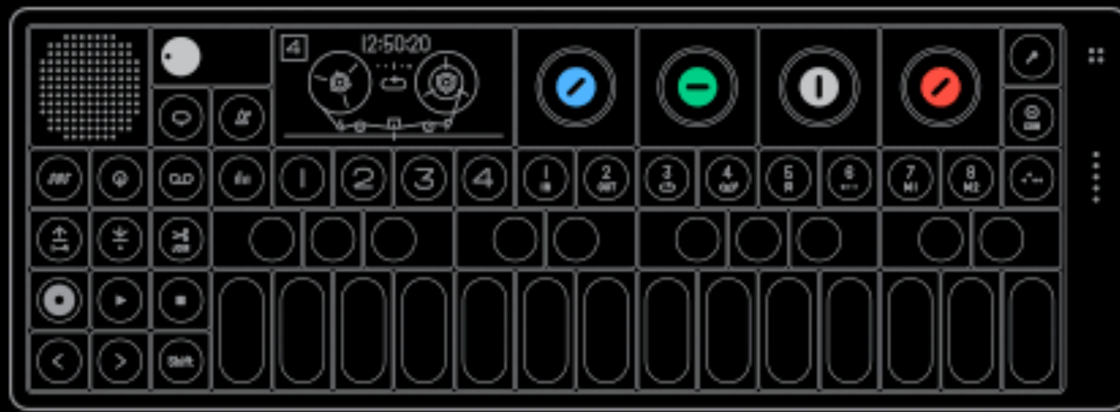

Automatic Synthesizer Preset Generation with PresetGen

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The preset generation problem

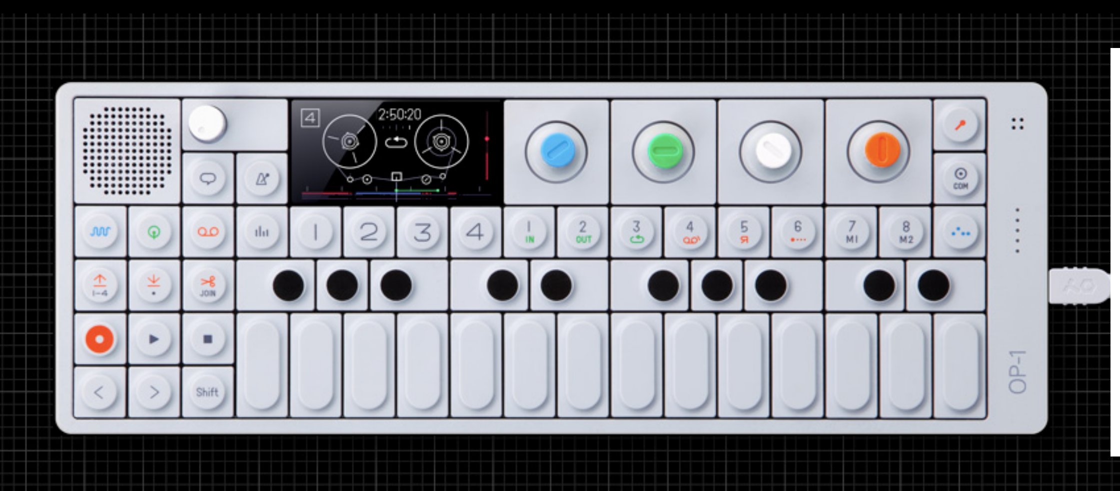
- Modern synthesizers are very powerful and have many parameters resulting in a vast and complex search space.
- The possibilities of a given synthesizer are unknowns and the search space is beyond human grasp.
- Preset search is time-consuming and tedious.
  - Musicians and sound designers spend time tuning parameters instead of making music.
  - The solution found might not be optimal

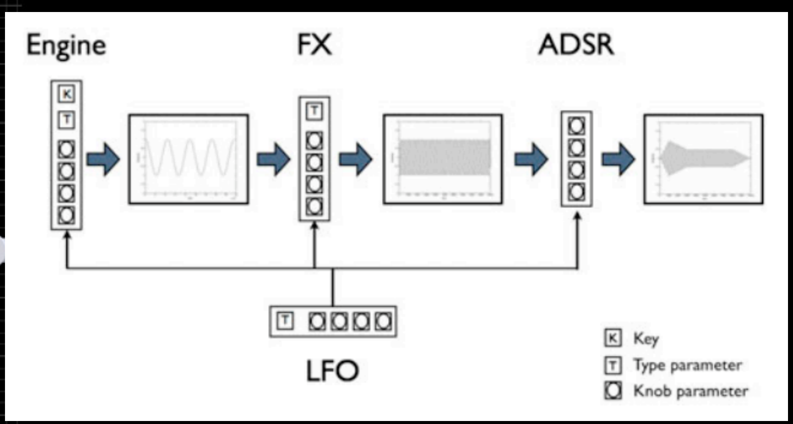
➡ We want to automate preset generation:
Given a target sound, and a synthesizer, give me a preset for that sound.

Example synthesizer: the OP-1

- The OP-1 is a commercial synthesizer that has a very large presets search space:
  - 7 synthesis engines
  - 3 types of LFO (Low frequency oscillators)
  - 4 types of special effects
  - 120 keys

  (The first three items are bracketed together:) Each with 4 parameters with 32767 possible values each
- The total number of distinct presets is of the order of 10^{76}
- Added challenges: The space is highly discontinuous and the synthesis engines are non-deterministic (adding warmth to the sound).





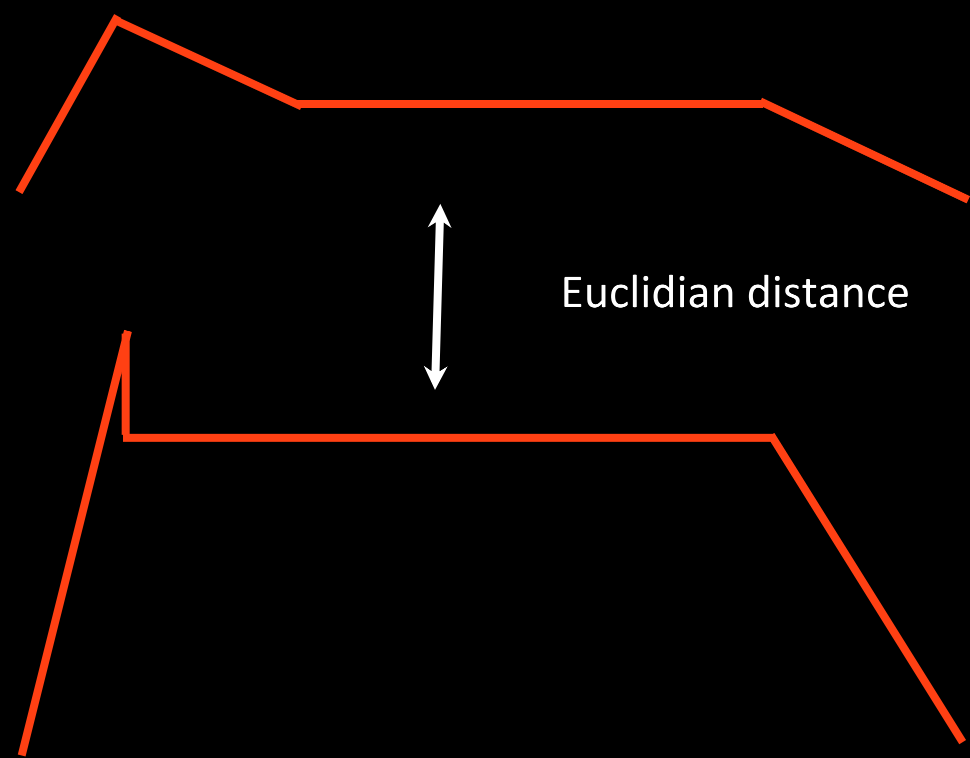
Our solution: PresetGen

- We use evolutionary algorithms to locate multiple distinct OP-1 presets to replicate a given target sound
- We minimize the 3 objectives distances (Envelope, FFT, STFT) using a multi-objective genetic algorithm: the Non-dominated Sorting Genetic Algorithm-II (NSGA-II)

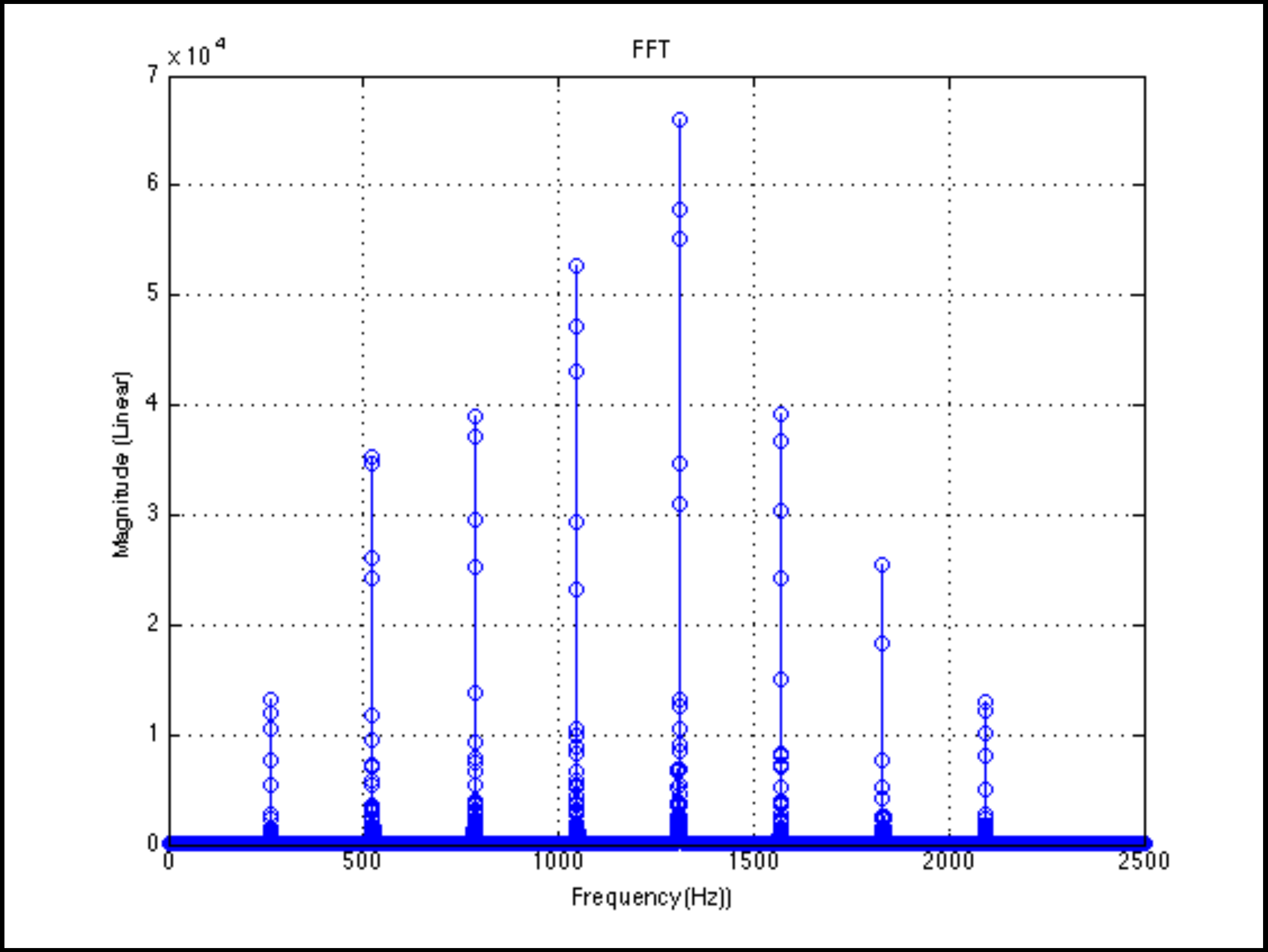
1st Objective: Temporal envelope distance

Target sound

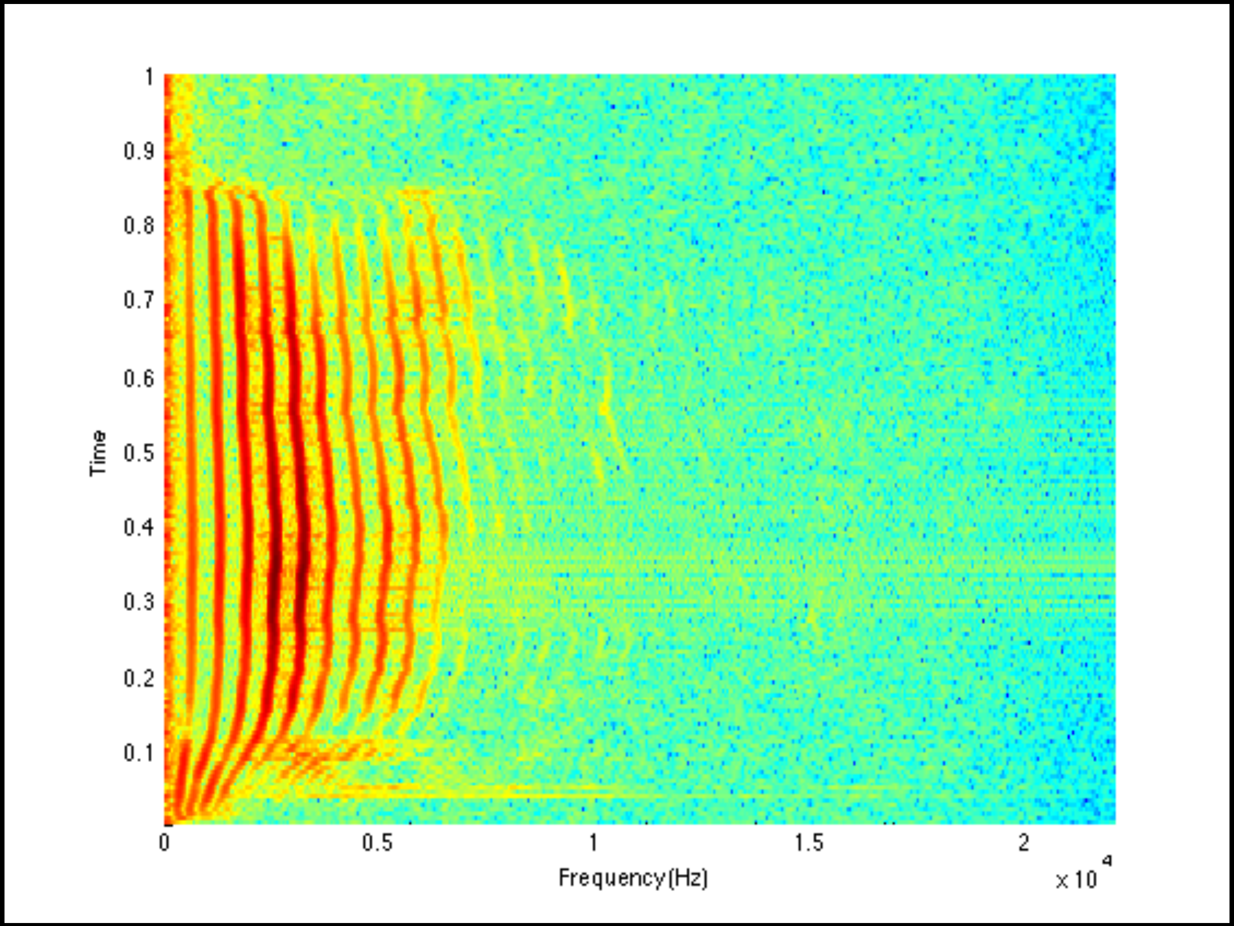
OP-1 generated sound



2^{nd} objective: FFT distance for spectral signature



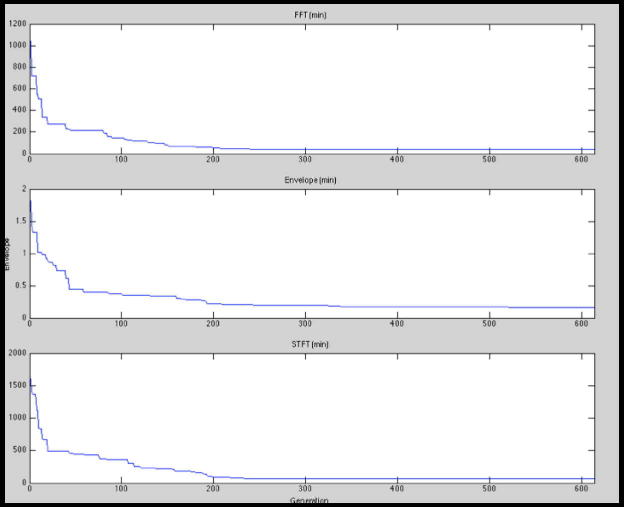
3^{rd} objective: STFT distance for spectral content dynamic



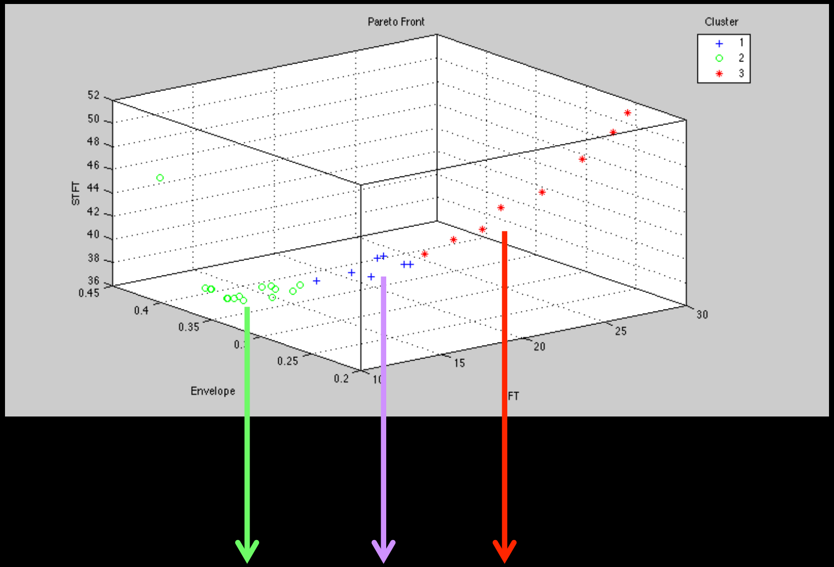
Results

1. We analyse the target sound

2. We evolve presets

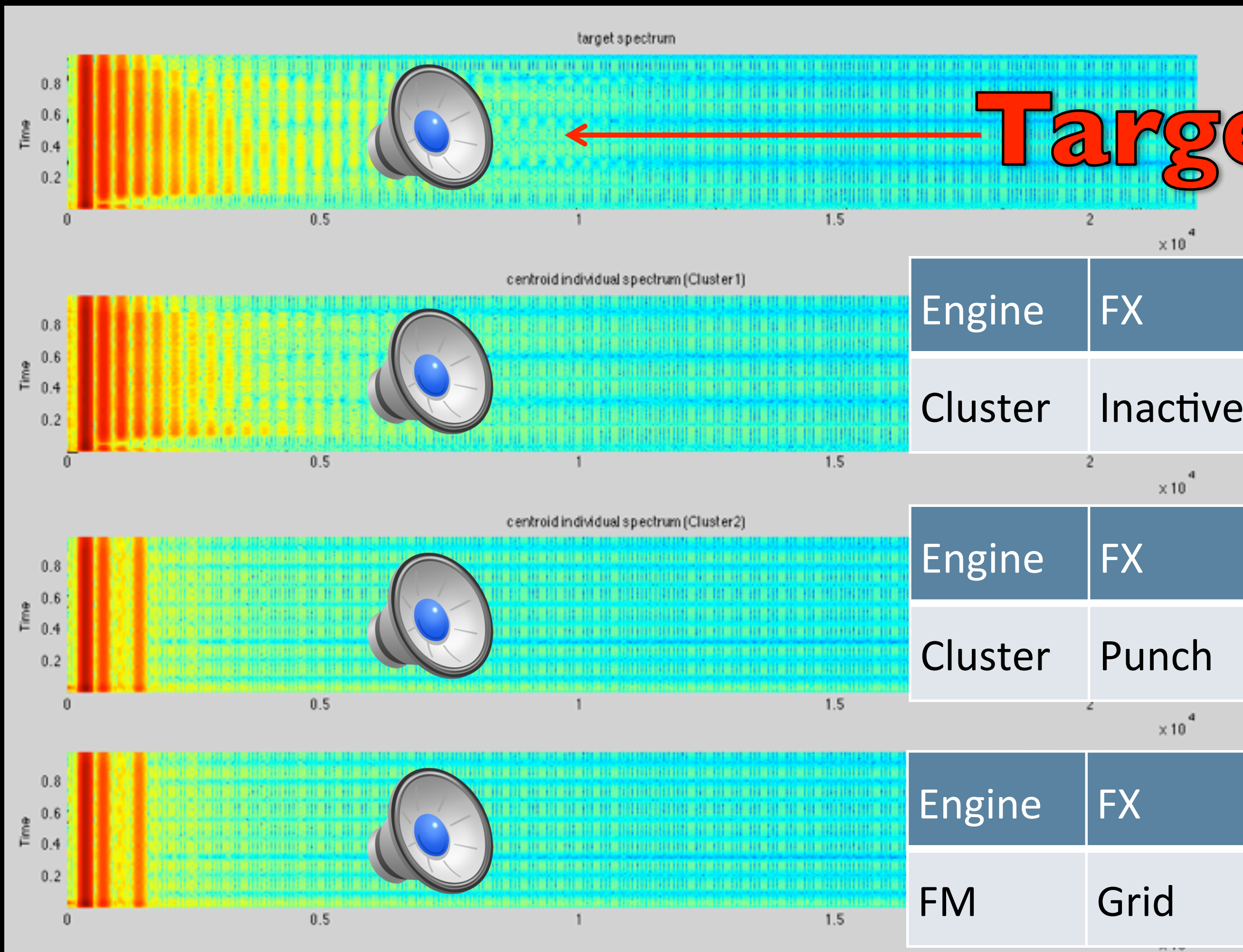


3. We cluster the Pareto front



4. We return a variety of presets that approximate the target sound using various synthesis methods!

Examples

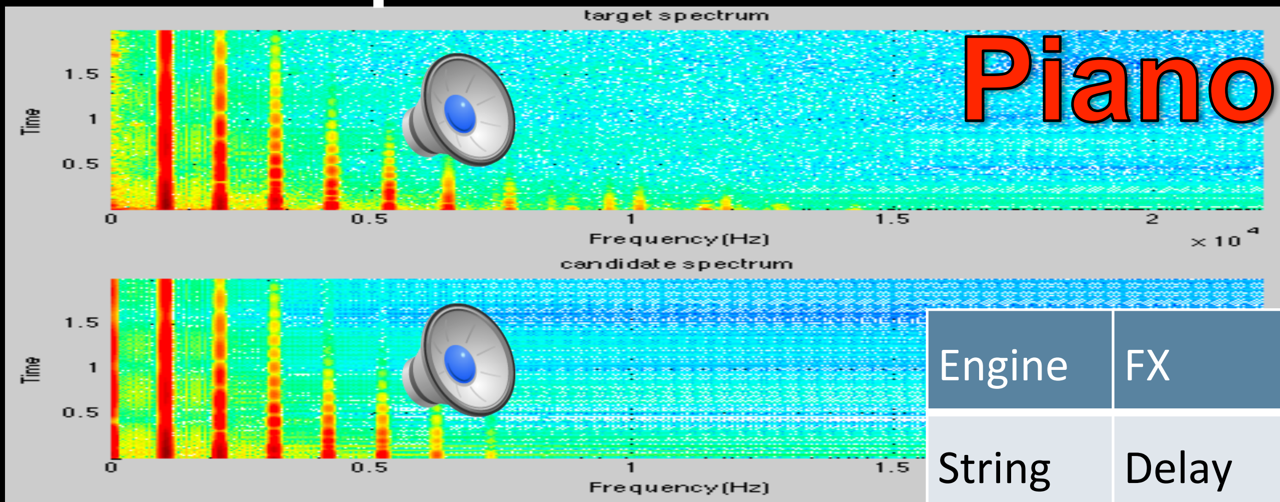


Engine	FX	LFO	Key	Octave
Cluster	Inactive	Inactive	12	0

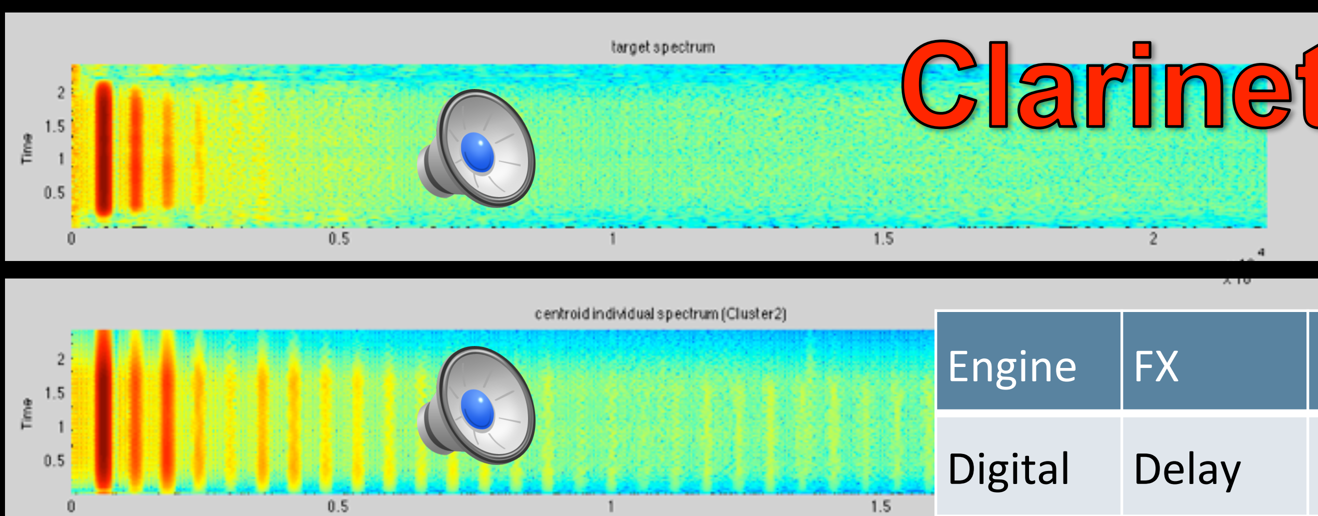
Engine	FX	LFO	Key	Octave
Cluster	Punch	Inactive	0	1

Engine	FX	LFO	Key	Octave
FM	Grid	Element	0	1

Examples of instruments



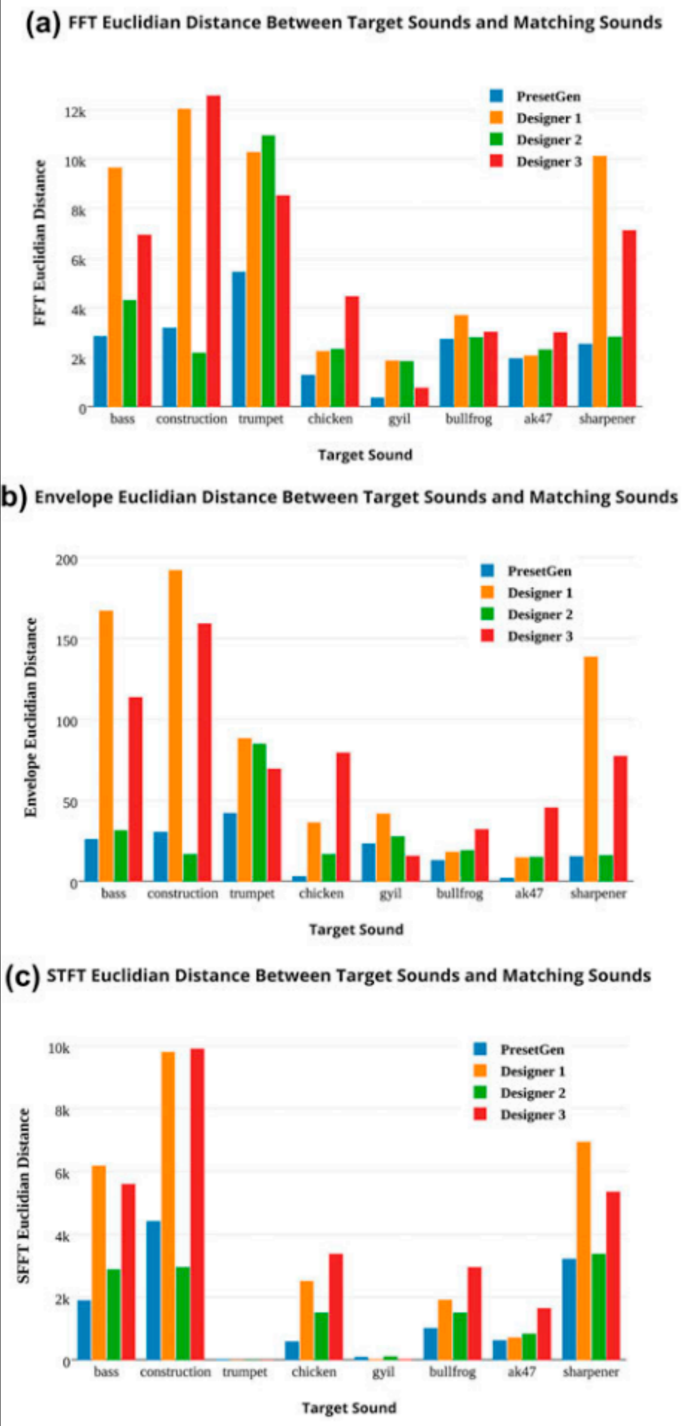
Engine	FX	LFO	Key	Octave
String	Delay	Tremolo	44	1



Engine	FX	LFO	Key	Octave
Digital	Delay	Tremolo	9	1

Empirical Evaluation

- PresetGen compared to human sound designers.
  - 8 target sounds:
  - 3 human sound designer
  - 14 auditors judge similarity across dimensions.
- Results:
  - PresetGen sounds rated more similar to target (avg 17%)
  - PresetGen outperform humans at the task both in competency and efficiency.



In Conclusion:

PresetGen automates a creative task to human competitive levels and would fit well at a computer-assisted creativity tools in many synthesizers.

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