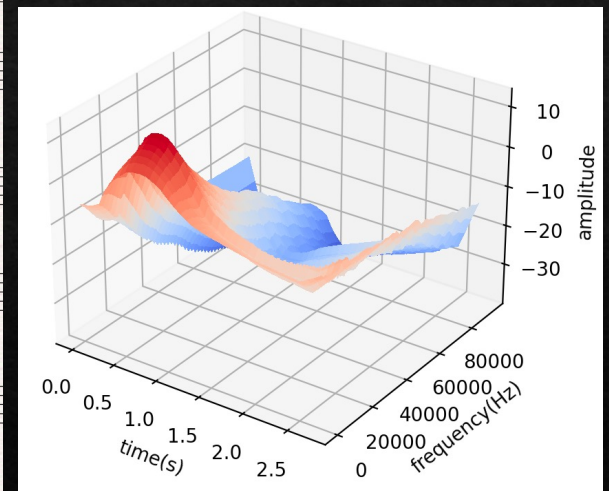
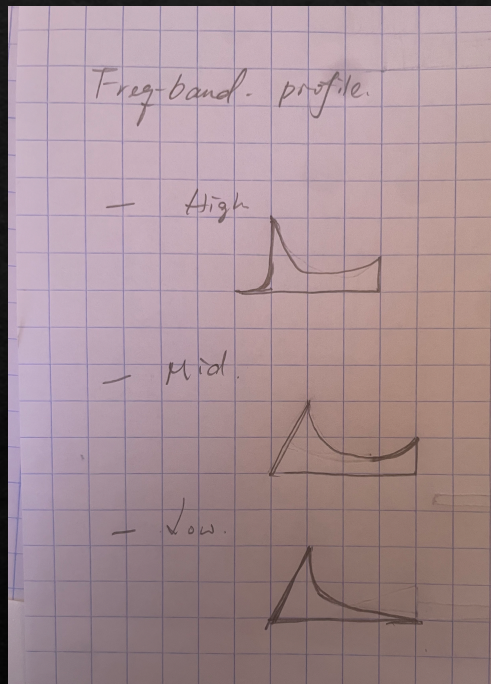
Piano

Violin 1

Violoncello

Use case

- ◆ Condition 2: Given a morphology adjustment
- ◆ Draw a 'profile'
- ◆ Result 2:



Use case

◆ Condition 3 Higher textural complexity

- ◆ Low frequency band:
Increase temporal
complexity
- ◆ Mid frequency band:
Increase both temporal
and pitch sequence
complexity
- ◆ High frequency band:
Same

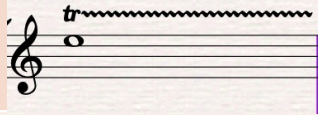
◆ Result 3:

A musical score for five instruments: Flute, Timpani, Piano, Violin, and Violoncello. The score is written in common time (C) and features various dynamic markings and articulations.

- Flute:** Starts with a whole rest, followed by a half note G4, then a half note A4. Dynamics: *sf* (sforzando) and *f* (forte).
- Timpani:** Starts with a whole rest, followed by a half note G2, then a half note A2. Dynamics: *p* (piano) and *f* (forte).
- Piano:** Starts with a whole rest, followed by a half note G2, then a half note A2. Dynamics: *f* (forte).
- Violin:** Starts with a whole rest, followed by a half note G4, then a half note A4. Dynamics: *mp* (mezzo-piano) and *f* (forte). The notation includes a *div.* (divisi) marking.
- Violoncello:** Starts with a whole rest, followed by a half note G2, then a half note A2. Dynamics: *mp* (mezzo-piano) and *f* (forte).

Notations

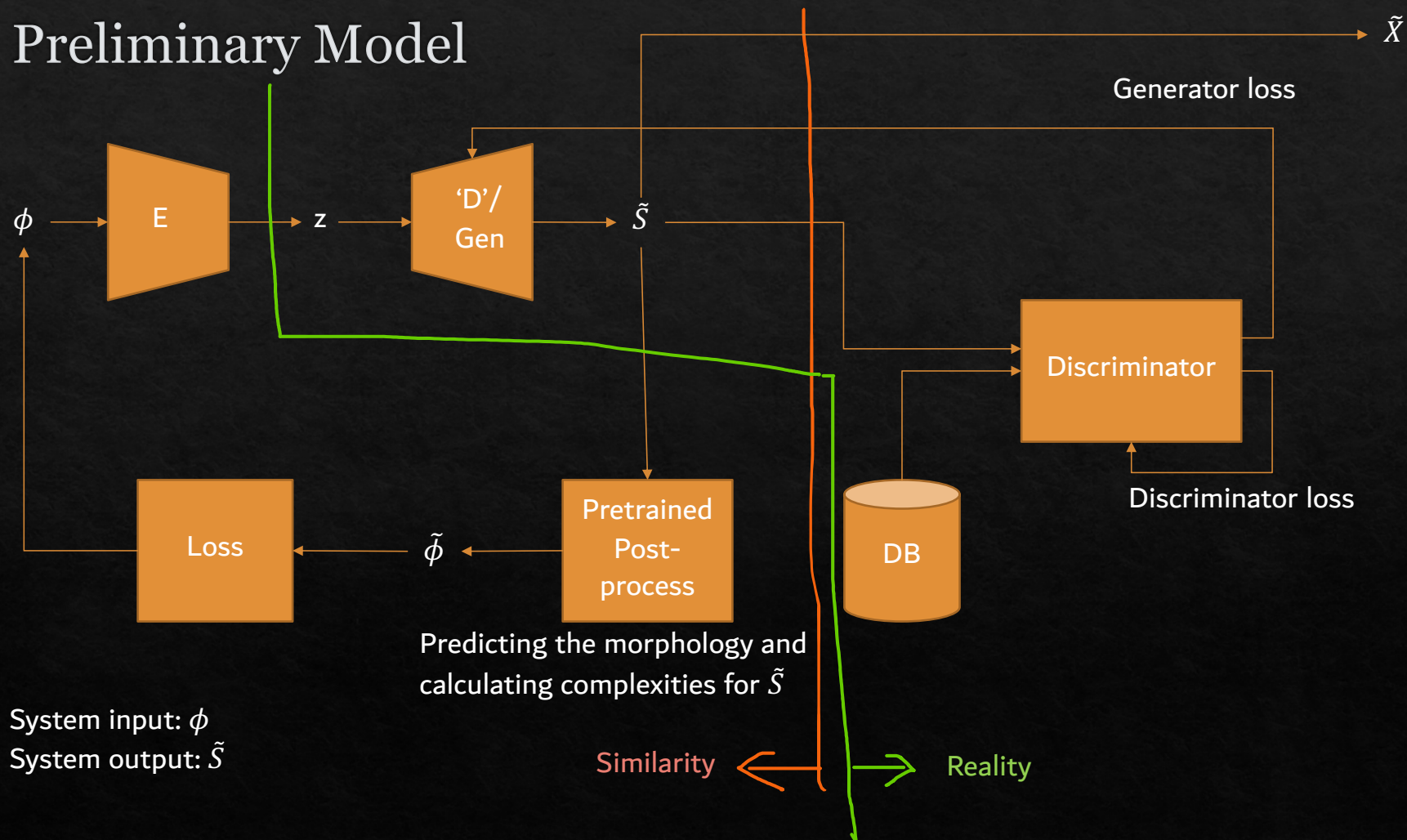
- ❖ X: sound
- ❖ S: symbolic representation of scores
- ❖ ϕ : parameters (will explain)
 - ❖ Morphology: time-frequency-amplitude 3D surface
 - ❖ Textural complexity:
 - ❖ Pitch complexity: counts of pitch alteration in a time unit(measure/ sec)
 - ❖ Tempo complexity: counts of new transient in a time unit

Articulation	Score	Pitch complexity	Tempo complexity
Trill		15	16
Tremolo		0	16
Gliss		7	1

Problem Analysis

- ◇ Generate a musically reasonable score given the following constraints:
 - configuration(what instruments to use)
 - morphology
 - textural complexity
- ◇ Two sub problems:
 - ◇ Similarity in parameter space → Encoder-Decoder structure regressor
 - ◇ Reality in symbol space → GAN model

Preliminary Model



Reference

- [1] L. Crestel and P. Esling, “Live orchestral piano, a system for real-time orchestral music generation,” *Proc. 14th Sound Music Comput. Conf. 2017, SMC 2017*, pp. 434–442, 2019.
- [2] H.-W. Dong, C. Donahue, T. Berg-Kirkpatrick, and J. McAuley, “Towards Automatic Instrumentation by Learning to Separate Parts in Symbolic Multitrack Music,” 2021.
- [3] C. Cella, “Orchidea : a comprehensive framework for target-based computer-assisted dynamic orchestration,” pp. 1–44, 2021.