

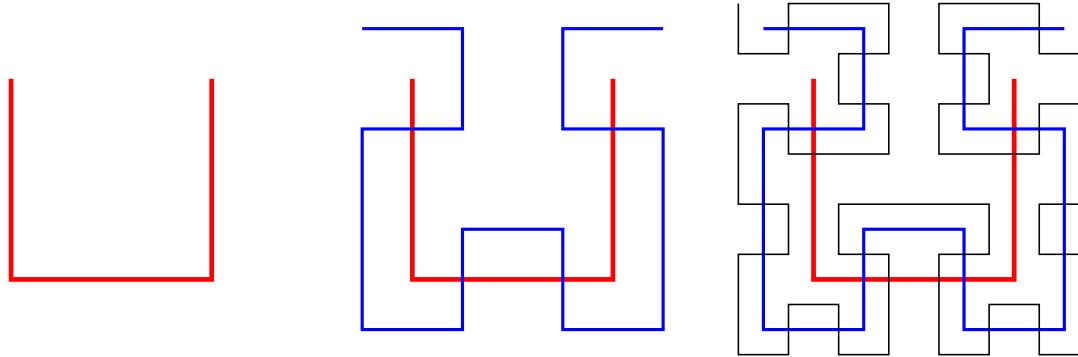
Hilly Sounds

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CS 410 and 410P

What is Hilly Sounds?

Hilbert curve



Hilbert Curve, first to third orders

- Space filling curve discovered by mathematician David Hilbert.
- Based on simple production rules that can be applied repeatedly.
- Fills n -dimensional space when taken to its limit.
- For k iterations for $n = 2$, we get a grid with side length 2^k .

Encoding and decoding

Assume we are dealing with RGB color space in a two-dimensional image. We are given a color mapping $C : \mathbb{R} \rightarrow \mathbb{R}^3$ and space mapping $S : \mathbb{R} \rightarrow \mathbb{R}^2$, as well as the inverse color functions $C^{-1} : \mathbb{R}^3 \rightarrow \mathbb{R}$.

Encoding

For each sound sample s at time t ,

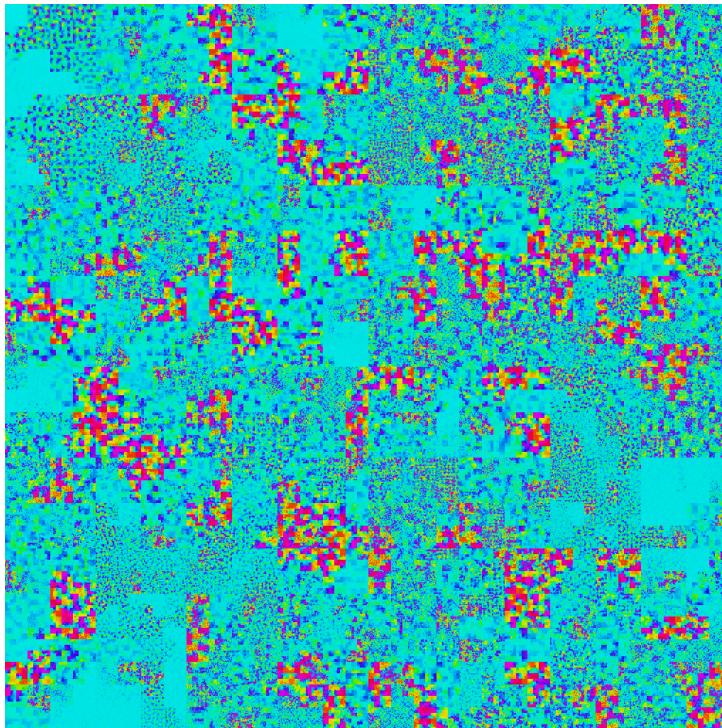
1. Convert the sample to a color (r, g, b) by $C(s)$.
2. Find the corresponding position (x, y) by $S(t)$.
3. Write the color to the position in the image.

Decoding

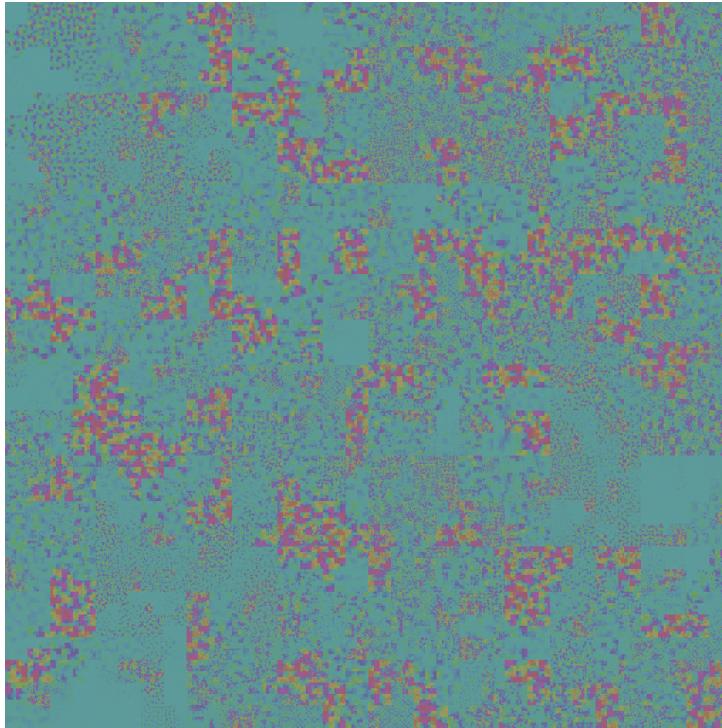
To find the sound sample s at time t :

1. Find the corresponding position (x, y) by $S(t)$.
2. Read the pixel (r, g, b) from the image at that position.
3. Convert the pixel data to the sample s by $C^{-1}(r, g, b)$.

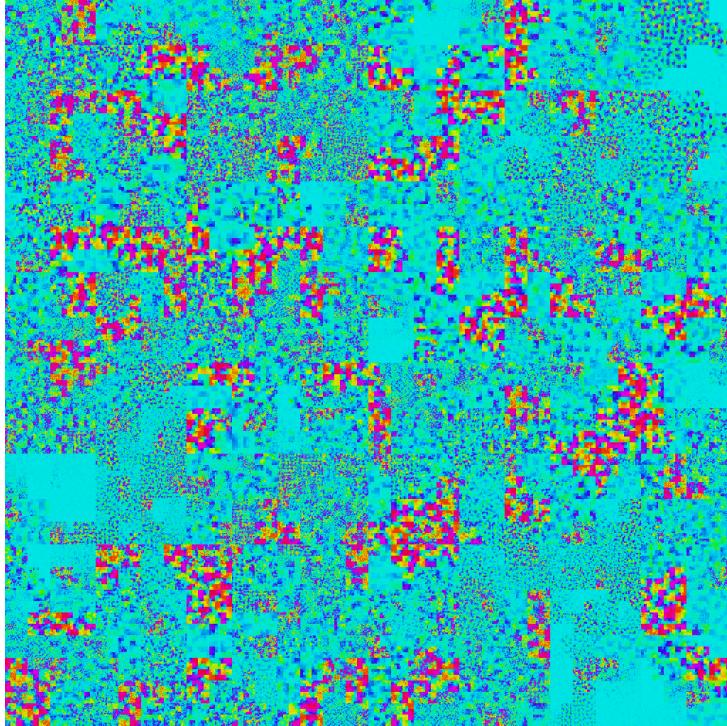
Demo (music)



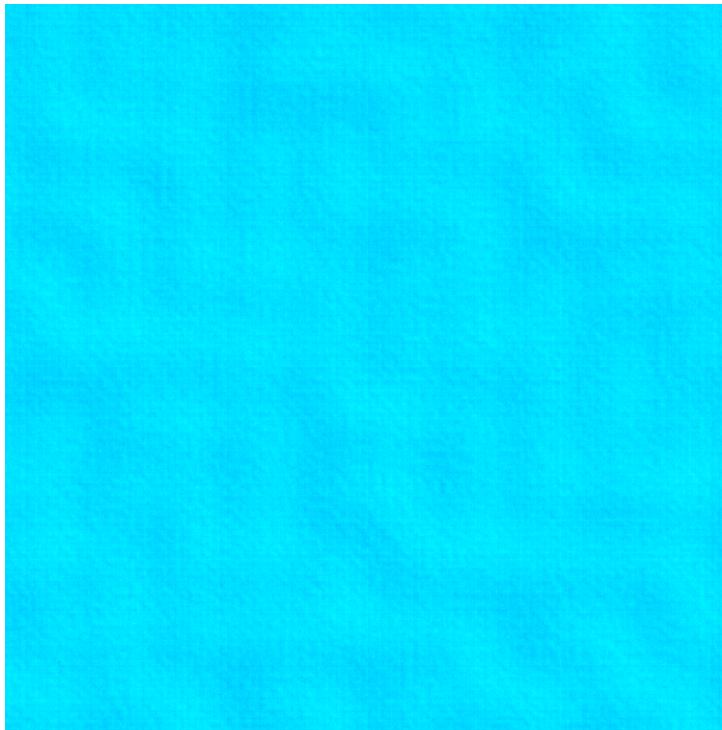
Demo (music, low contrast)



Demo (music, flipped horizontally)



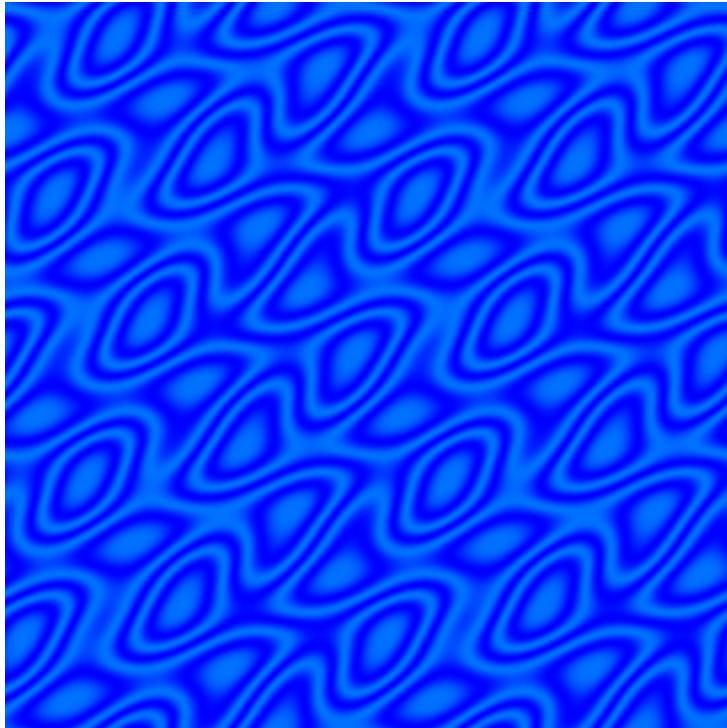
Demo (noise)



Demo (noise, blurred)



Demo (sinusoidal)



Future work

- Frequency domain instead of time domain.
- Color strategy:
 - Use other color spaces besides HSV.
 - User-specified gradients.
- Space strategy:
 - Higher dimensions of curves.g. time as the third dimension).
 - Other space-filling curves (e.g. Moore curve).

Implementation

- Written in Rust, currently available at <https://github.com/kittcass/hilly-sounds>.
- Still a work in progress, but very usable now.
- Fully fleshed out CLI, with bash/zsh/fish autocompletion.

Credits

- [Fun Maker by ROADTOMUSIC](#) (provided by Tunetank.com)
- "Hilbert Curve, first to third orders" by Geoff Richards, public domain

Questions?