

# Spectrograms

## ▼ Introduction

A spectrogram illustrates how the constituent frequencies of a signal vary over time. This application generates the spectrogram of several audio files, including a

- DTMS tone,
- human voice saying “MapleSim”,
- violin note played with vibrato, and an entire violin scale,
- C8 piano note,
- series of dolphin clicks,
- and more.

Interestingly, some electronic musicians hide images in their music; you can only view these images with a spectrogram of the appropriate part of the audio. This includes the track “My Violent Heart” by the Nine Inch Nails; you can view this spectrogram in this application.

The [Spectrogram](#) function was introduced in Maple 18, and also lets you plot the waveform and power spectrum

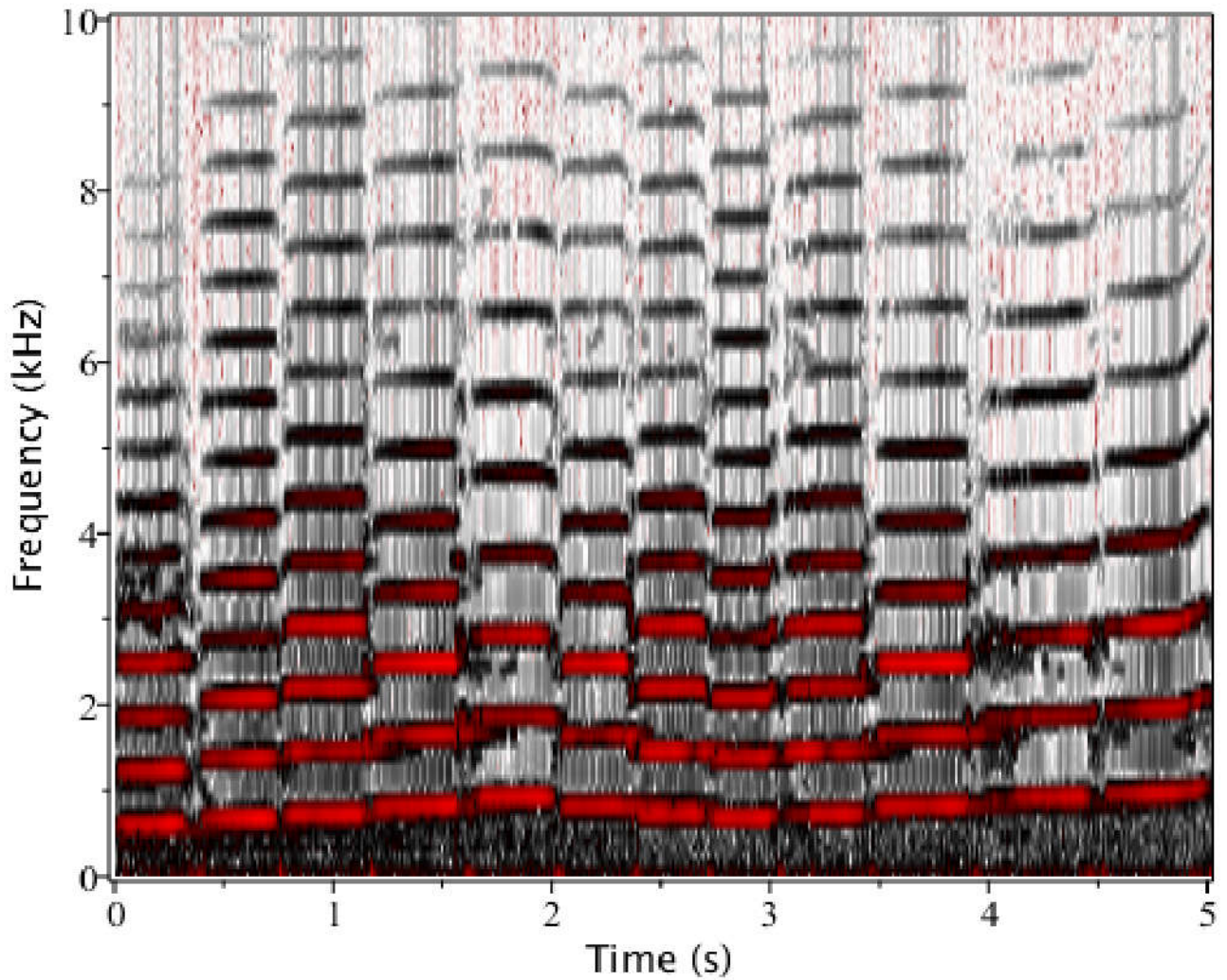
- > restart :
- > with( SignalProcessing ) :

## ▼ Violin

- > f1 := AudioTools:-Read( "Violin\_for\_spectrogram.wav" ) :

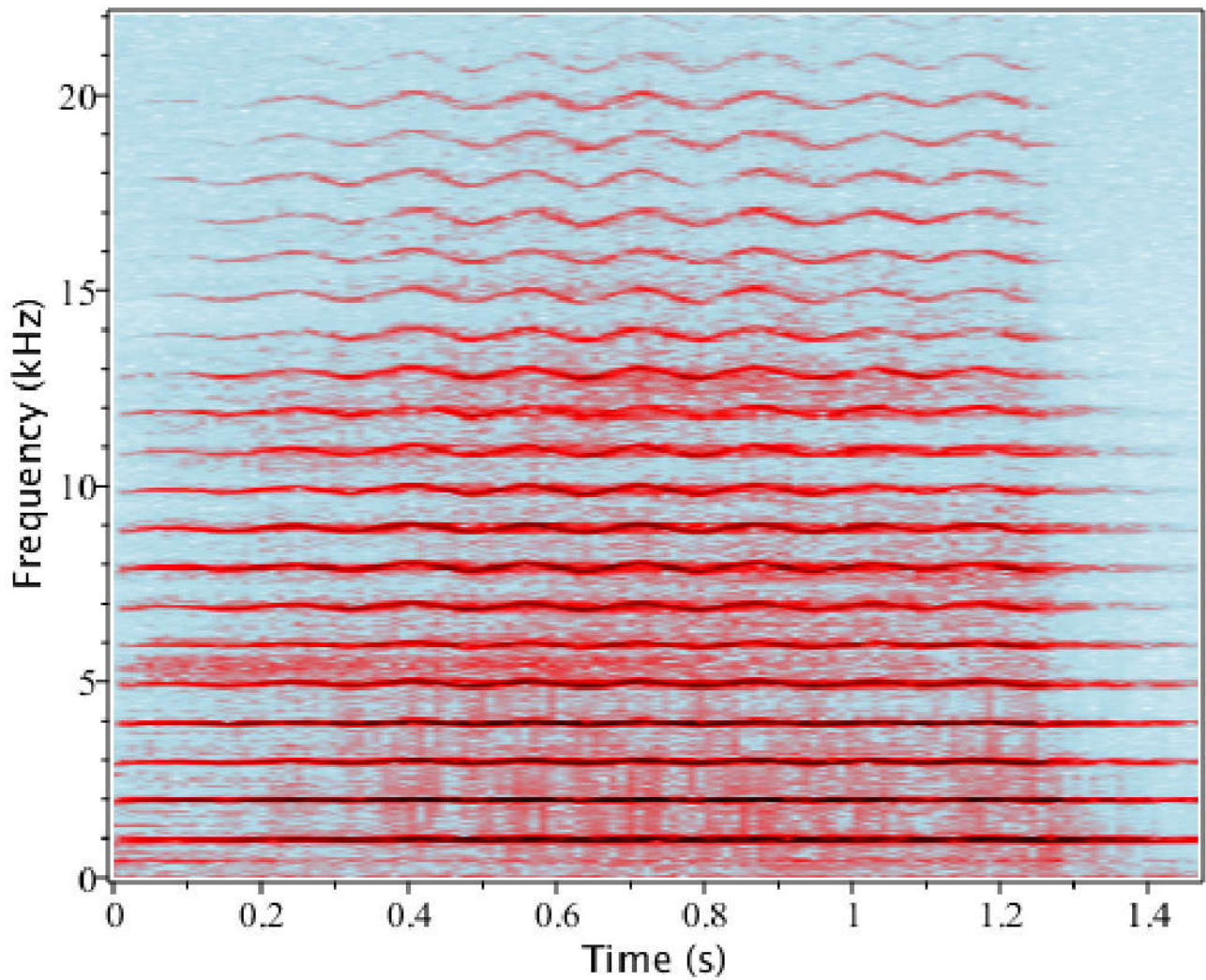
A series of notes

- > Spectrogram( f1, colorscheme = [ "SteelBlue", brown, "white", "black", red ], fftsize = 512, reduceplot = 0, view = [ 0 ..5, 0 ..10 ], size = [ 800, 400 ] )



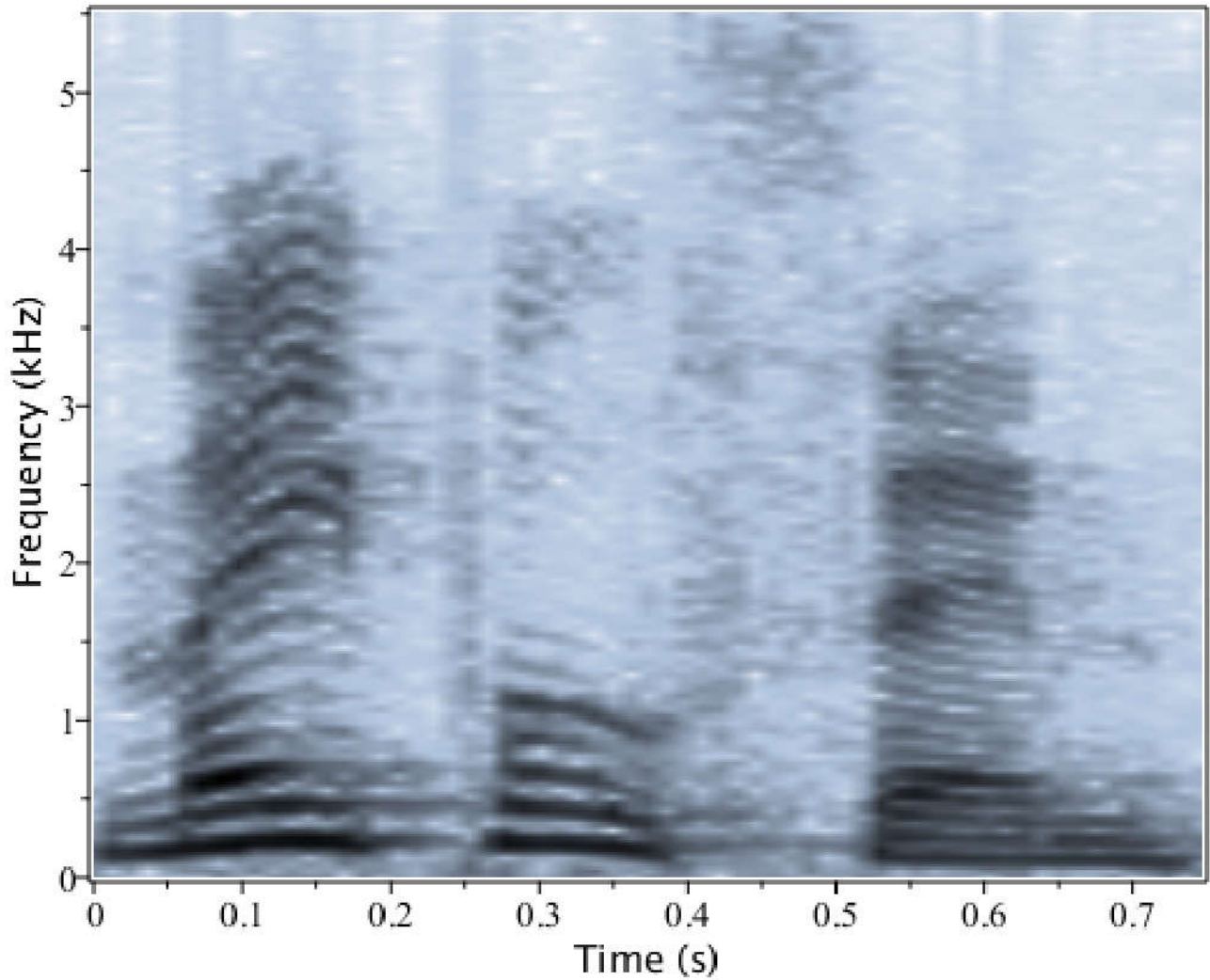
A single note played with vibrato

- > f2 := AudioTools:Read("ViolinThreePosVibrato.wav") :
- > Spectrogram(f2, colorscheme = ["zgradient", [white, LightBlue, red, black]], markers = [0, 0.5, 0.75, 1]), fftsize = 2<sup>10</sup>, channel = 1, size = [800, 400])



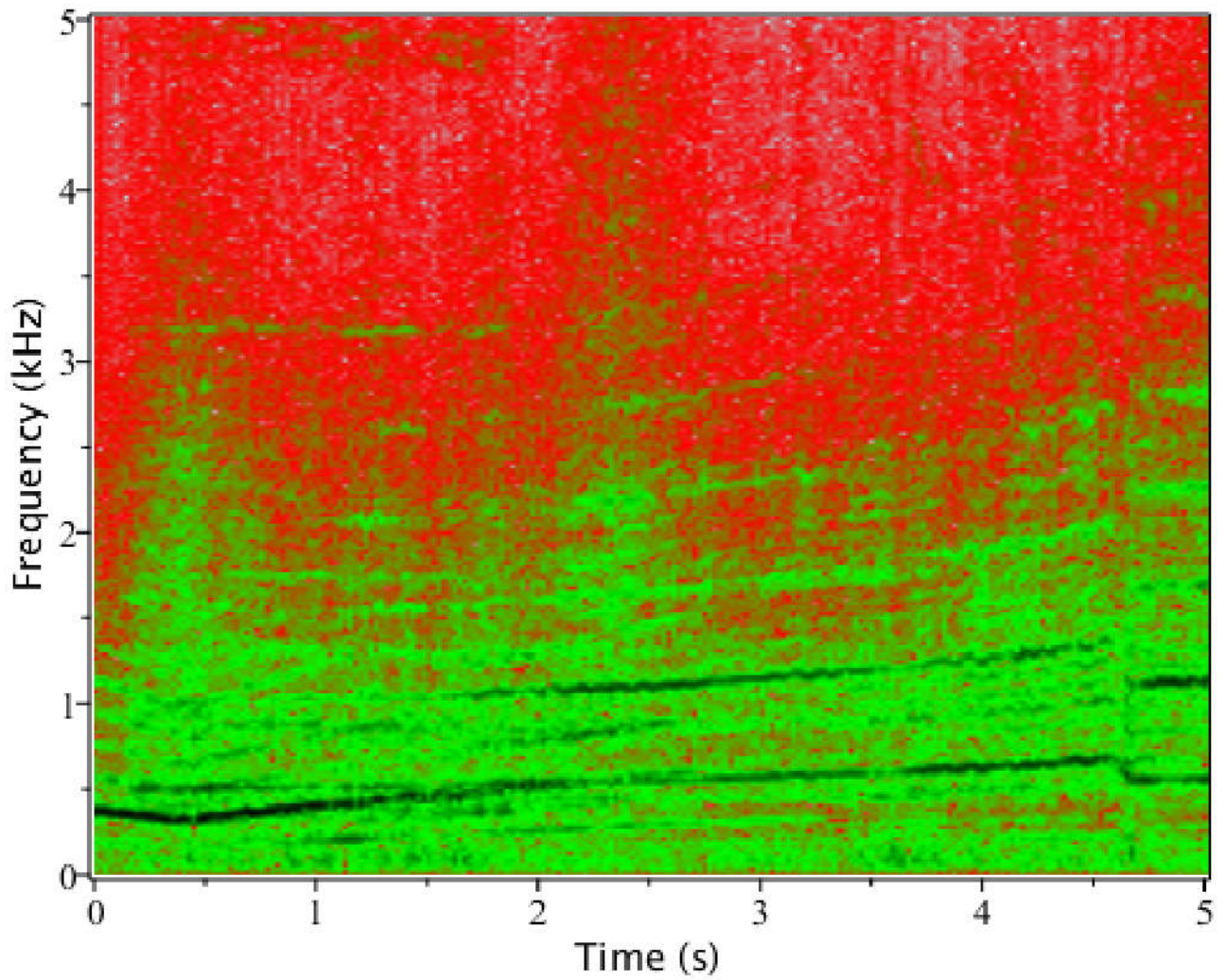
## ▼ Human Voice

- > `f3 := AudioTools:-Read("maplesim.wav") :`
- > `Spectrogram(f3, colorscheme = ["zgradient", [white, LightSteelBlue, black]], markers = [0, 0.5, 1],  
fftsize = 256, size = [800, 400])`



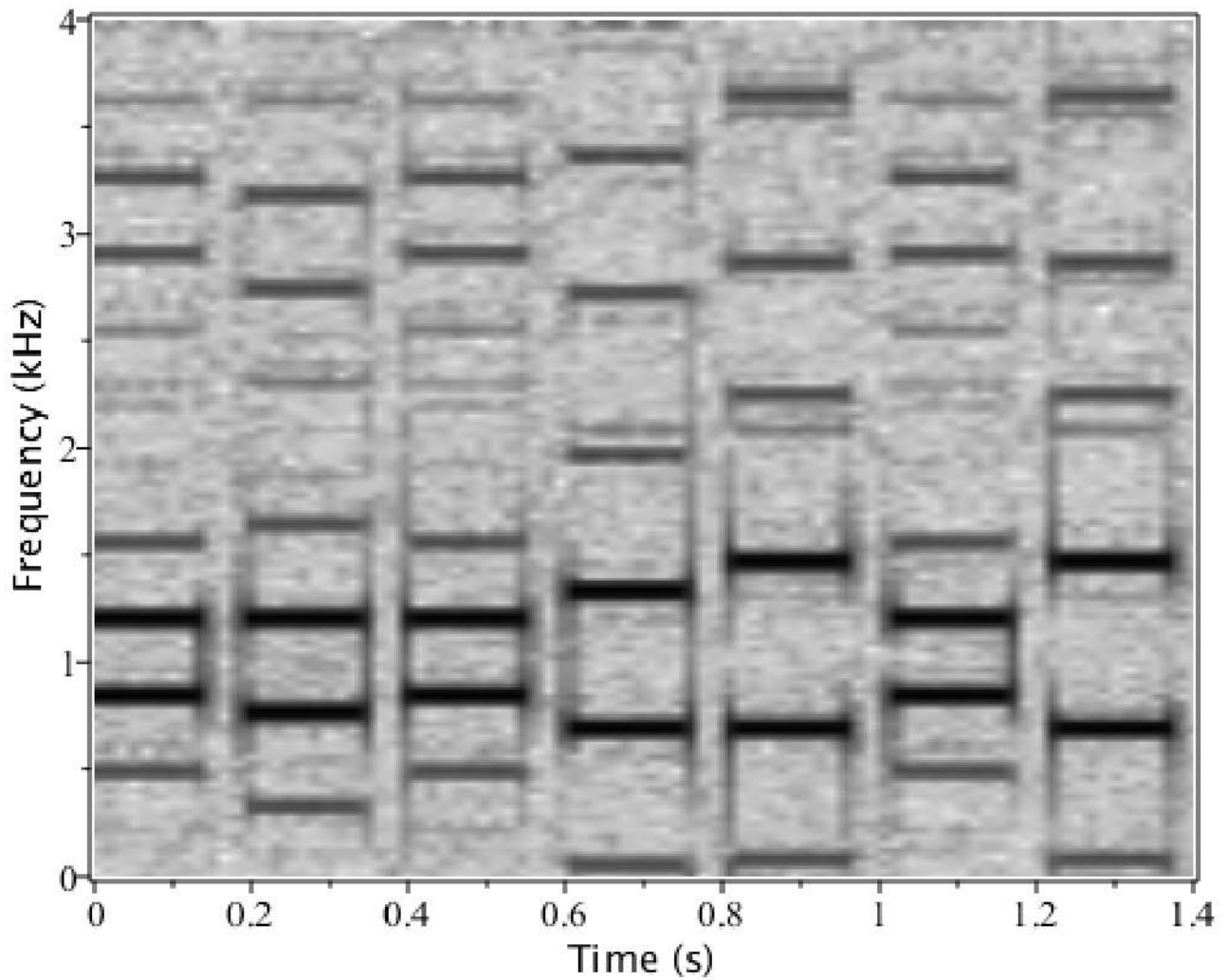
## ▼ Engine Shifting Gears

- > `f4 := AudioTools:Read("car3.wav") :`
- > `Spectrogram(f4, colorscheme = ["zgradient", [white, LightBlue, red, green, black]], markers = [0, 0.25, 0.5, 0.75, 1], fftsize = 2048, channel = 1, size = [800, 400], view = [0 ..5, 0 ..5])`



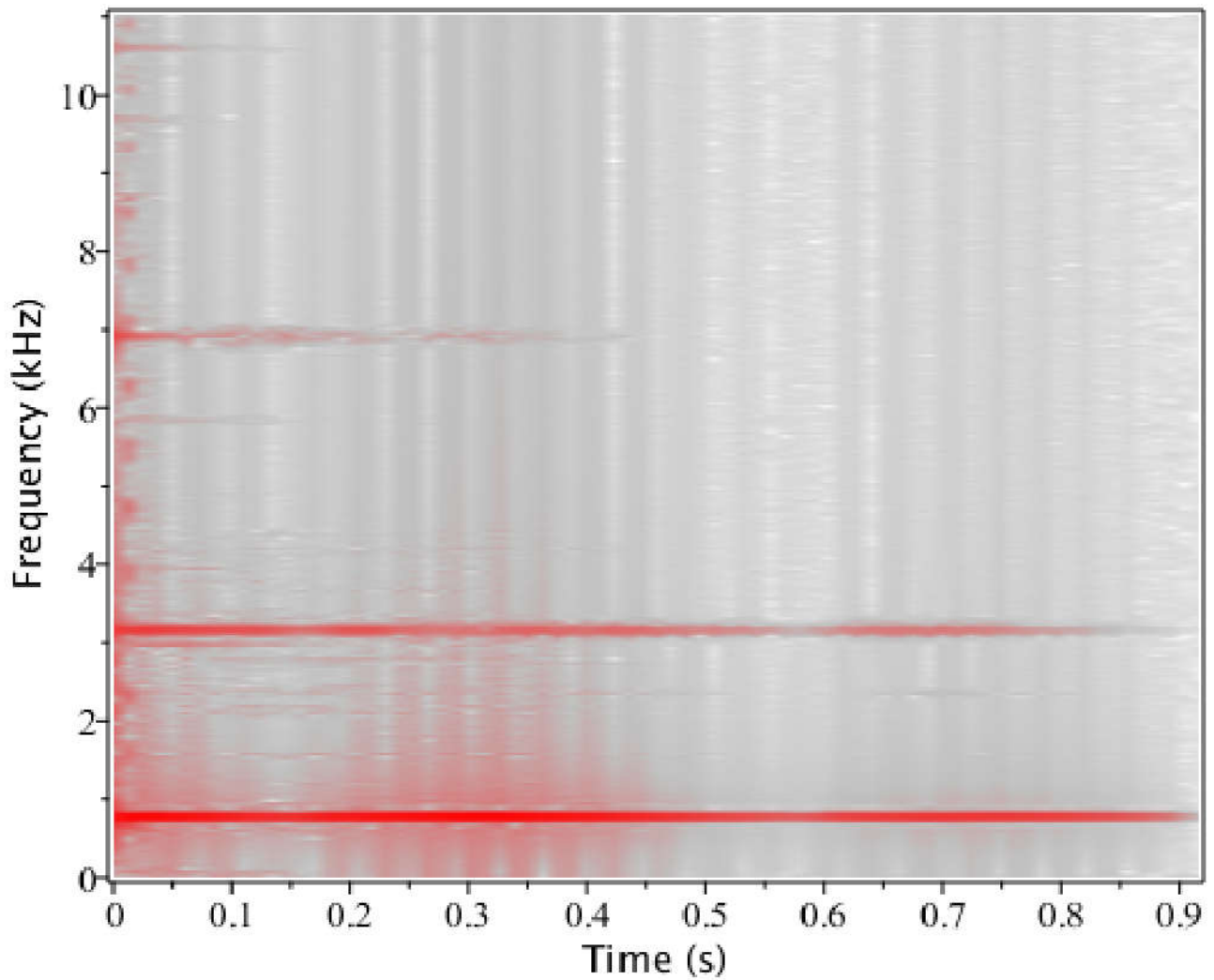
## ▼ DTMF

- > `f5 := AudioTools:-Read("DTMF.wav") :`
- > `Spectrogram(f5, colorscheme = ["zgradient", [white, grey, black]], markers = [0, 0.5, 1]), fftsize = 256, size = [800, 400])`



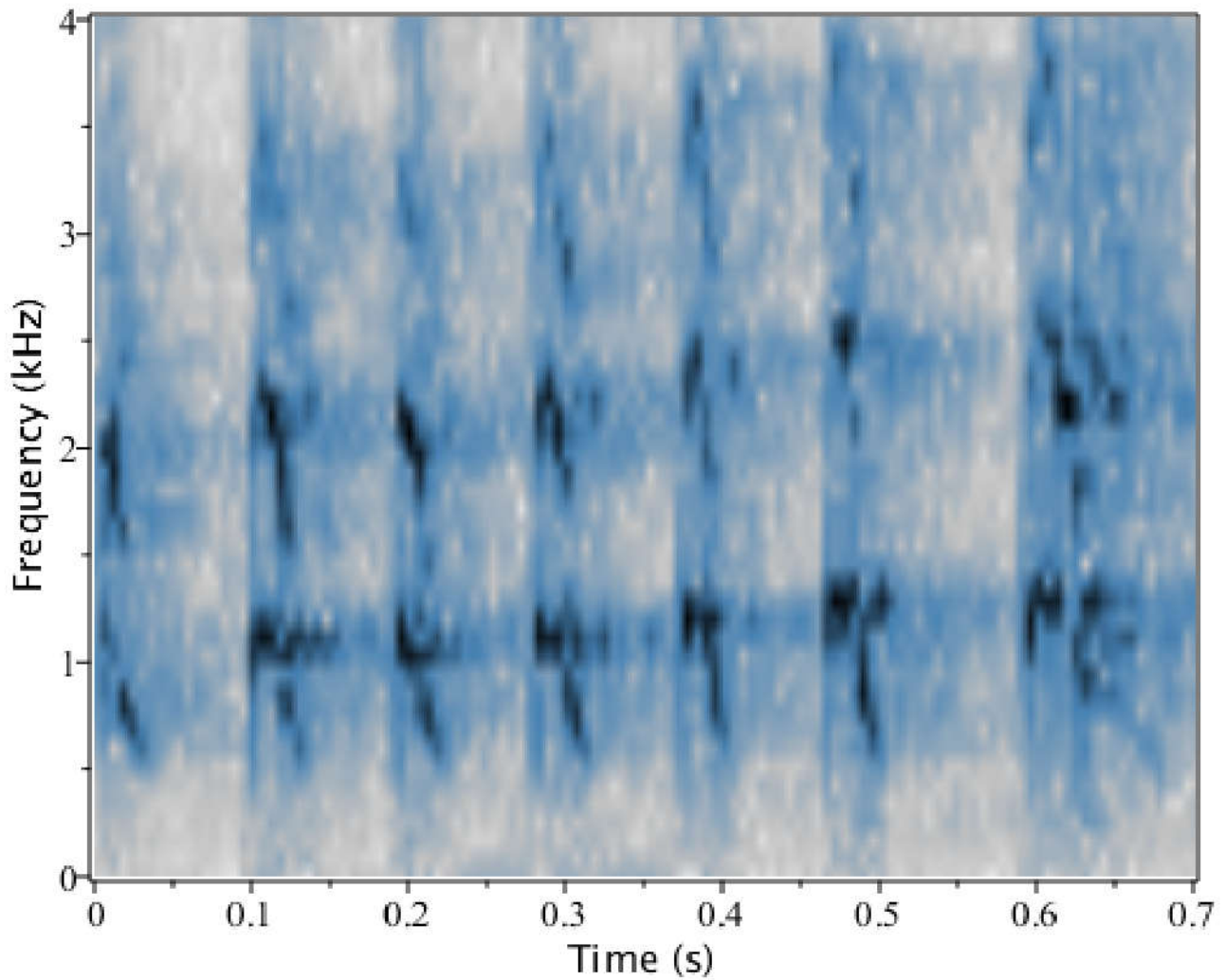
## ▼ Ding

- > `f6 := AudioTools:Read("ding.wav") :`
- > `Spectrogram(f6, colorscheme = ["zgradient", [white, grey, red]], markers = [0, 0.5, 1], fftsize = 512, size = [800, 400])`



## ▼ Dolphin Clicks

- > `f7 := AudioTools:-Read("dolphin.wav") :`
- > `Spectrogram(f7, colorscheme = ["zgradient", [white, grey, SteelBlue, black]], markers = [0, 0.5, 0.85, 1], fftsize = 256, size = [800, 400], channel = 1, view = [0..0.7, 0..4])`

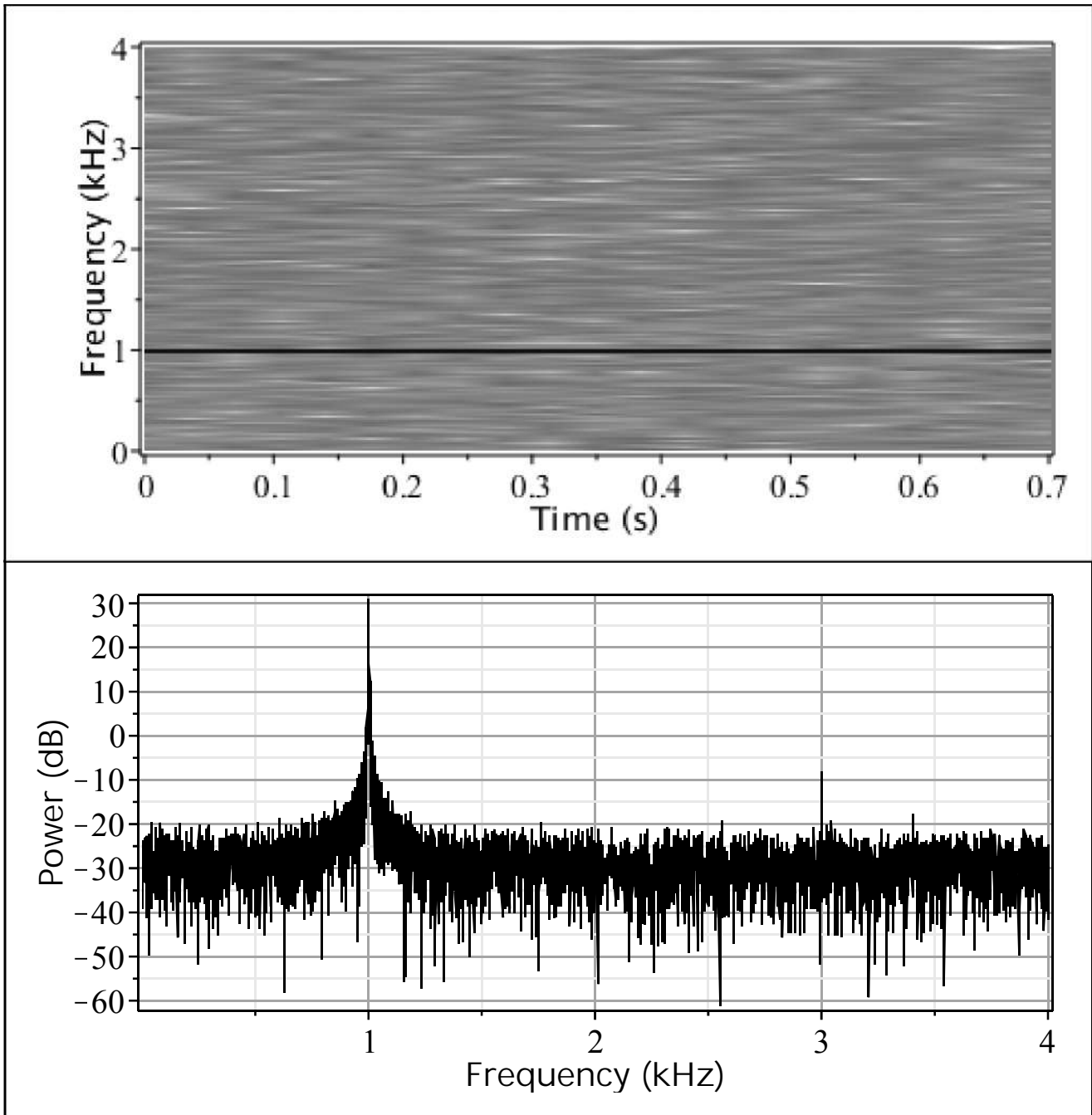


## ▼ 1KHz Wave

Note that the spectrogram and power spectrum both identify a peak at 1 KHz

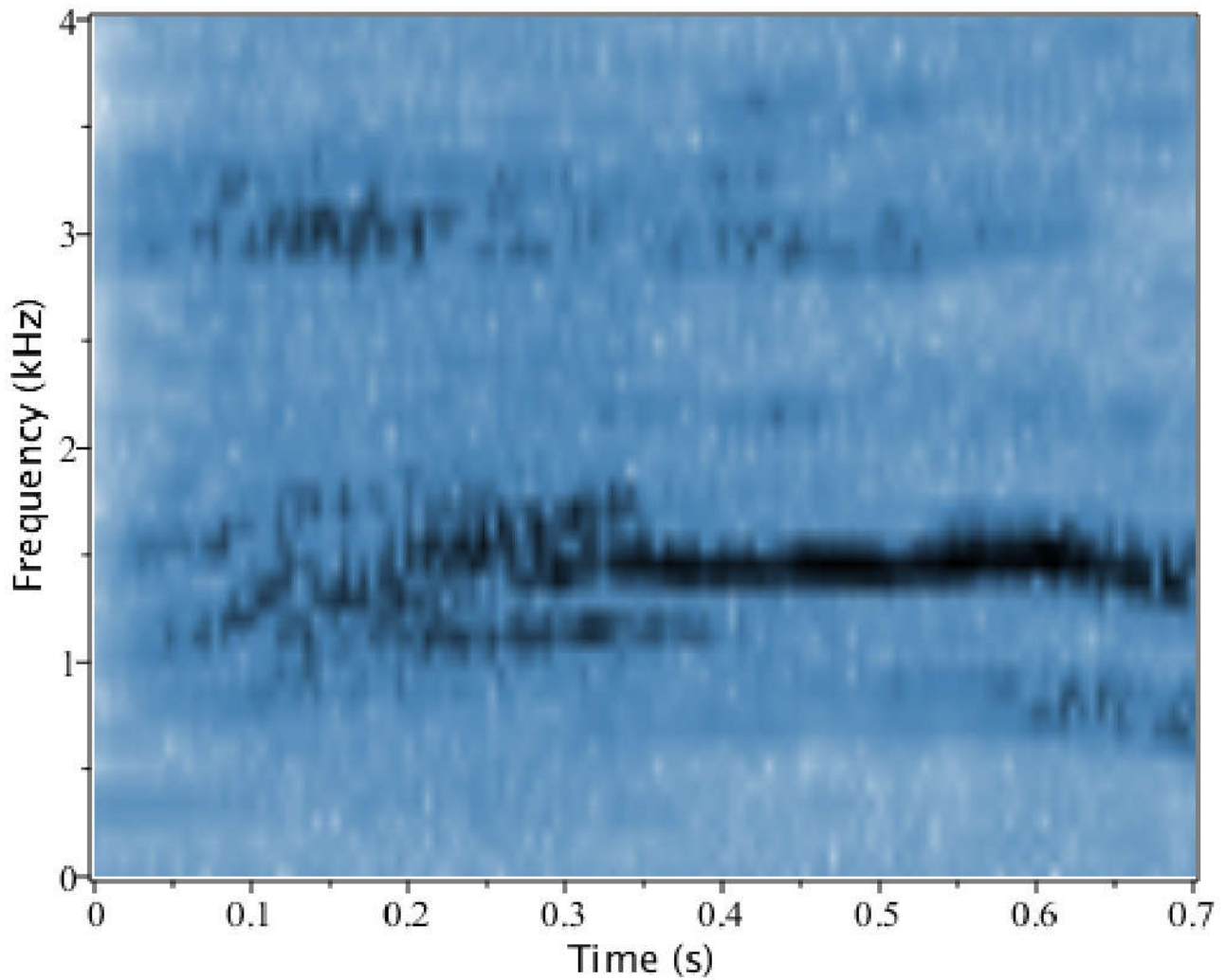
- > `f8 := AudioTools:Read("1khz.wav") :`
- > `Spectrogram(f8, colorscheme = ["zgradient", [white, black], markers = [0, 1]], fftsize = 512, size = [800, 400], view = [0 ..0.7, 0 ..4], includepowerspectrum)`





## ▼ Wilhelm Scream

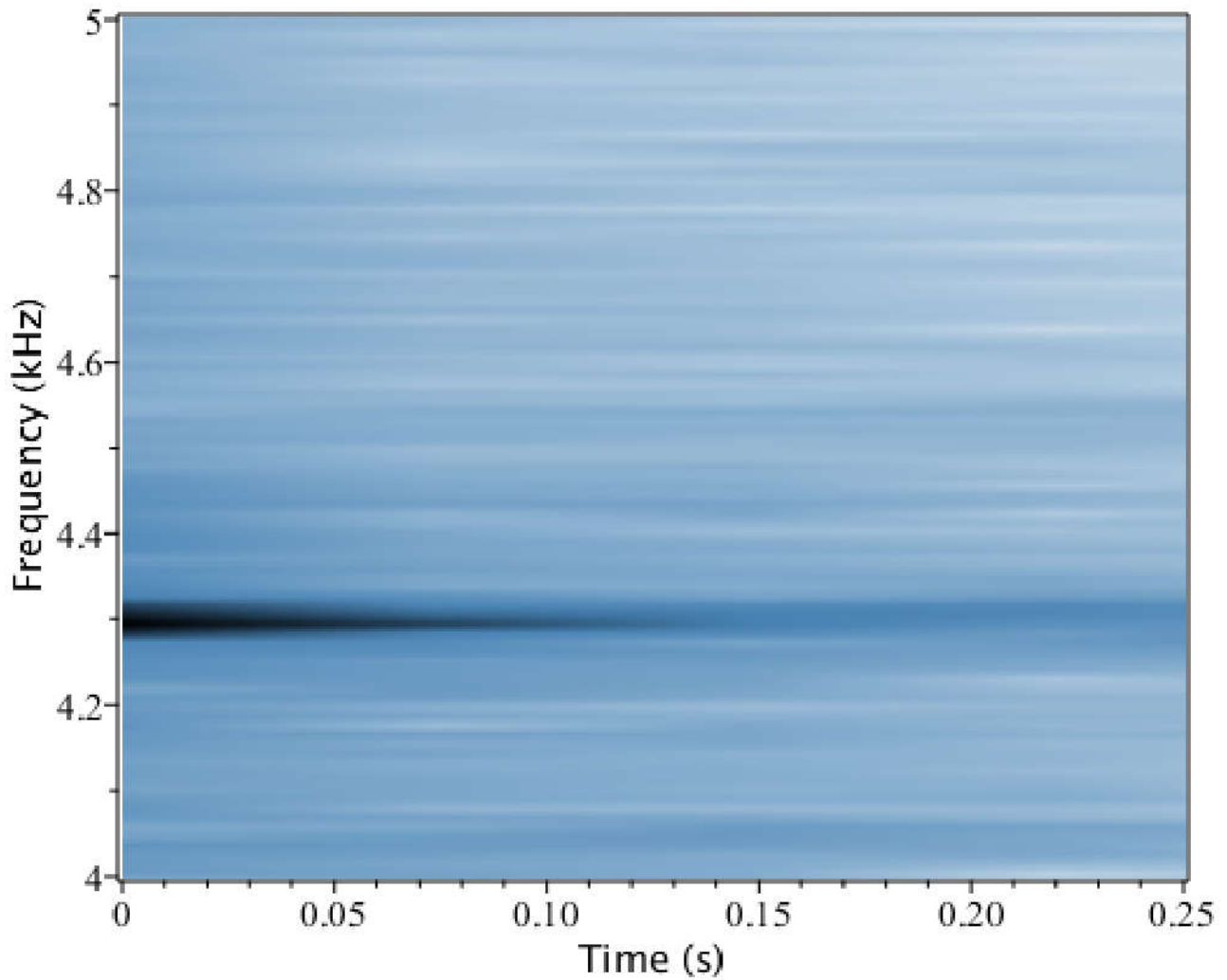
- > `f9 := AudioTools:Read("wilhelmscream.wav") :`
- > `Spectrogram(f9, colorscheme = ["zgradient", [white, SteelBlue, black]], markers = [0, 0.85, 1], fftsize = 512, size = [800, 400], view = [0..0.7, 0..4], channel = 1)`



## ▼ Piano Note C8

Should have a frequency of 4186 Hz

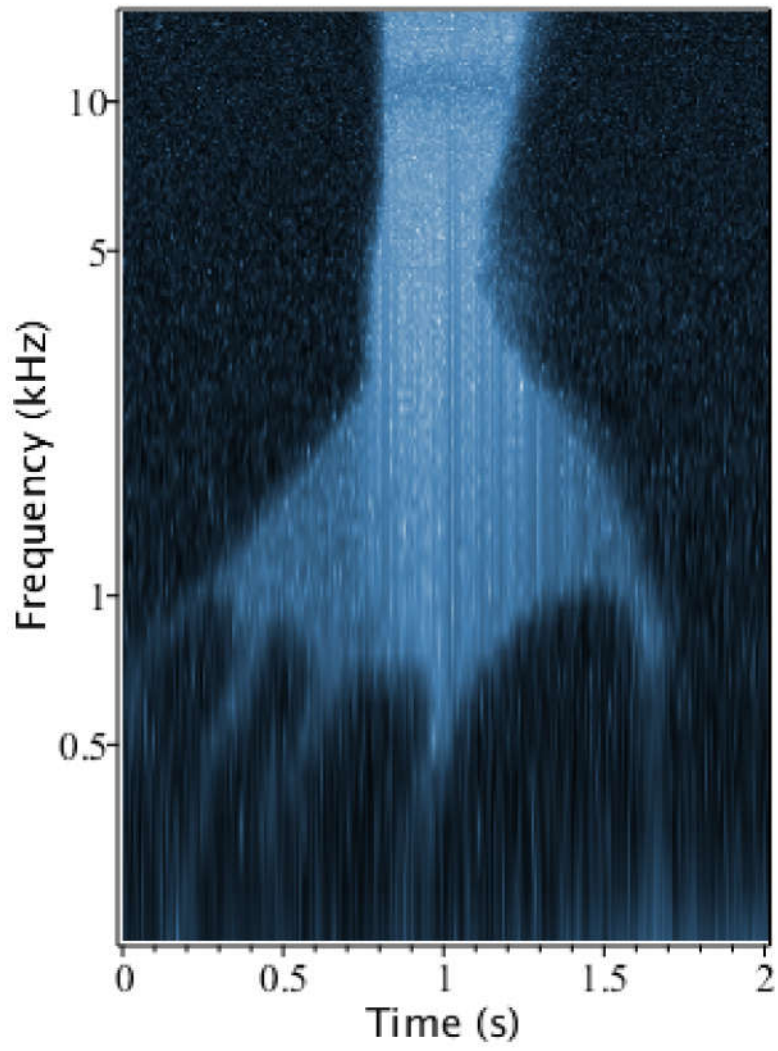
- > `f10 := AudioTools:Read("pianoFF_C8.wav") :`
- > `Spectrogram(f10, colorscheme = ["zgradient", [white, SteelBlue, black]], markers = [0, 0.9, 1]), fftsize = 212, size = [800, 400], view = [0 .. 0.25, 4 .. 5], channel = 1)`



## ▼ Nine Inch Nails

An image hidden in a spectrogram of the song "My Violent Heart" on the album "Year Zero"

- > `f11 := AudioTools:Read("nineinchnails.wav") :`
- > `Spectrogram(f11, colorscheme = ["zgradient", [white, SteelBlue, black]], markers = [0, 0.5, 1]), fftsize = 29, size = [300, 400], reduceplot = 1, axis[2] = [mode = log], view = [0..2, 0.2..15])`



Compare to the "Year Zero" album cover

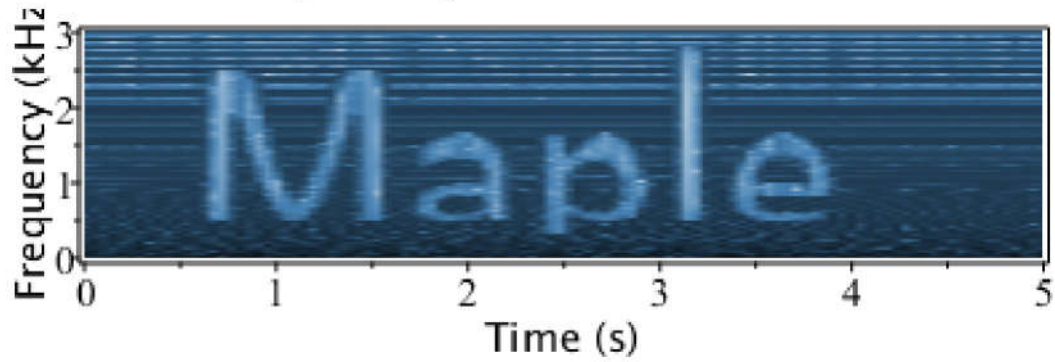


## ▼ Maple

A message hidden in a spectrogram...

> `f13 := AudioTools:-Read("maple.wav") :`

> `Spectrogram(f13, colorscheme = ["zgradient", [white, SteelBlue, black]], markers = [0, 0.5, 1], fftsize = 211, channel = 1, view = [0..5, 0..3])`



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