

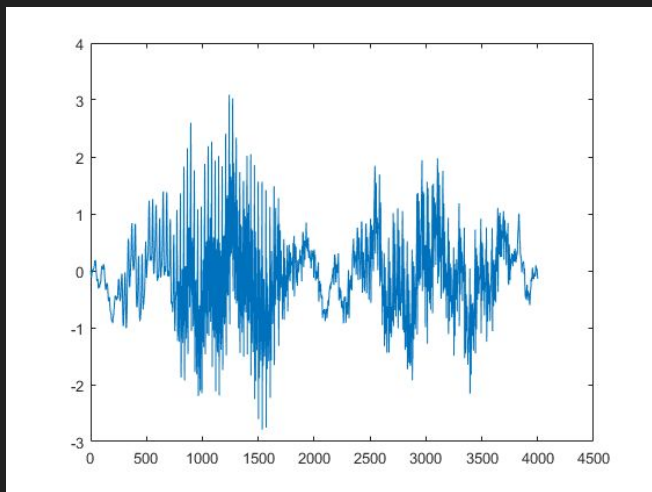
Predicting synthesizer parameters to mimic a sound

Deep Reinforcement Learning applied to sound
synthesis

Frédéric Tamagnan's proposal for a research internship

Sound synthesis : a daily-issue for musicians

How to mimic/reproduce a sound that i'm listening with my synthesizer ?



Bassline from a song



Which values of my synthesizer parameters to choose to mimic it ? Cutoff, Resonance, Envelope, etc

Predicting parameters to mimic a sound

Parameters can be continuous (ex : VCF freq) or categorical (ex : type of waveform).

Goal : Predicting a set of *parameters* to approximate this sound with a given synthesizer.

Sound synthesis : a reinforcement learning approach

Agent state representation

Observation : current parameters + sound produced by the synthesizer with current parameters

Reward : Similarity measure between original sound and sound produced by the synthesizer with current parameters

Environment state representation

Action : small variation of a parameter



Examples of variations

Variation of
waveform

Variation of Attack

Variation of LFO

Initial Preset



Open issues for this problem

- Which deep reinforcement learning algorithm to choose -> Deep Q learning ? in this case, we have to discretize parameters (discrete actions space). Deep Deterministic Policy Gradient instead ? in order to keep a continuous action space.
- How to extract relevant features from a sound, which transformation to use ? raw amplitude vs spectrogram, etc
- Which architecture of neural networks to use ? CNN (for a spectrogram input) vs RNN (for raw amplitude input) vs ...

Open issues for this problem

- Which reward function to use ? (similarity measure between original sound and sound produced by the synthesizer with the actual parameters ? or similarity measure between true parameters and predicted parameters ?)
- How to deal with the pitch of the input ? Does the system have to be invariant by pitch ? How to deal with a complex-chord as an input ?

Bibliography

1. Lai, Yung - Hsiang, Shyh-Kang Jeng, D. Liu and Yuanchuan Liu. "Automated Optimization of Parameters for Fm Sound Synthesis with Genetic Algorithms." (2006).
2. Diemo Schwarz. State of the Art in Sound Texture Synthesis. Digital Audio Effects (DAFx), Sep 2011, Paris, France.
3. Lillicrap, Timothy P., et al. "Continuous control with deep reinforcement learning." arXiv preprint arXiv:1509.02971 (2015).
4. Mnih, Volodymyr, et al. "Playing atari with deep reinforcement learning." arXiv preprint arXiv:1312.5602 (2013).
5. Arulkumaran, Kai, et al. "A brief survey of deep reinforcement learning." arXiv preprint arXiv:1708.05866 (2017).