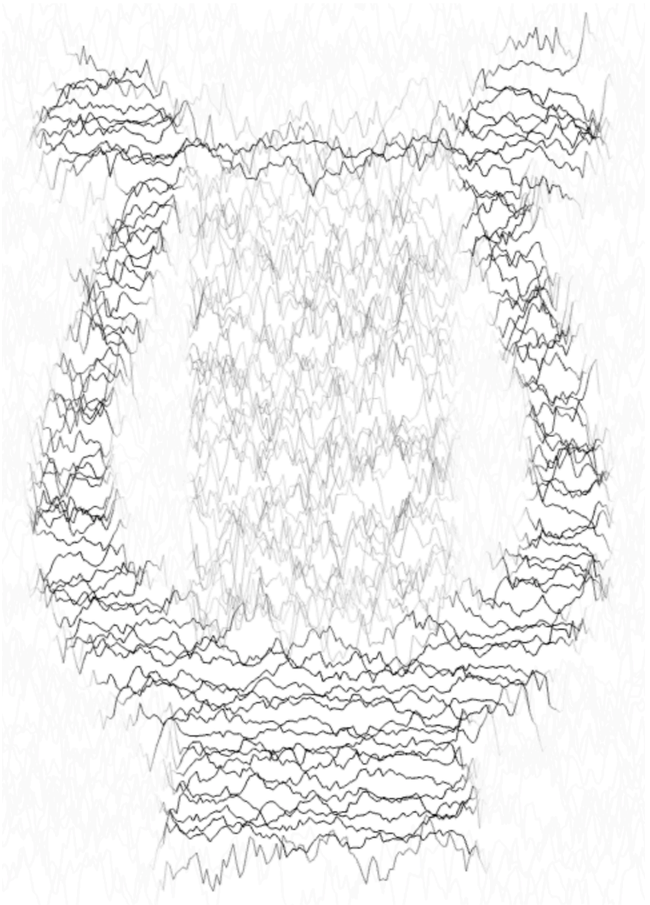

CS 498PS – Audio Computing Lab

Some things we didn't talk about yet …

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Superficial coverage of things we didn't cover

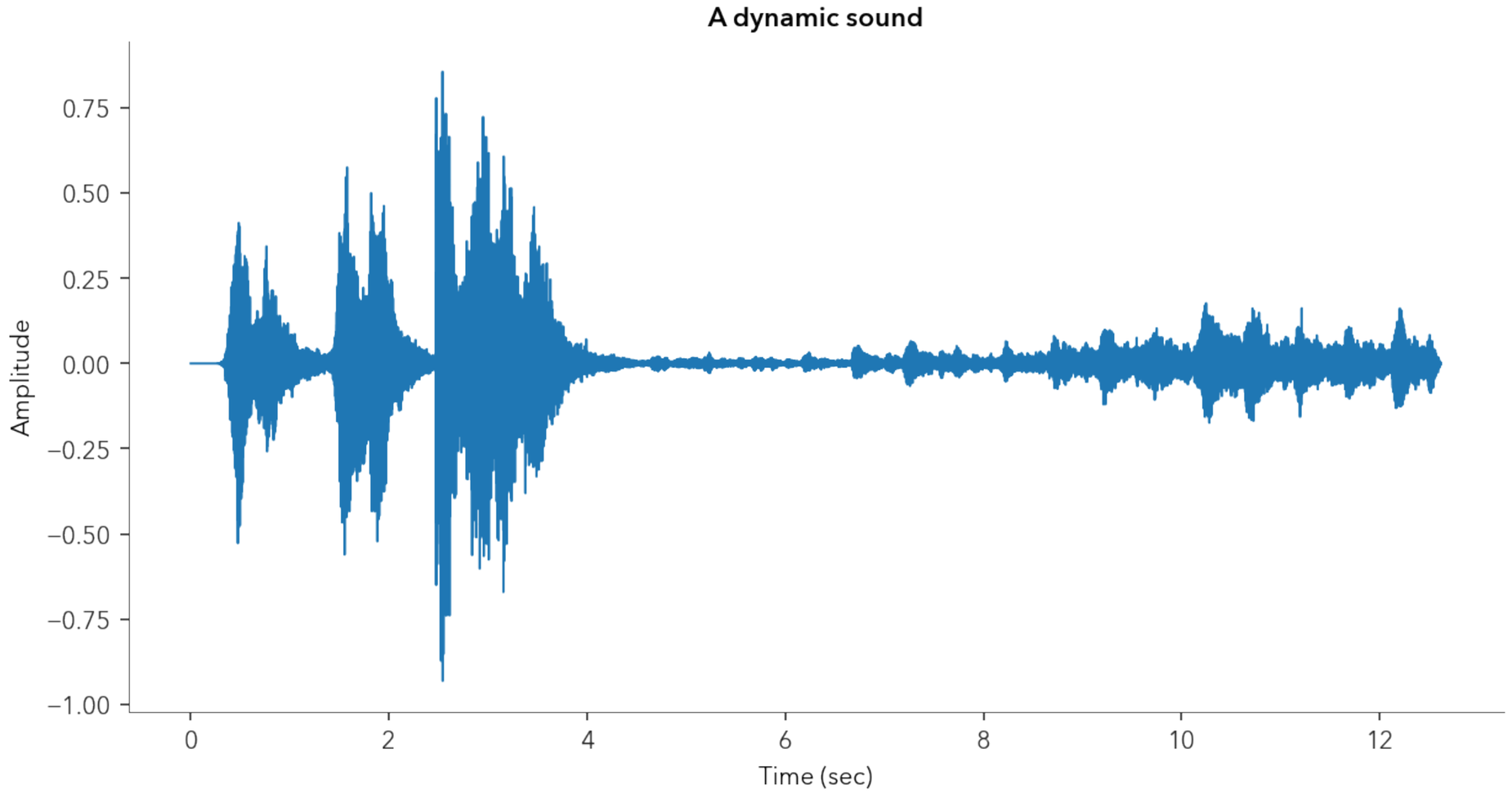
- Dynamics processing
- The Phase Vocoder
- What's happening in audio today?
- Open question time

Dynamics Processing

- Manipulating amplitude
  - Compressors
  - Limiters
  - Expanders
  - Gates
  - De-essers
  - …

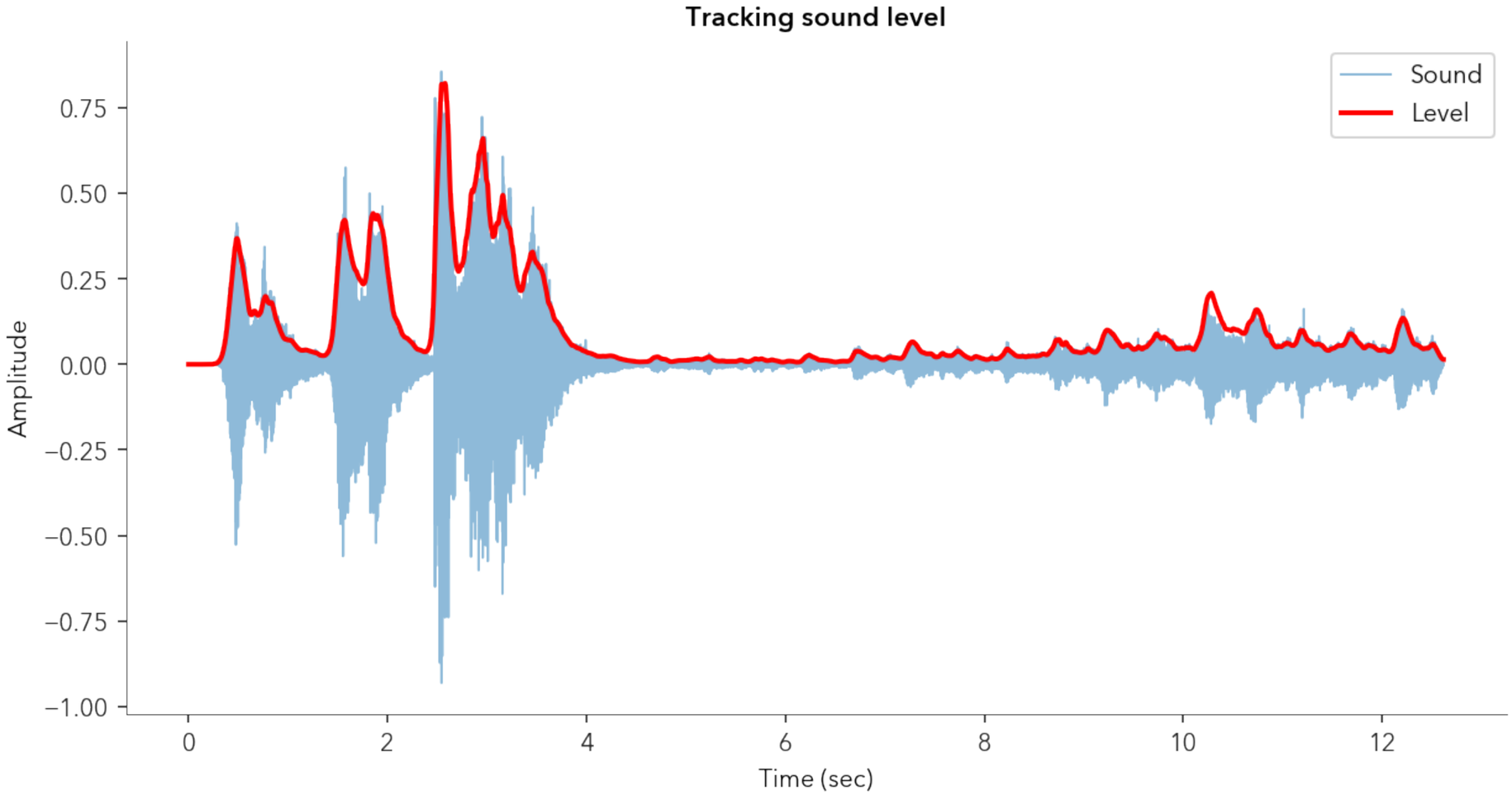
A familiar example

- Wild dynamic changes (too loud and too soft)



Tracking the levels

- We square and lowpass filter it to get signal level

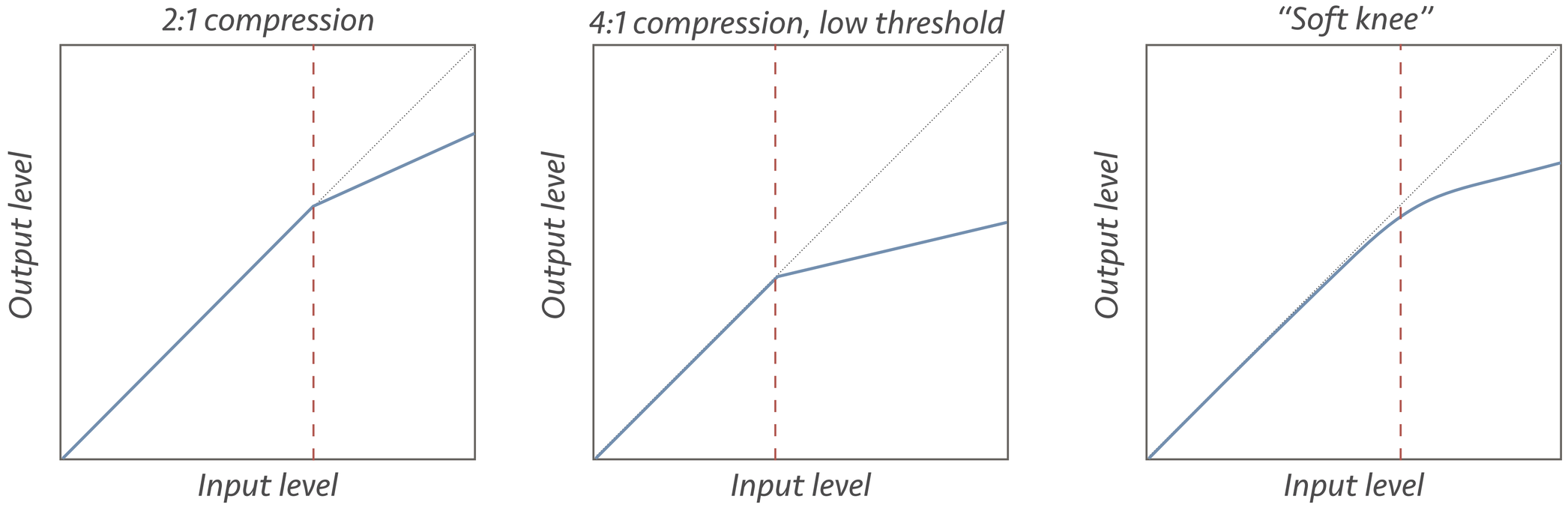


Dynamics processing

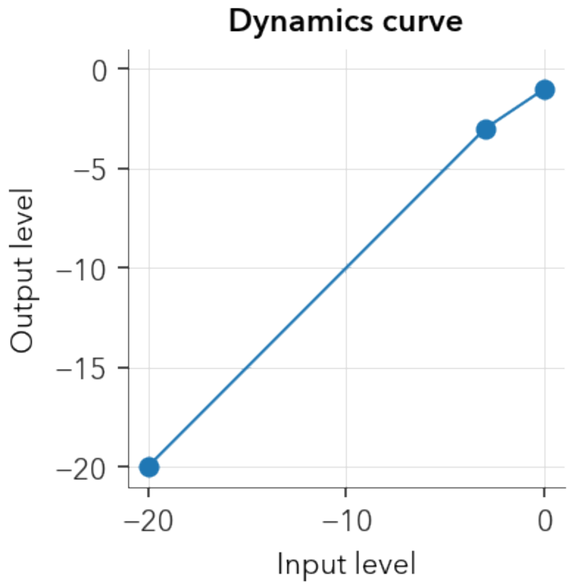
- Use a function that remaps the sound levels
  - E.g. reduce peaks, amplify soft parts, etc.
- Usually defined in log space
  - $-\infty$ representing zero level, and 0 representing the peak
- Mapping can be arbitrary
  - Although it is usually quite simple

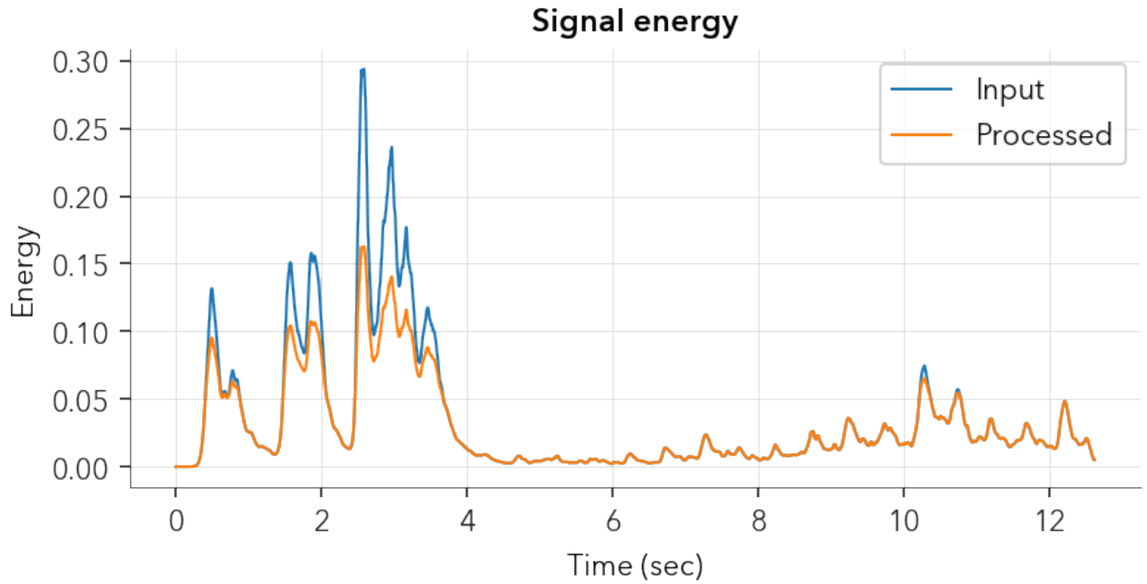
Dynamics curves

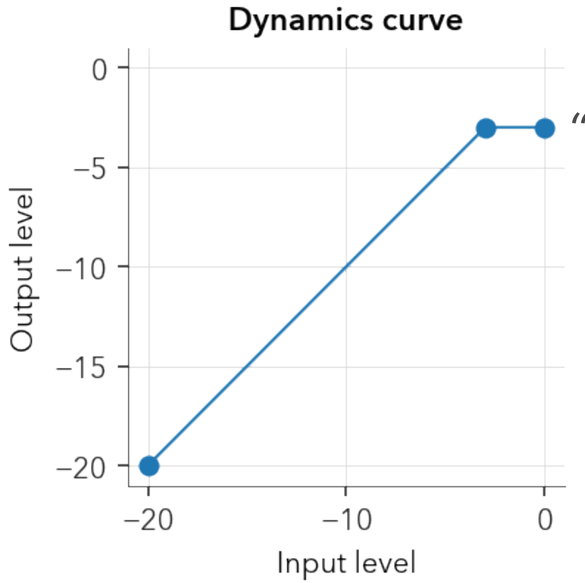
- Basic form has two parameters:
  - *Threshold* and *compression ratio*
  - More complex forms have:
    - "*knee*", *gain*, *attack time*, and *release time*



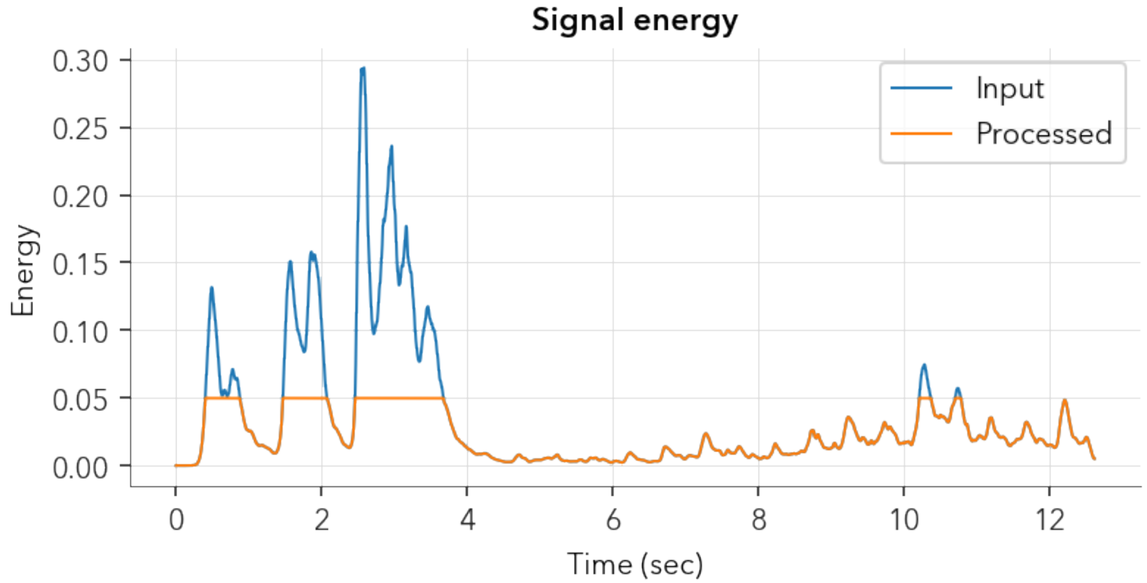
Basic compressor examples



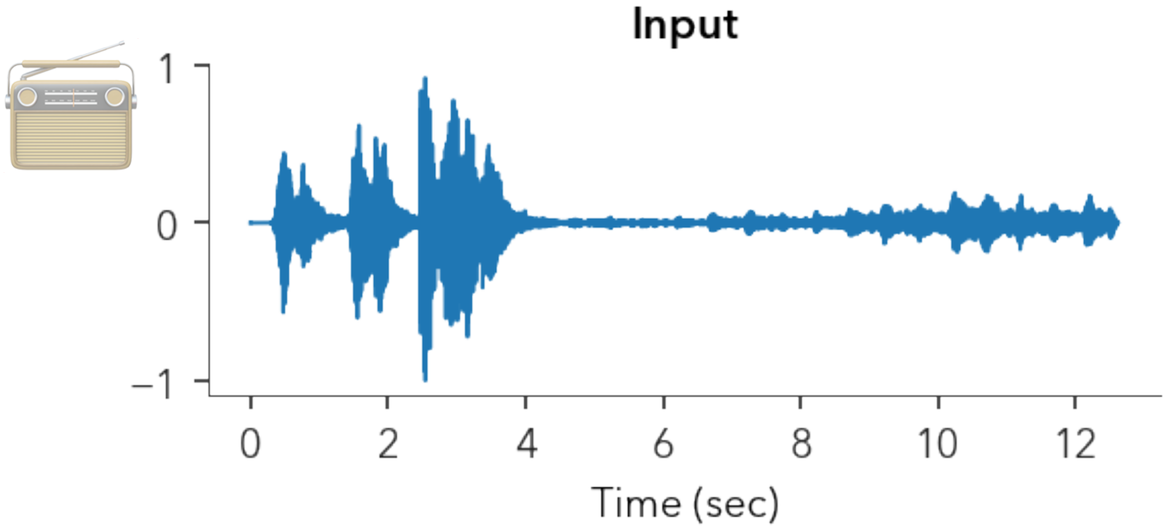


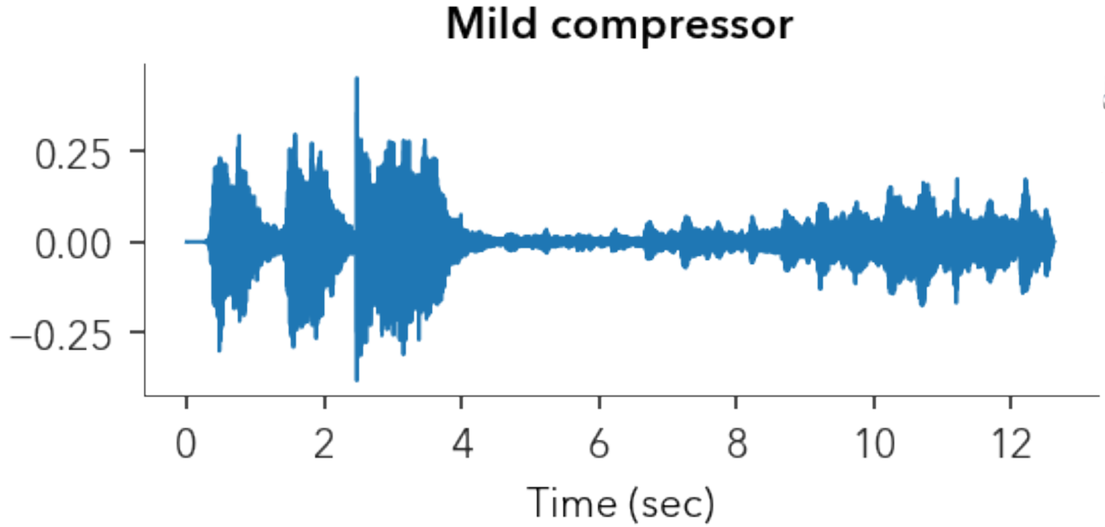


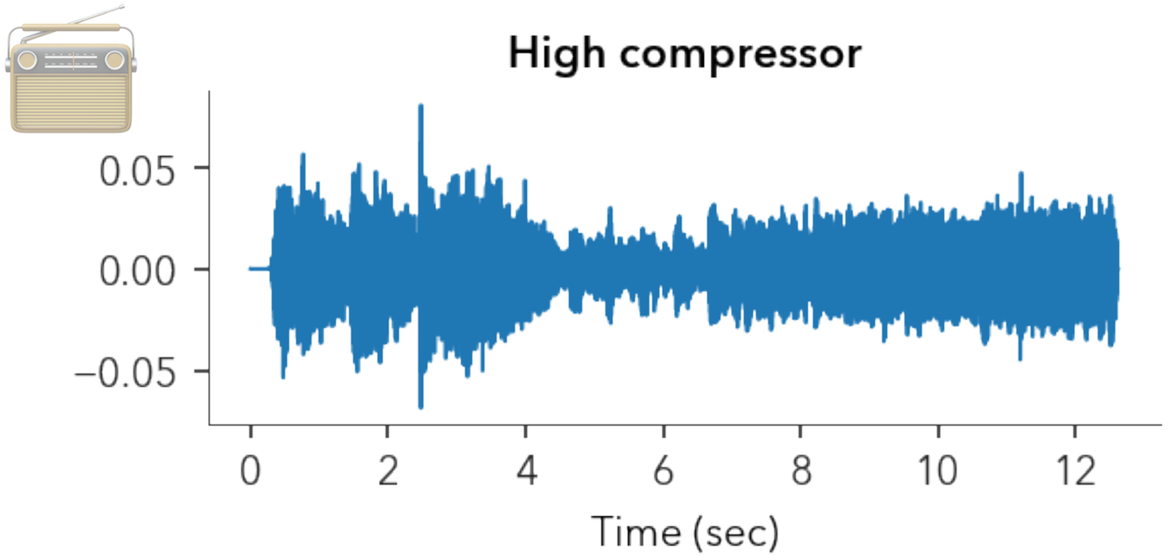
"Limiter"

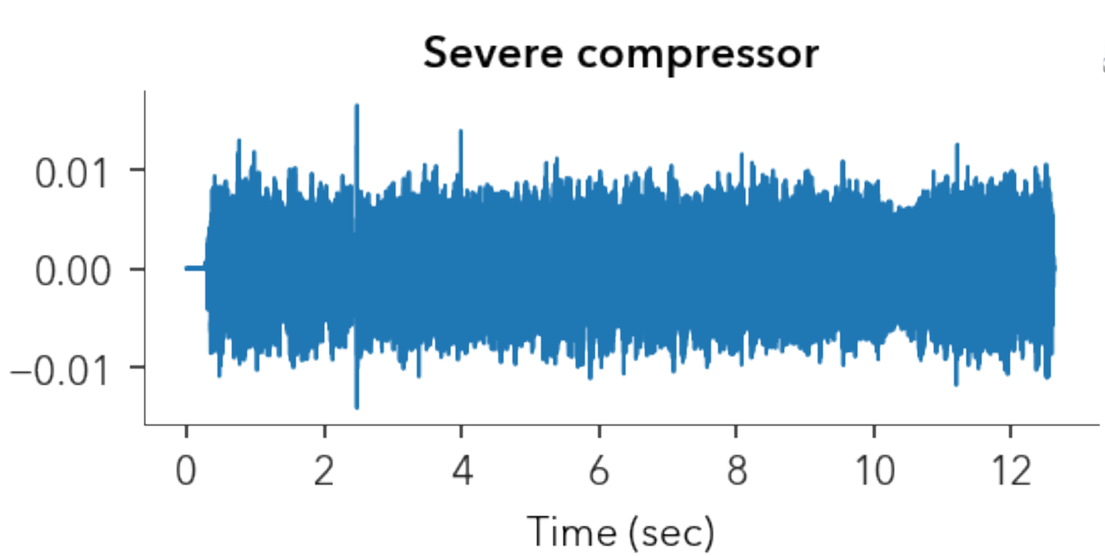


Effects on audio signal



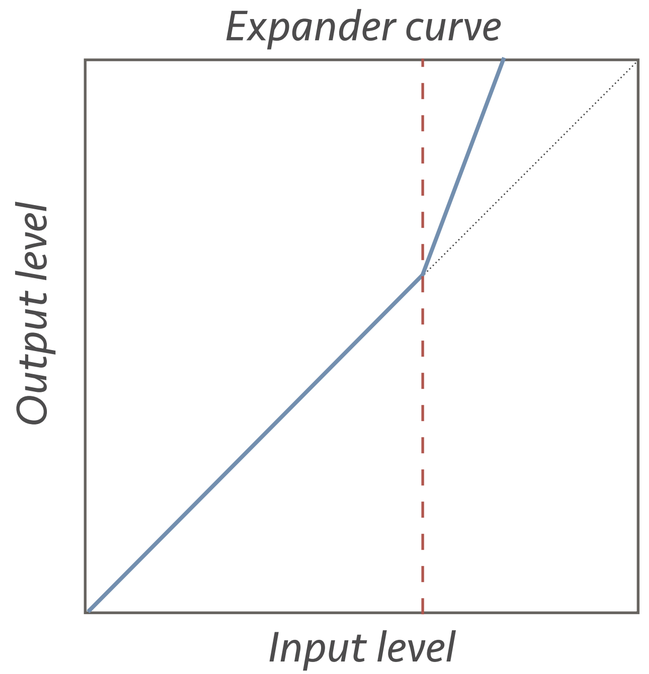






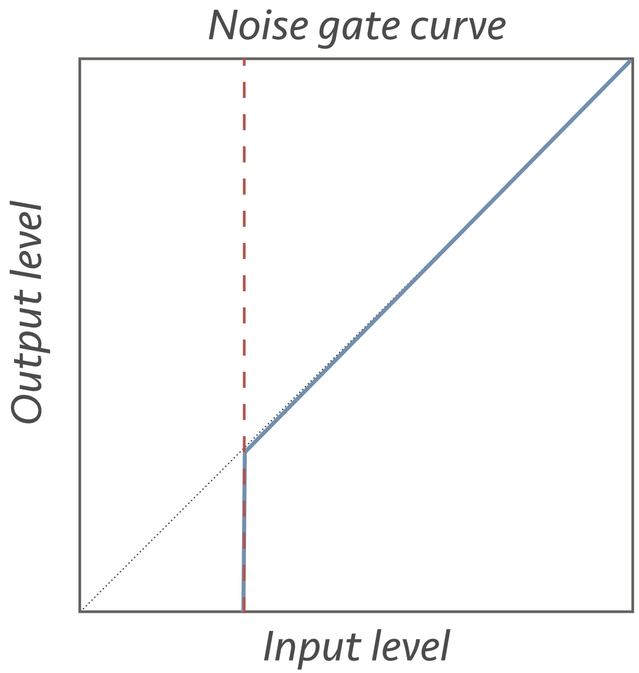
Expanders

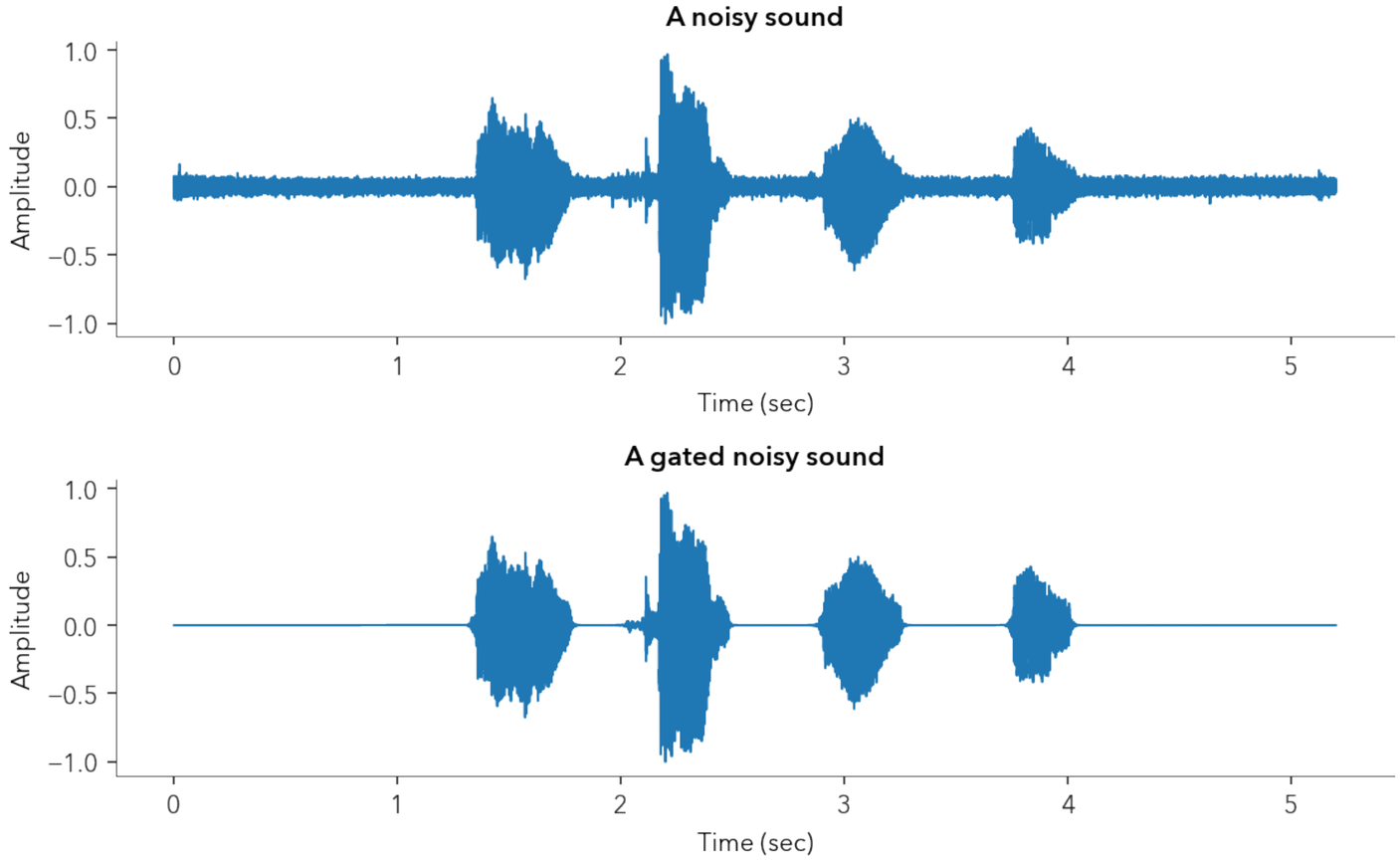
- Expanders boost peaks instead of compressing them
  - Inverse compression ratio
- You can use them to “liven up” audio
  - But be careful not to clip, etc.



Noise gates

- Change the low side of the curve
  - Can be used to silence soft parts of signal



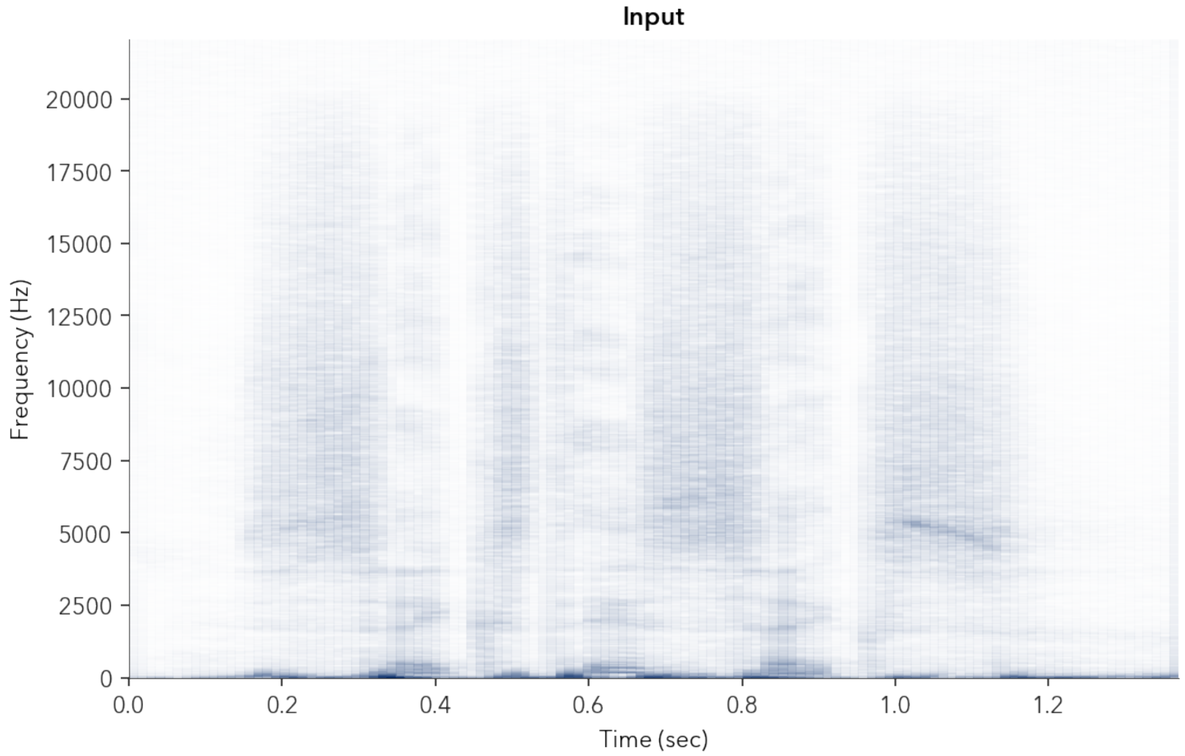


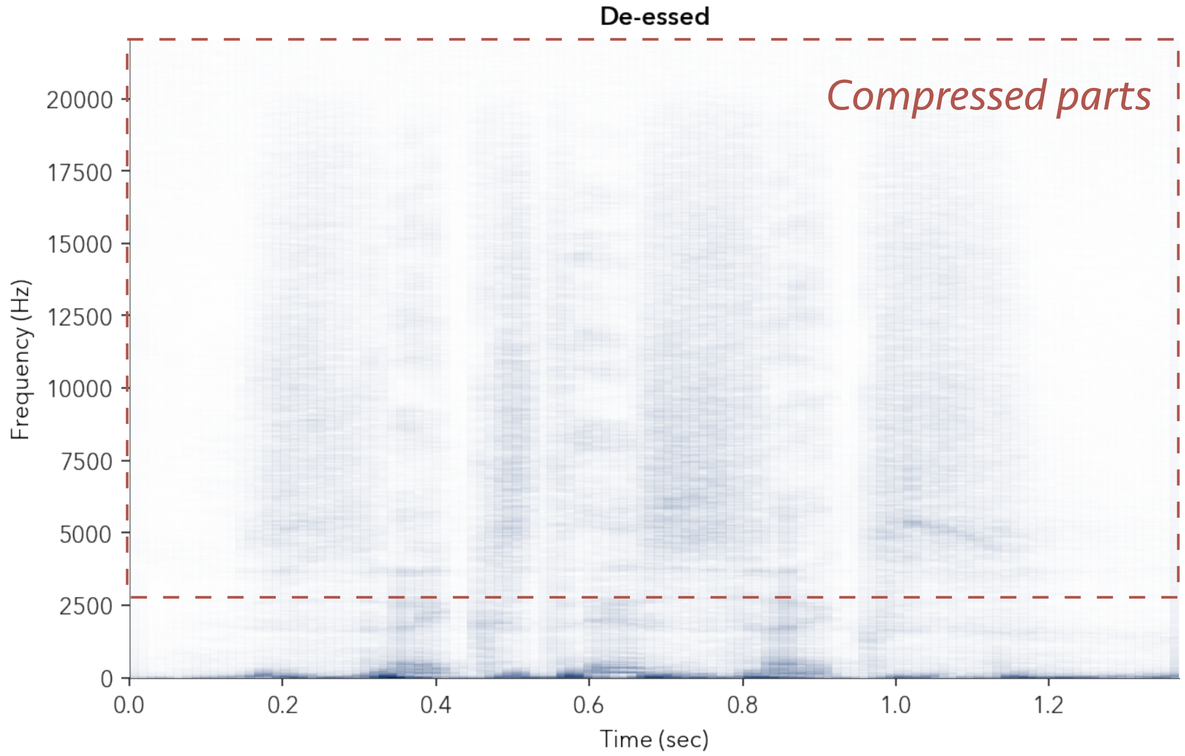
Input

Gated input

Multi-band compressors


- Use a different compressor at each frequency band
  - E.g., the de-esser: compress high frequencies only



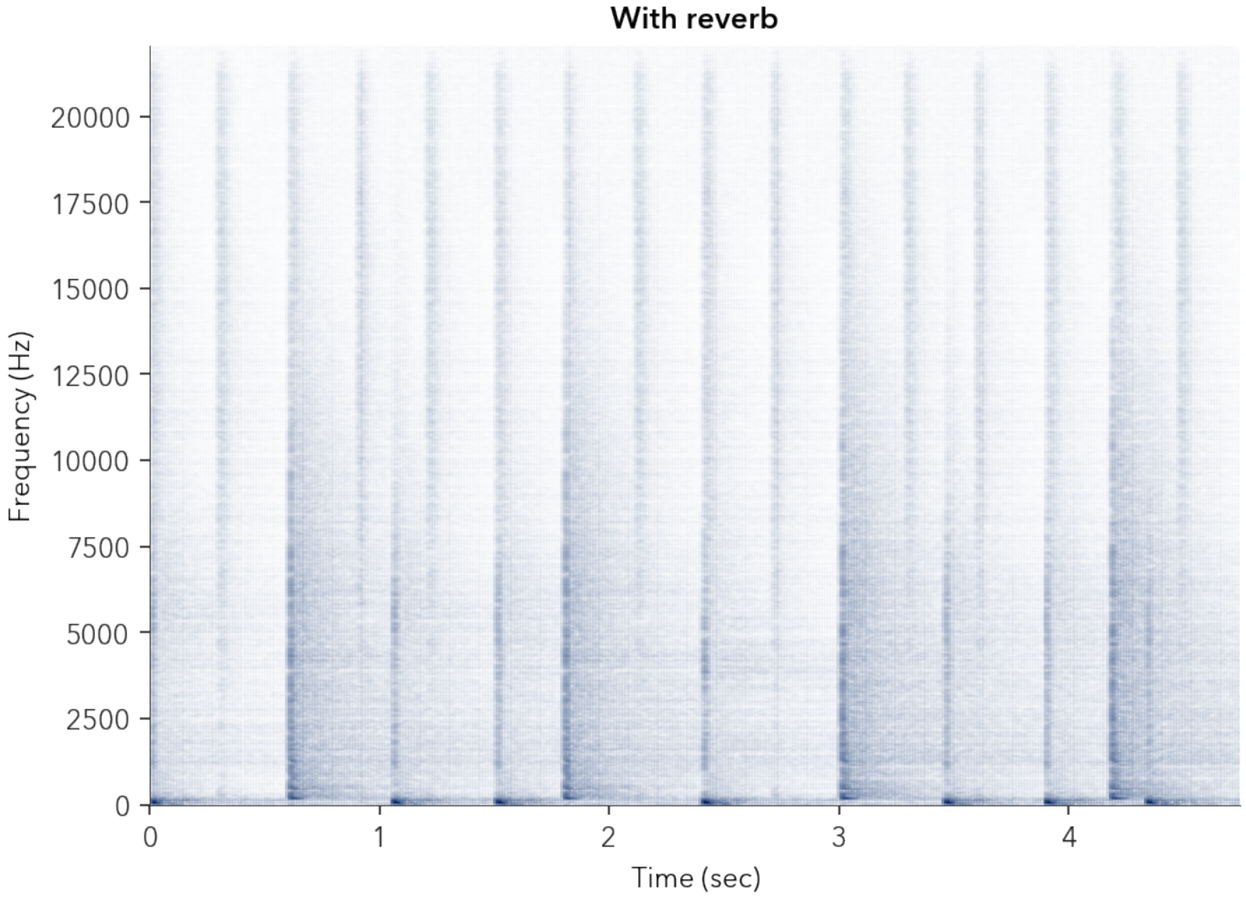


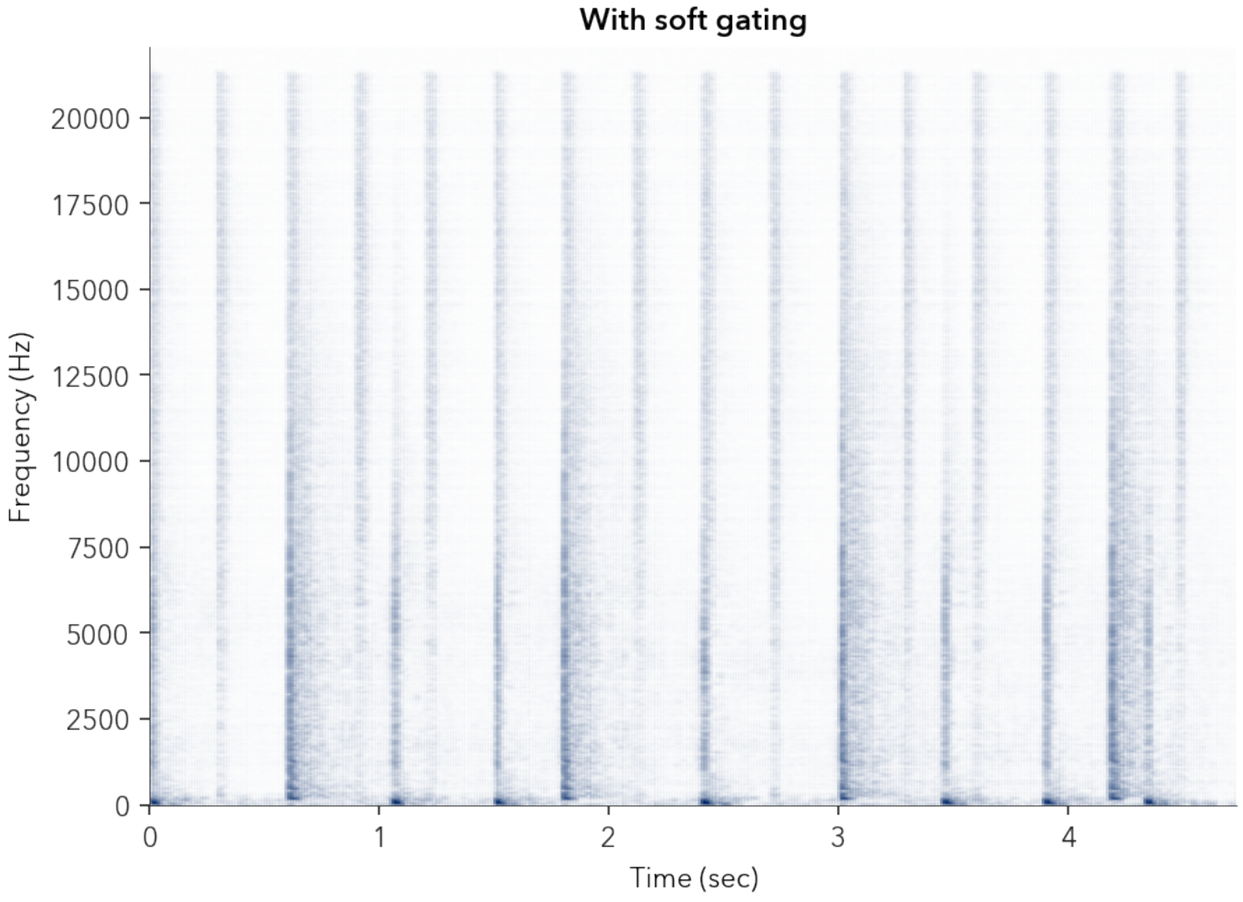
One more application

Reverberated input

Using a soft gate

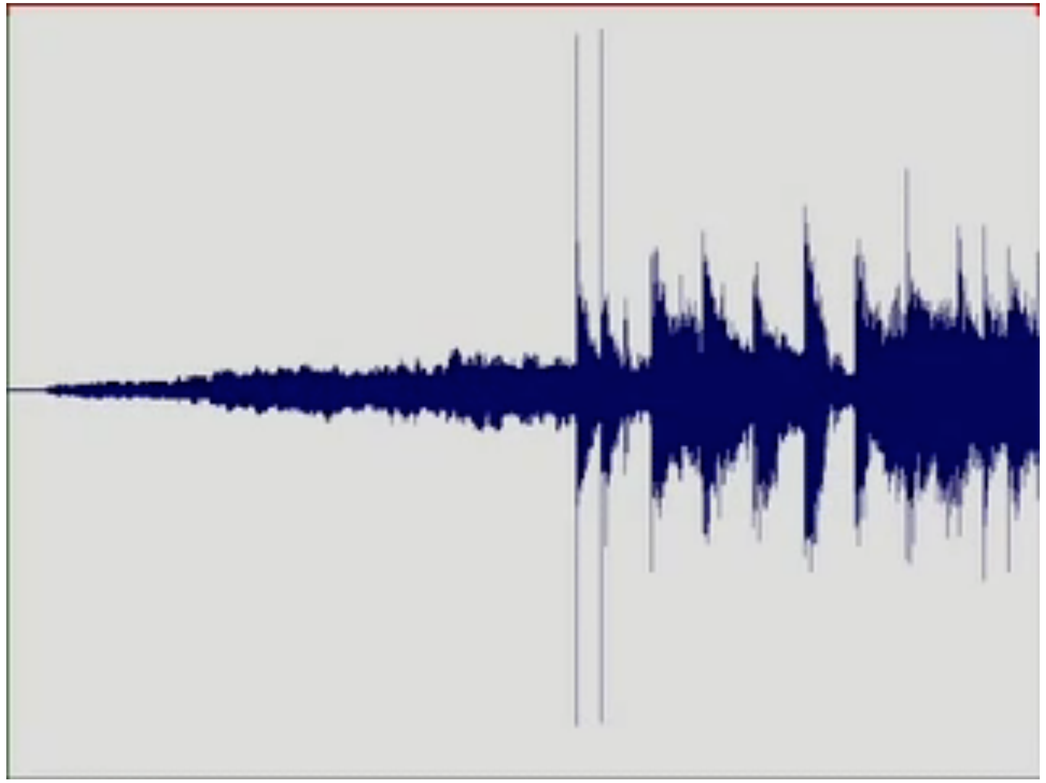
- Minimizing reverb with a soft gate
  - Gate suppresses the reverb tails





The loudness war!

- Compression can be used to make audio tracks louder
  - Music today is much louder! And with less clarity/punch



https://www.youtube.com/watch?v=3Gmex_4hreQ

The phase vocoder

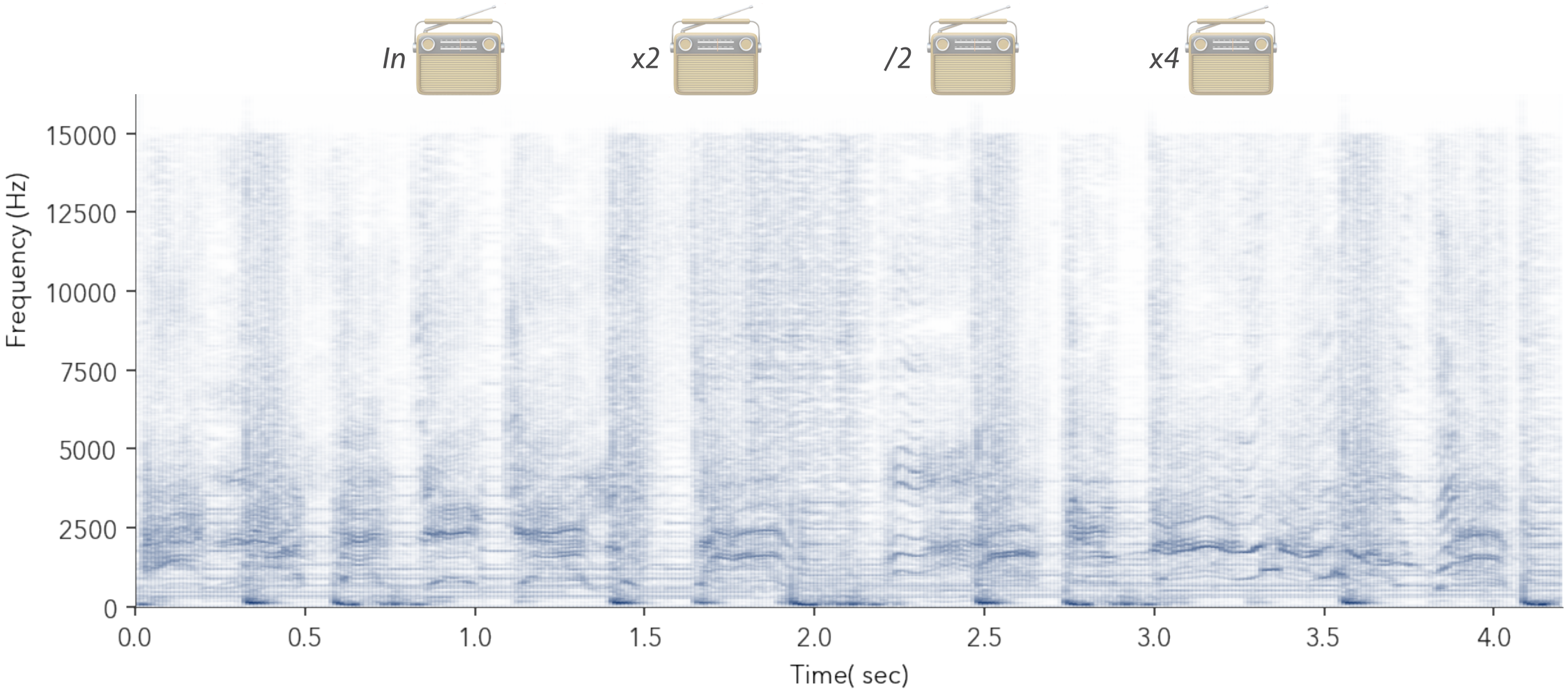
- You've already seen it, it's the STFT
  - Plus a little more …
- Very useful tool for pitch/time modifications
  - Change input's pitch without changing time
  - Change input's length without changing pitch
- Works with *polyphonic* inputs
  - PSOLA will not work on music since there are many pitches

Basic idea for PV time-stretch

- Perform STFT and obtain magnitude and phases
- Resample the magnitude amplitude to desired length
  - Simple linear interpolation over time
- Manually construct sensible phases
  - Interpolated phases will not work
  - *Phase unwrapping*

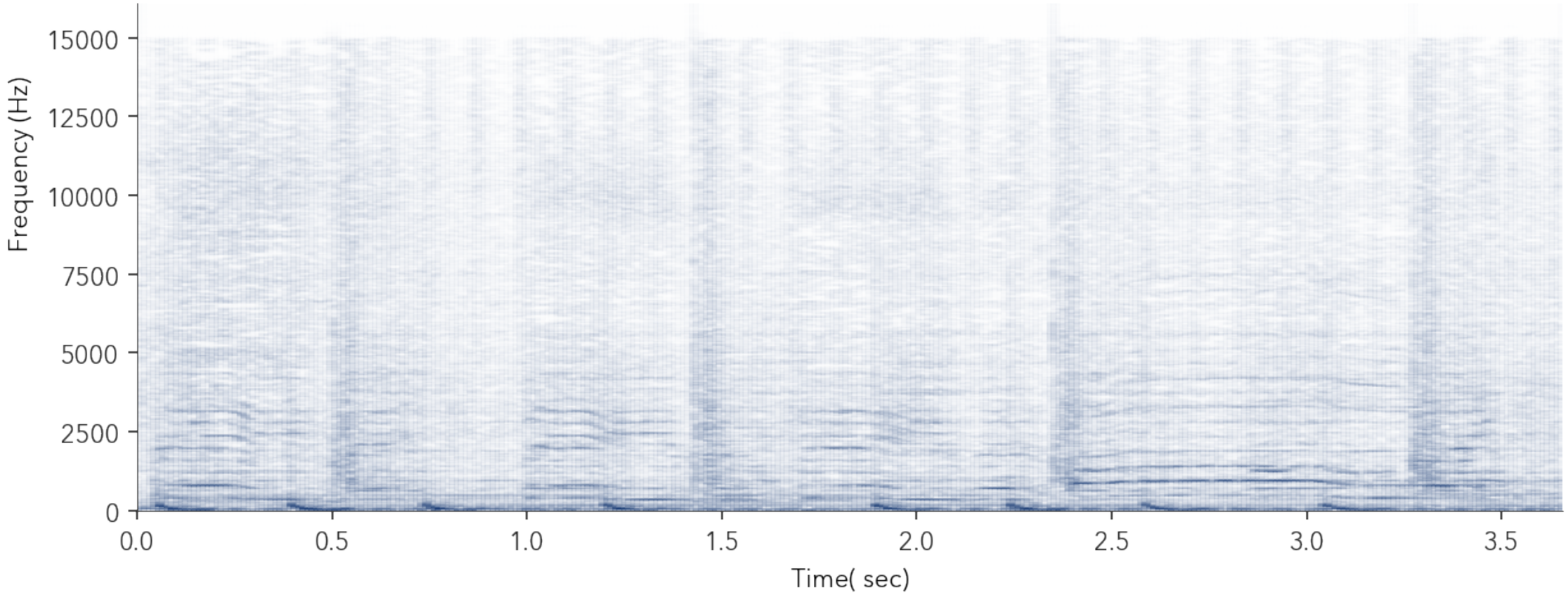
Example

- Does a reasonable job for stretching time



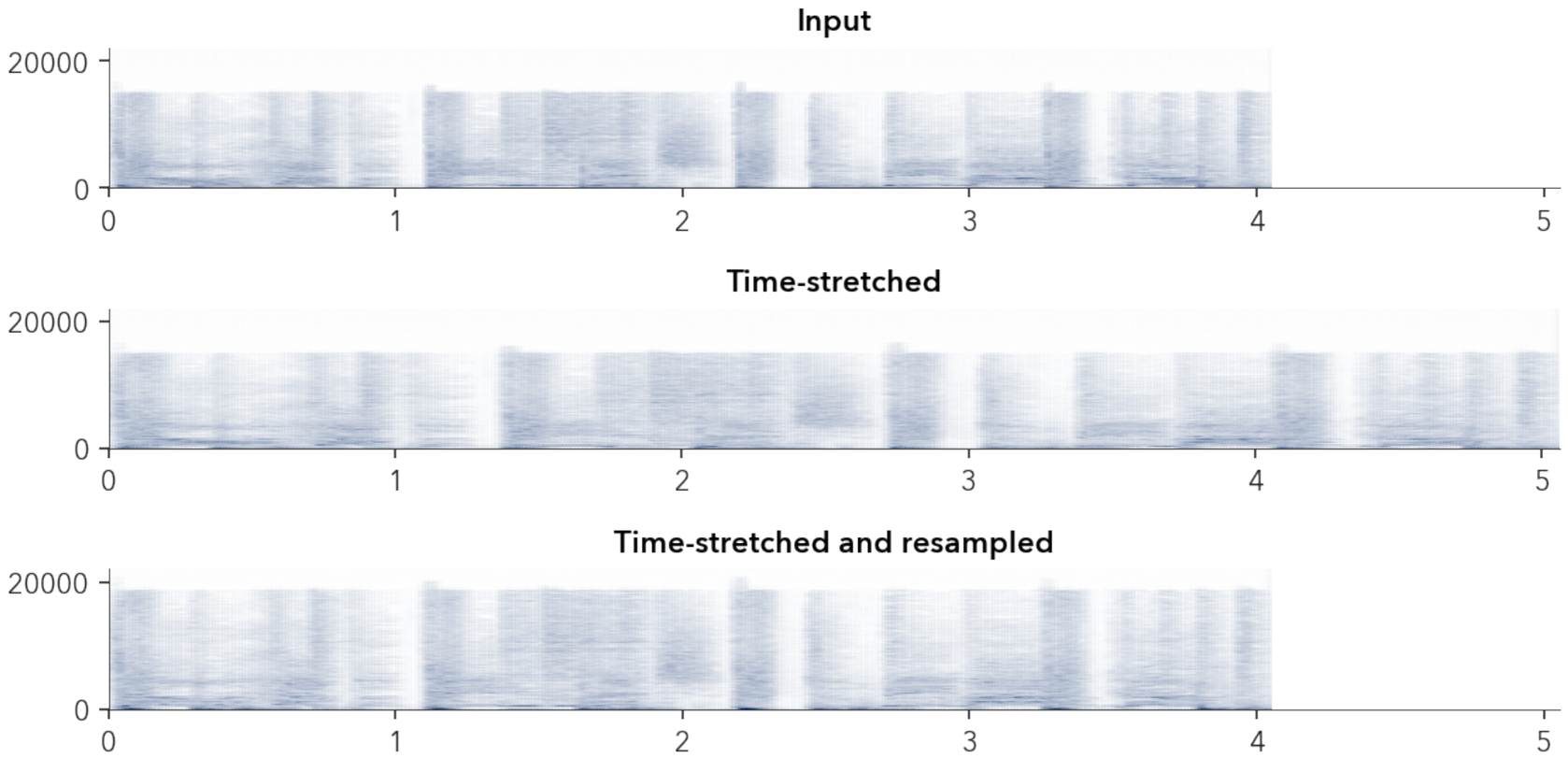
Example

- Long DFT sizes make for a dreamier sound



What about pitch-shifting?

- Time-stretch the input and play at different rate
  - e.g., slow down by two and play with double sample rate
    - results in same length at twice the pitch(es)



Input clip

Time-stretched by 1.25

Time-stretched by 1.25 and played 1.25 faster

So what's hot today?

- Generative models
  - WaveNet, SampleRNN, etc …
    - Generalize linear prediction models, can create realistic sounds
- Sound recognition technology
  - Speech rec, audio annotations, music IR
- Array processing (still)
  - Basic component of many speech-enabled assistants

Open question time!

- What did we not cover?
- What audio question is still unanswered?
- Wanna learn more?
  - ECE310/551 - Digital Signal Processing I/II
  - ECE537 - Speech Processing Fundamentals
  - ECE402 - Electronic Music Synthesis
  - MUS407/409 - Electroacoustic Music Techniques I/II