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AUD175 Project 1 HD Exemplar

Gareth Parton

AUD175 Project 1: Analysing Sound

Student Name: EXEMPLAR

Student Number: xxxx

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Audio Analysis

Audio Analysis 1

This is **a recording of traffic noise at Victoria Square / Tarntanyangga, Adelaide, South Australia.** Recording was done using a microphone built as a **coincident pair,** a pair of directional mics that are angled symmetrically from the center line. *(Bartlett & Bartlett, 2016, p. 111)*

This audio recording is a complex waveform made up of multiple inharmonic sounds, originating from background ambient noise and vehicles in traffic. **The sudden, harsh timbre of a vehicle's hydraulics as well as another vehicle's brakes are audible amongst the otherwise relatively indistinct noise.**

Frequency analysis tool: *Insight 2 within Avid Pro Tools*

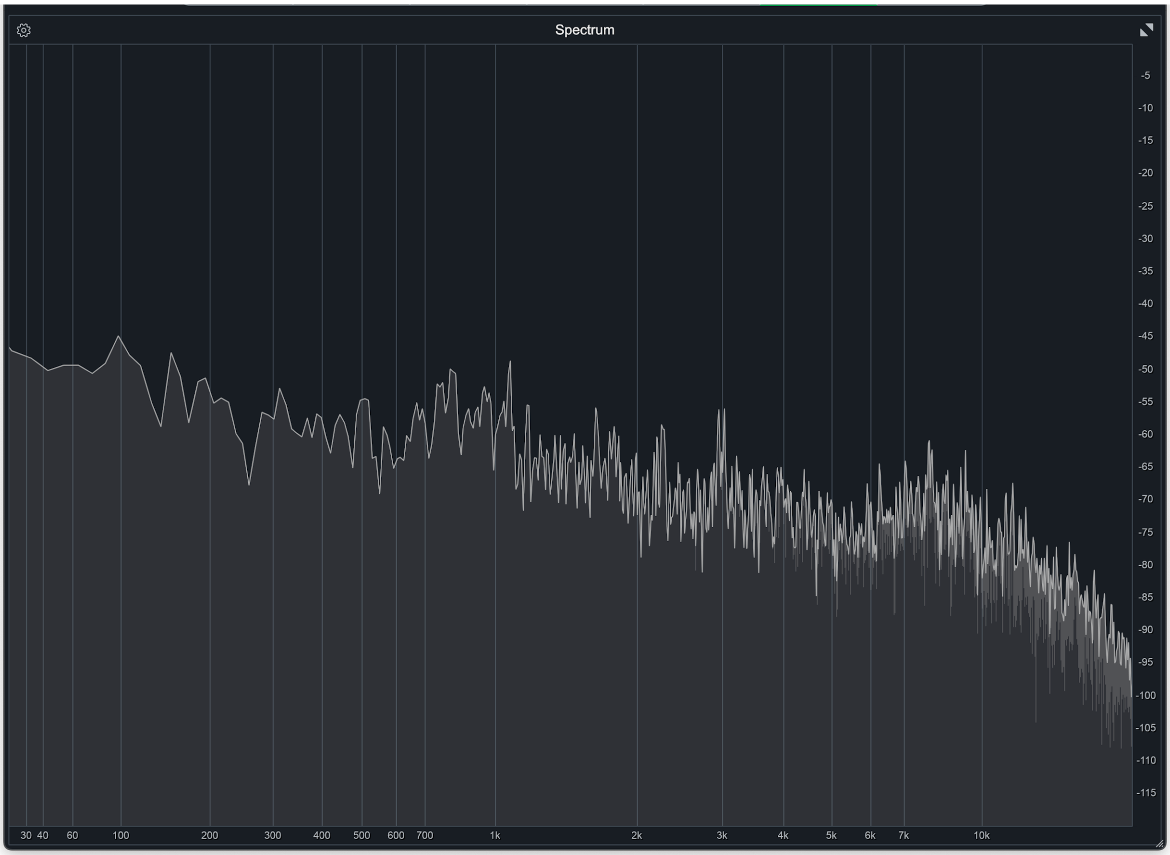

Figure 1: Screenshot of traffic noise visualised in Insight 2's Spectrum tool

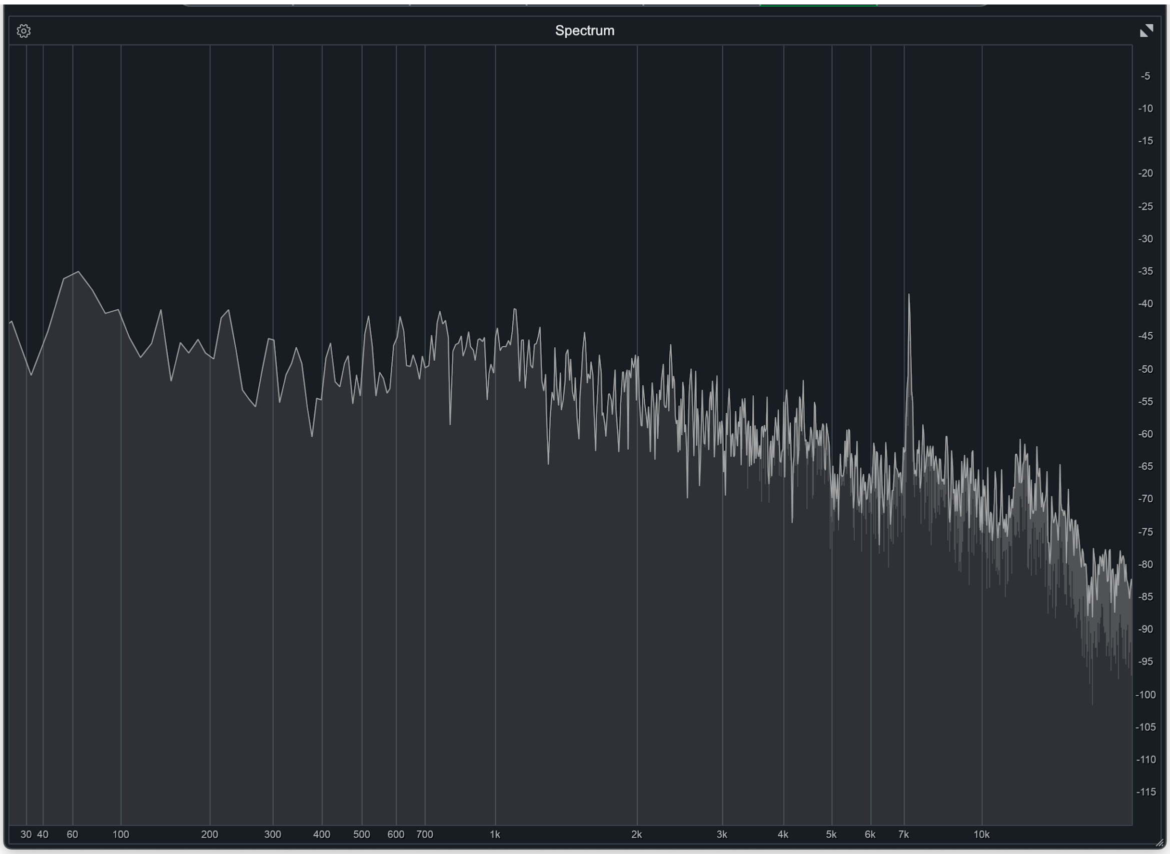

Figure 2: Notice the increase in amplitude at ~7.2k kHz.

This frequency analysis shows no particular musical harmonic information; what it does show me is a spectrum of broadband noise that I liken to pink noise, described as “a signal of random noise with equal energy per octave.” *(Bartlett & Bartlett, 2016, p. 485)* While not an exact match, the correlation I observe is that the traffic produces a spectrum that, like pink noise, is more intense at lower frequencies and less intense at higher frequencies. However, there are also some noticeable spikes observed with the recording of a vehicle using its brakes, the spikes occurring at ~7.2 kHz (Figure 2) and ~4.2 kHz (Unfortunately, due to user error I was unable to catch this particular screenshot cleanly).

Taking a closer look at the frequency bands and amplitude in Figure 1, the majority of the recording appears to hover around -50 to -40 dB on the lows, while the mids hover closer to -70 to -60 dB. In Figure 2, we can observe the ~7.2 kHz spike where that frequency briefly rises to just above -40 dB, and we can see the spike is concentrated around that area. Figure 2 was taken after I had seen the spikes on the spectrogram analysis, as I found it easier to see where the spike occurred on the frequency band this way.

Waveform analysis tool: *Avid Pro Tools*

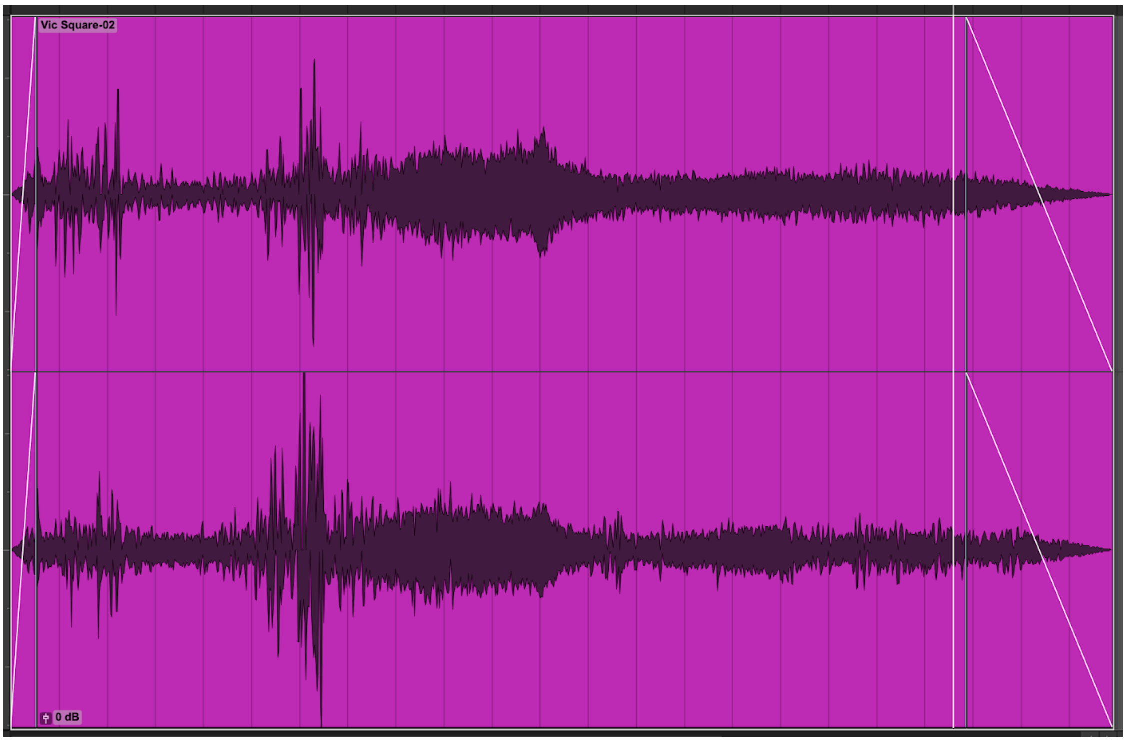

Figure 3: Screenshot of Waveform in Pro Tools

The waveform of this recording has a somewhat chaotic envelope, with a transient attack at the beginning after the fade where something like hydraulics were heard, and peak in amplitude some time later which showed that the largest spike in the waveform appeared noticeably larger on the right channel than on the left channel. That spike had me particularly curious, so I went back to replay the audio recording; Upon listening in, this was where a vehicle began to use the brake, with some lower frequencies also being heard, likely from the wind. To me, this suggested that the right microphone of the coincident pair was picking up more signals than the left, which tells me that the direction the sound was coming from was closer to the right of where I stood with the recording device at the time.

As this waveform was a recording of traffic noise, there isn't really an identifiable envelope of any individual sound, and thus no way to identify natural ADSR - that is, attack, decay, sustain and release. Instead, there are several audio signals being constantly mixed together as the envelope occurs with each individual sound being recorded. Curiously, this waveform may not quite match up with the way the sound plays out and where it spikes on the Spectrum and Spectrogram tools on Insight 2; neither tool showed me a drastic increase in dB output to the extent that it would be clipping on the right channel, but I suspect it might have been to do with the wind blowing on the microphones rather than any undesirable artefacts from the recording device.

Spectral analysis tool: *Insight 2 within Avid Pro Tools*

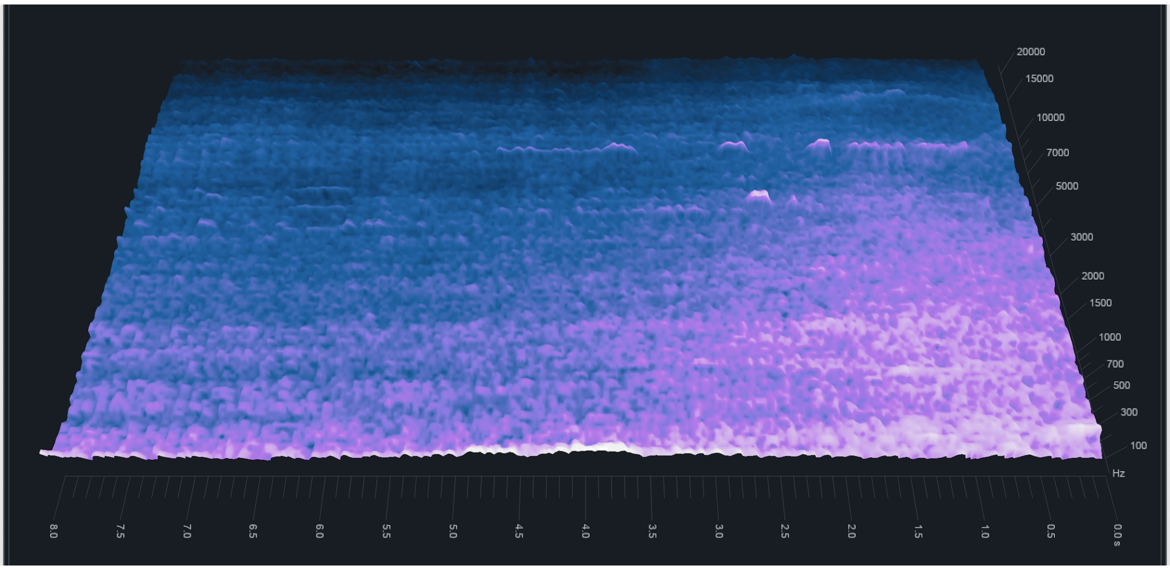

Figure 4: Screenshot of Spectrogram in Insight 2 for traffic noise - Front High view

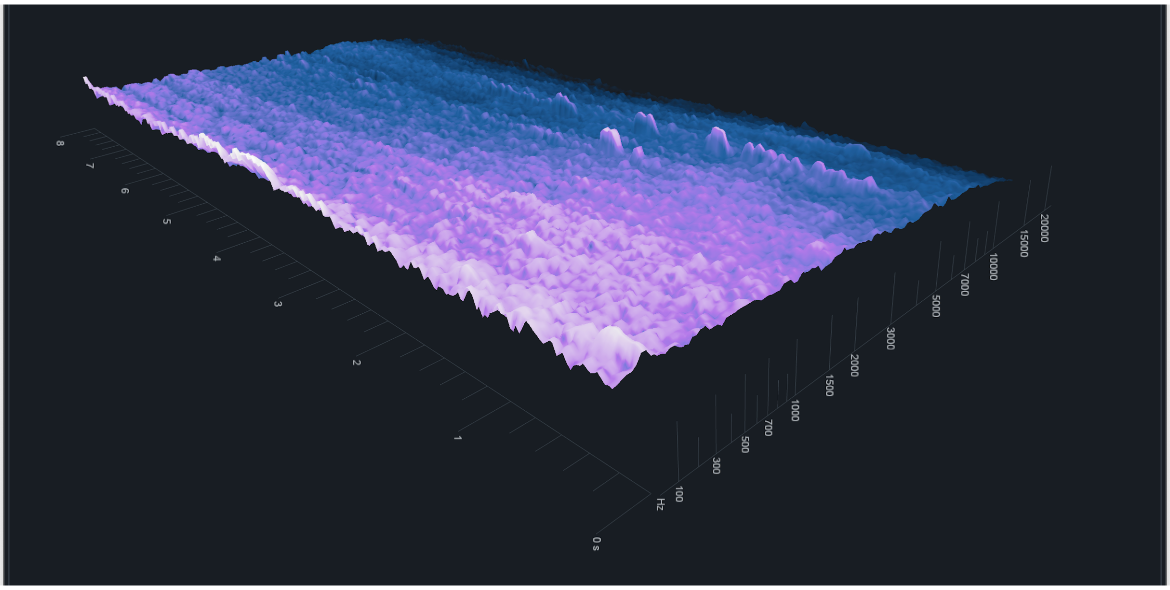

Figure 5: Spectrogram for traffic noise - Diagonal view

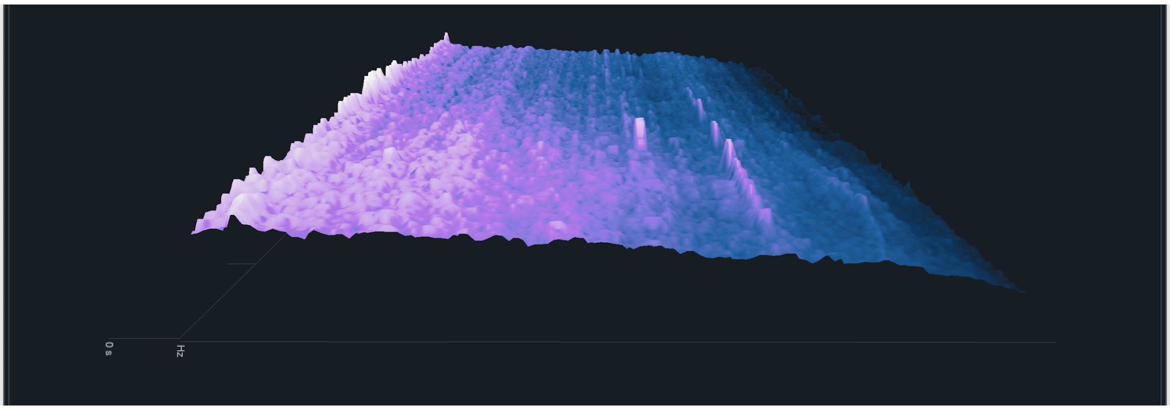

Figure 6: Spectrogram for traffic noise - Side Low view

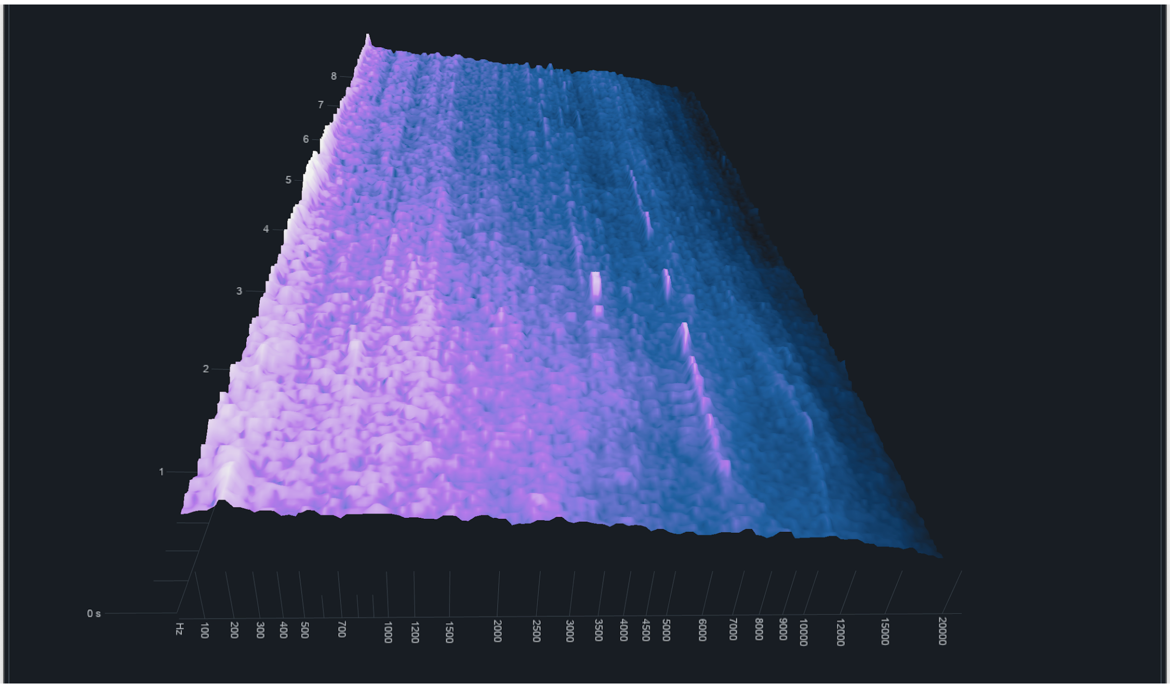

Figure 7: Spectrogram for traffic noise - Side High view

These screenshots of the Spectrogram tool allow us to observe the unusual spike in frequency previously described in the frequency analysis in greater detail over time; particularly, this is where I first noticed the ~7.2 kHz and ~4.2 kHz spikes before observing them in the spectrum visualiser (Figure 1/Figure 2). In Figure 4 and Figure 5 you can see both of their peaks in amplitude last for less than a second of real time, but also that the ~7.2 kHz frequency spikes up for longer overall, multiple times in the recording.

These figures also allows us to visualise the overall increase in amplitude for the recording at the point where I took the screenshot, which consistently got brighter throughout all frequencies closer to the 0 second mark of time elapsed, telling me that the amplitude increased as the recording went on; when matching this to the audio file itself, you could make the observation that the increase in amplitude was due to the traffic approaching closer to the audio recorder at the time.

Audio Analysis 2

This is **an audio recording of a kick drum,** recorded using a coincident pair microphone in the Live Recording Booth at SAE Institute Adelaide.

This audio recording is **a complex but short waveform, consisting of a transient made up of primarily low frequency signals that originated from a kick drum.** This means the audio decays quickly after the initial, sharp attack. **The timbre -** that is, “the quality of tone distinctive of a particular singing voice or musical instrument” *(Merriam-Webster Dictionary, n.d.)* - can be described as **a dull thump.**

Frequency analysis tool: *Insight 2 within Avid Pro Tools*

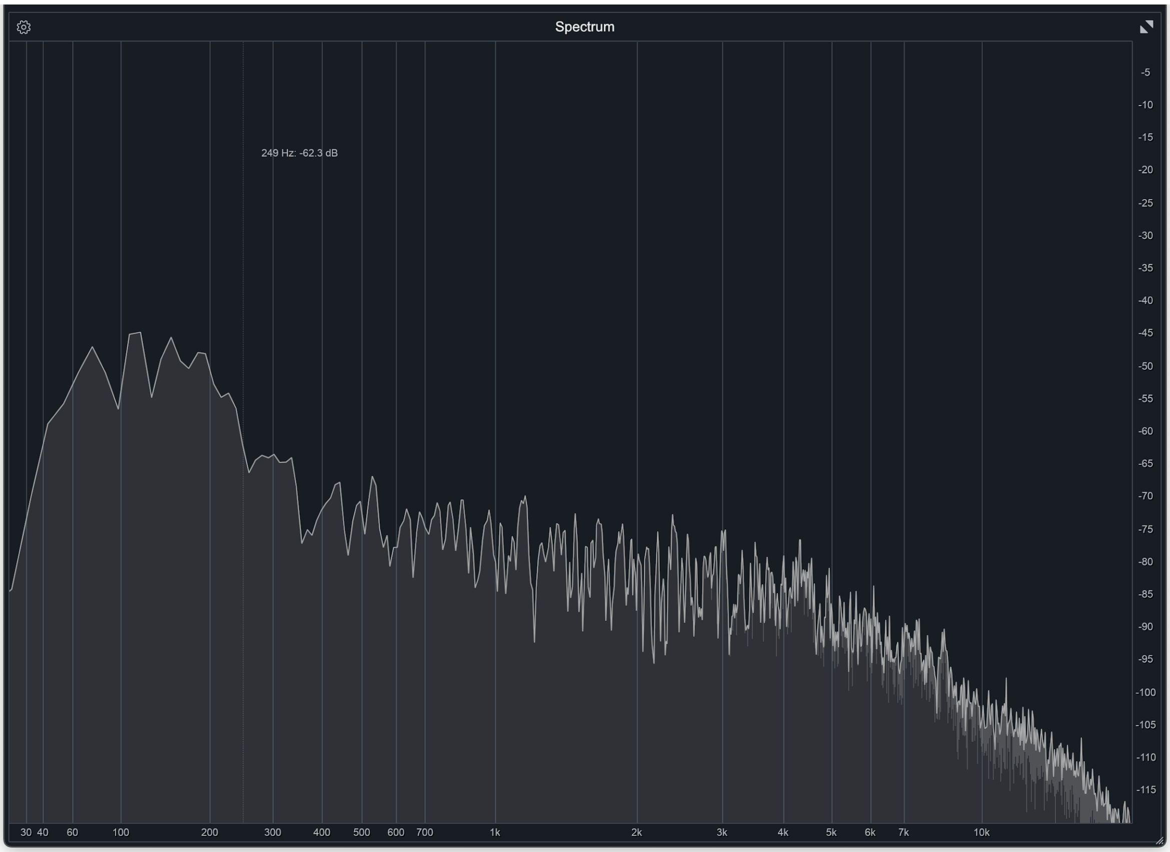

Figure 8: Screenshot of kick drum visualised in Spectrum on Insight 2

The Spectrum analysis of the kick (Figure 8) shows that the frequency of the kick drum is primarily made up of low frequency signals, though it also displays some audible mids as well. Notably, unlike the traffic, the frequency band shows lower amplitude for the mids (hovering around -70 dB) and highs (going from -85 to -115 dB), compared to the lows which peak at around -45 dB, similar to the traffic. There’s no observable harmonics that I could see from this spectrum, but you could perhaps consider the fundamental frequency to be ~120 Hz from Figure 1.

Waveform analysis tool: *Avid Pro Tools*

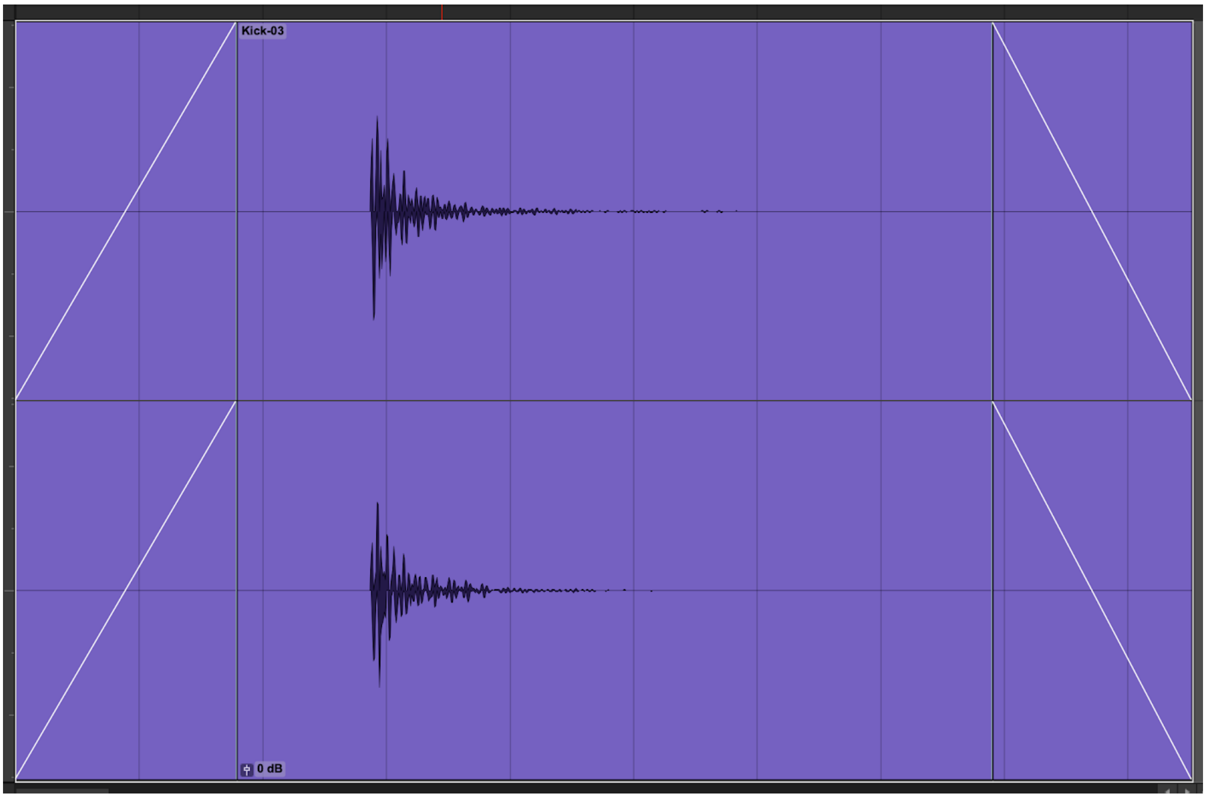

Figure 9: Screenshot of kick drum waveform in Pro Tools

The waveform analysis as seen in Figure 9 displays a transient envelope for the kick drum - that is, it contains a quick and sharp attack that quickly decays and releases without much sustain. Merriam-Webster Dictionary defines the word “transient” in an audio context as a noun, calling it “a temporary oscillation that occurs in a circuit because of a sudden change of voltage or of load.” *(Merriam-Webster Dictionary, n.d.)*

Just as the definition implies, one can observe the transient and its rapid decay, with only small, practically inaudible waveforms remaining for a short period of time. Notably, the artefacts remaining at the tail end of the waveform appear to present themselves more on the left channel than the right channel, which lines up with the slightly louder amplitude observed from the rest of the waveform on that channel. Both of these observations are what I believe to be a result of my position at the time this sound was recorded, where the drum was to the front-left relative to where I pointed the recording device.

Spectral analysis tool: *Insight 2 within Avid Pro Tools*

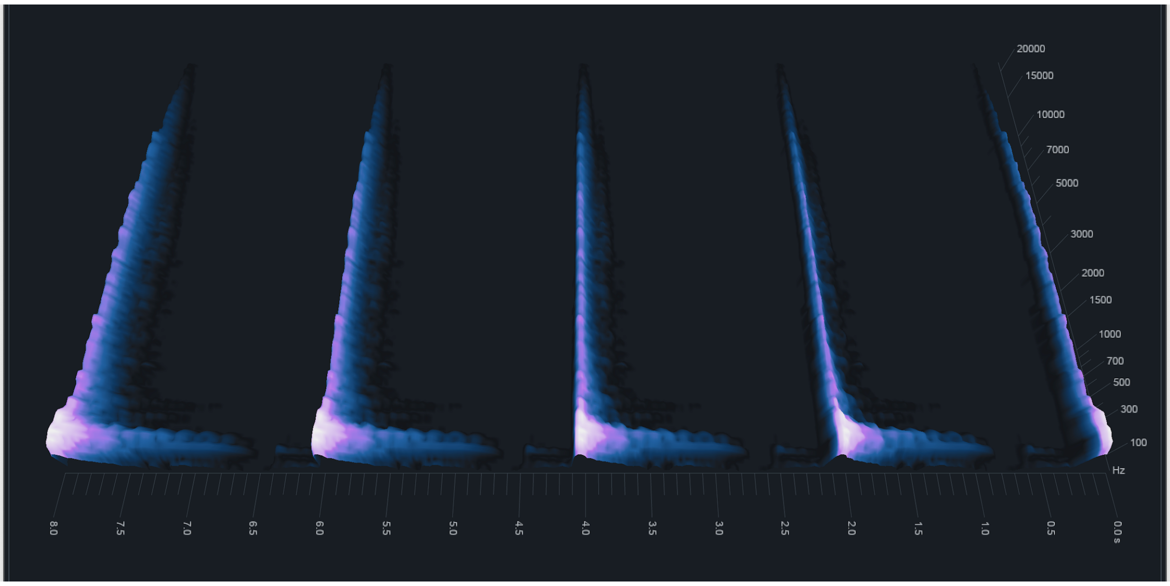

Figure 10: Screenshot of Spectrogram in Insight 2 for kick drum - Front High view

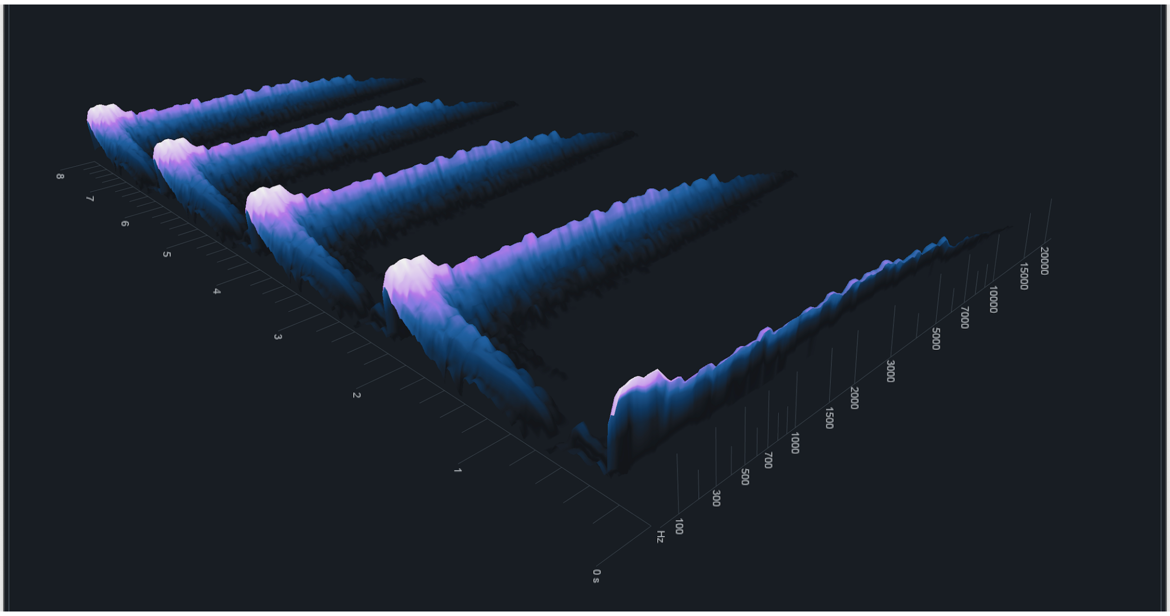

Figure 11: Spectrogram for kick drum - Diagonal view

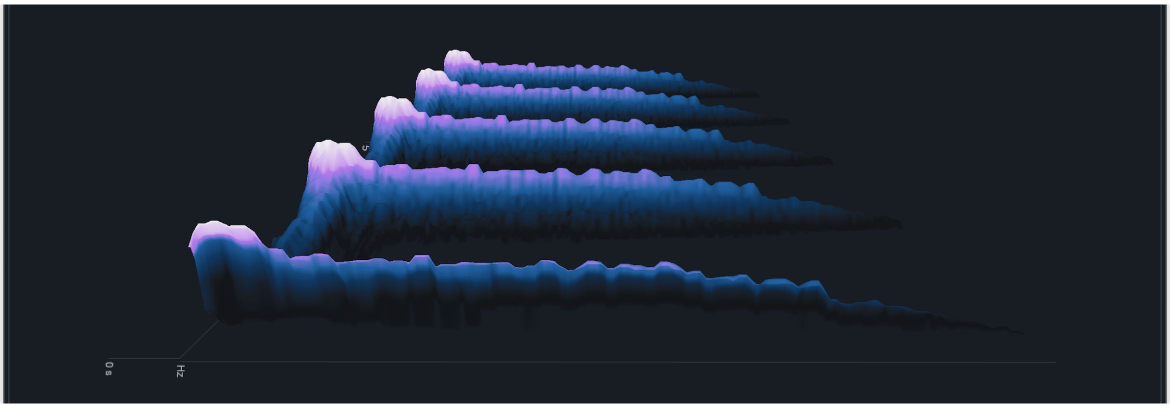

Figure 12: Spectrogram for kick drum - Side Low view

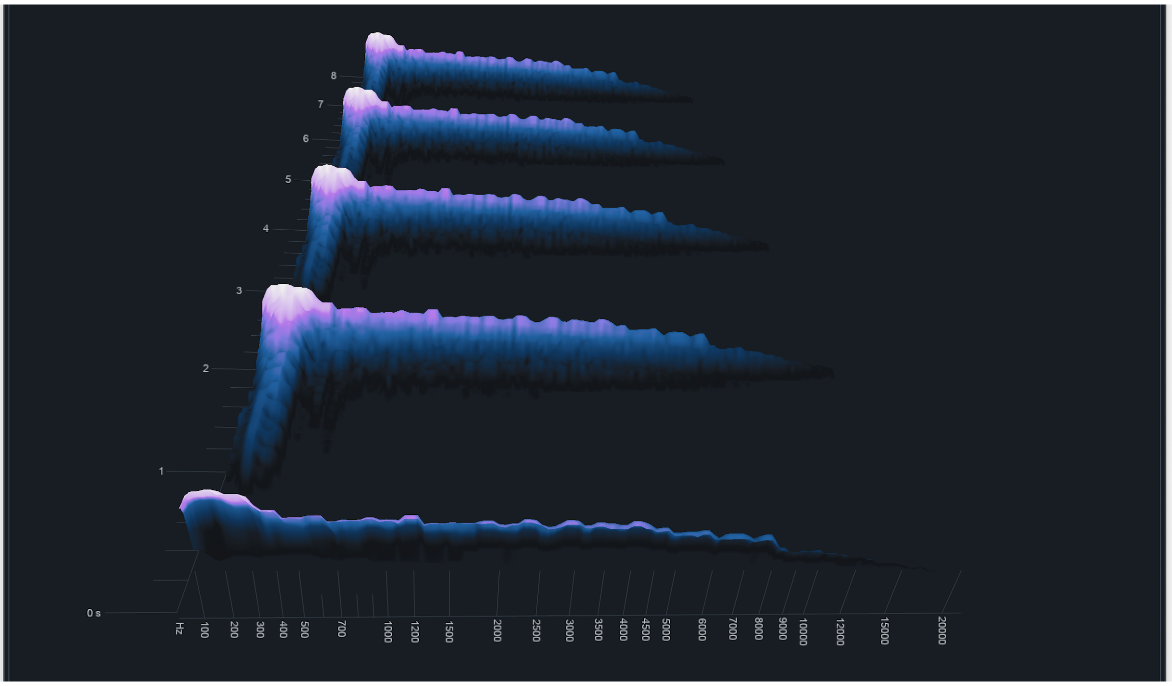

Figure 13: Spectrogram for kick drum - Side High view

The Spectrogram tool shows what I expect to see based on the Spectrum tool and waveform display - that is, a transient signal with a rapid decay made up primarily of bass frequencies. Strangely, though, this particular tool shows me an artefact of a low amplitude, low frequency signal (Figure 10) which isn't visible in the waveform or the Spectrum display. Upon listening to the original recording, my only guess is that the artefact was some sort of noise from the kick pedal or the foot hitting it, as otherwise the signal is practically inaudible right before the transient.

Audio Analysis 3

This is a recording of **a flute playing a harmonic C Major scale,** sourced from project files provided to us by our lecturer.

This audio recording is **a complex waveform made up of primarily harmonic signals and overtones, with a relatively high pitch and a soft timbre.**

Frequency analysis tool: *Insight 2 within Avid Pro Tools*

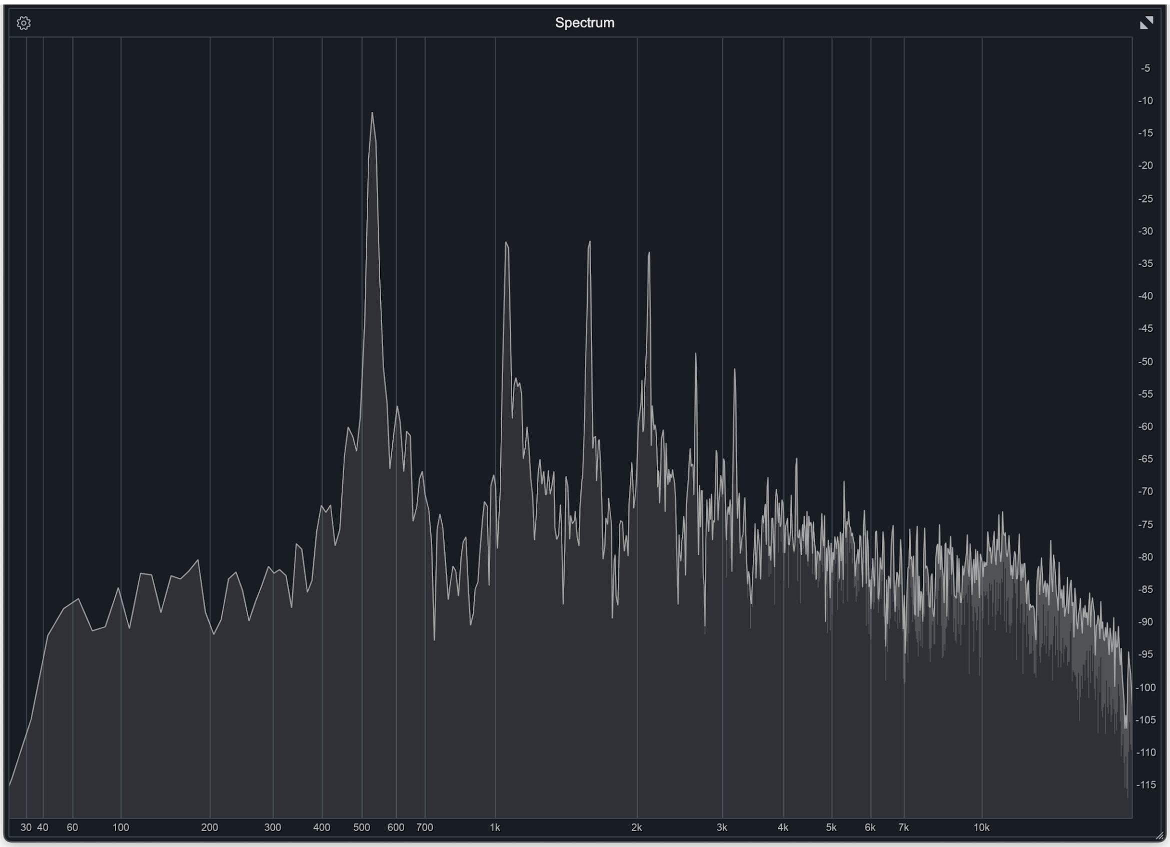

Figure 14: Screenshot of flute visualised in Spectrum on Insight 2 - low C note

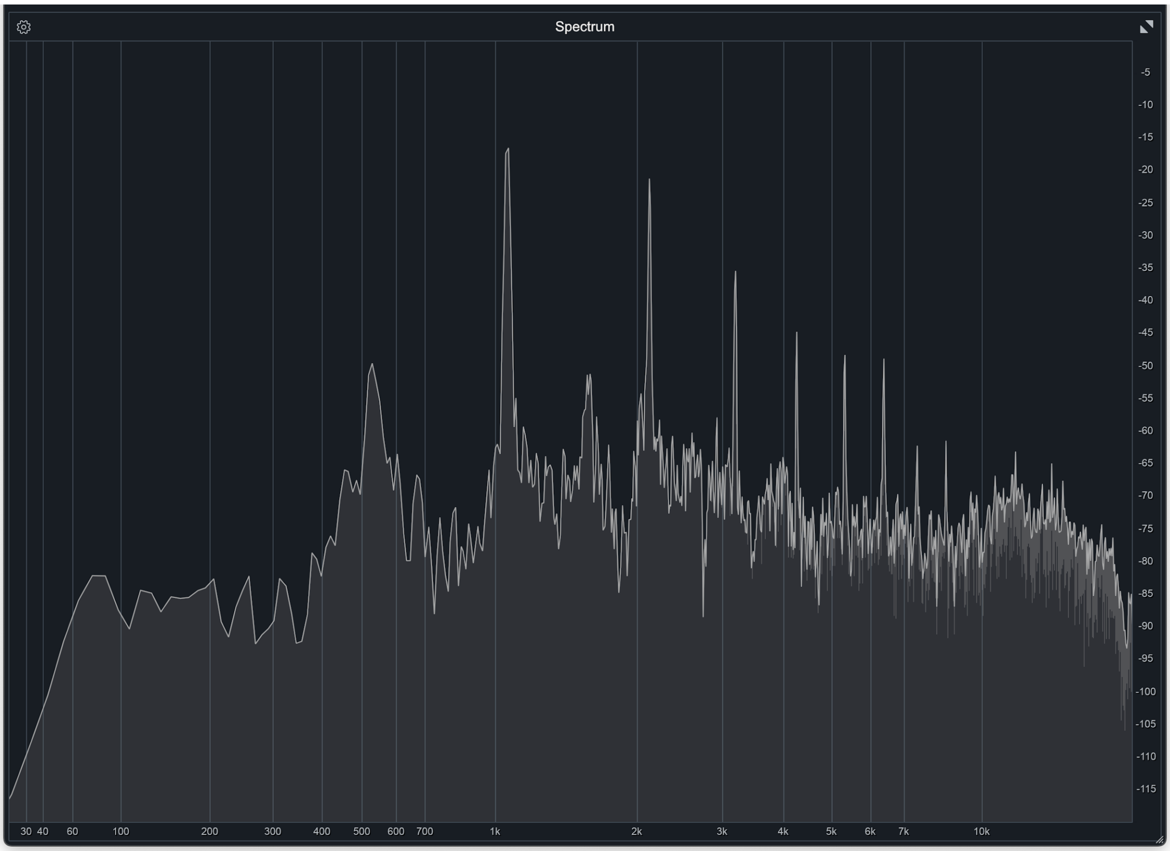

Figure 15: Spectrum tool visualising frequency of flute - high C note

The Spectrum tool is able to show me the harmonic overtones of the flute as it is being played, as well as identify the fundamental frequency which appears to sit at around ~520 Hz. Strangely, although Figure 15 shows a frequency about ~1.1 kHz as the most audible frequency at -15 dB (same as Figure 14's fundamental) and by all means should be the fundamental frequency of this recording, the ~520 Hz frequency is still experiencing a noticeable increase in amplitude which makes that same lower C note audible if you listen closely.

Waveform analysis tool: *Avid Pro Tools*

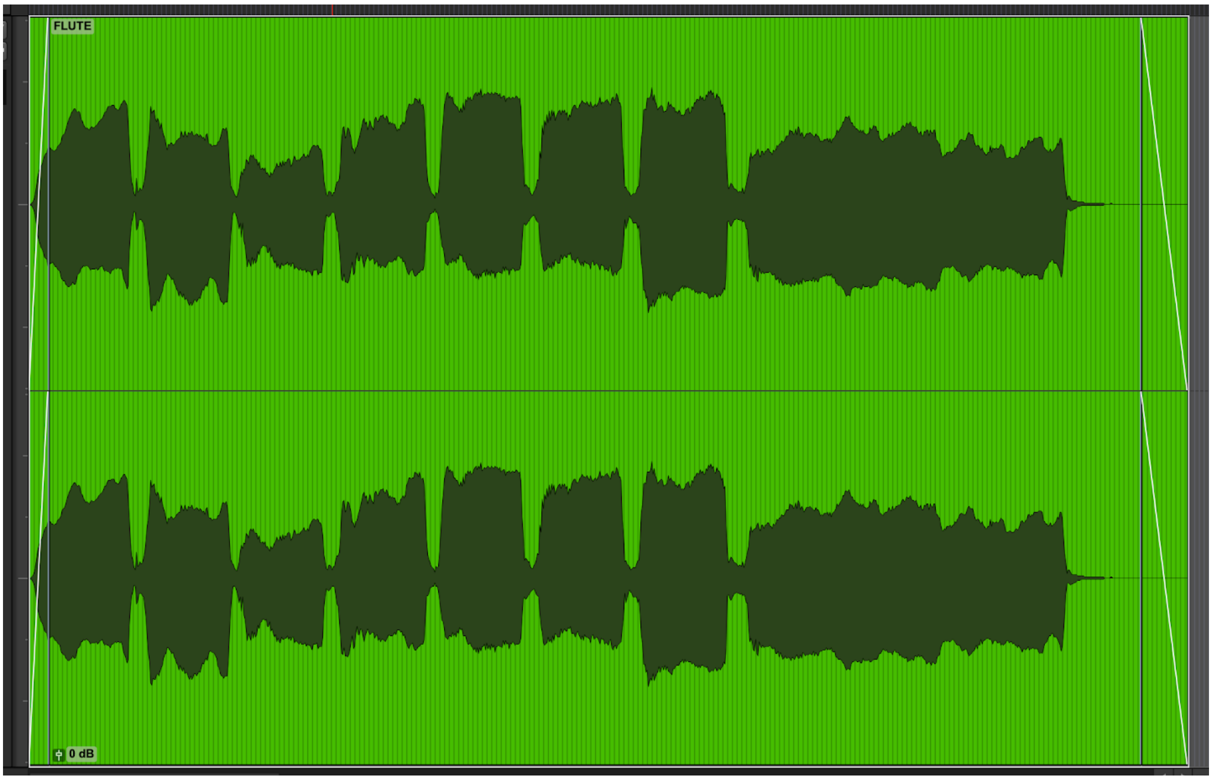

Figure 16: Screenshot of flute visualised in Spectrum on Insight 2

The waveform analysis (Figure 16) shows that the envelope of each individual tone played on the flute has a relatively quick attack with little to no decay before the sustain, which appears relatively consistent. This is then followed by a quick release. In between each note of the octave scale, there are still some audible signals from the performance, perhaps from the flute player’s mouth as they blow into the flute. Lastly, when the flute is released at the end, there remains a small waveform that decays slightly later than the rest of the audio.

Spectral analysis tool: *Insight 2 within Avid Pro Tools*

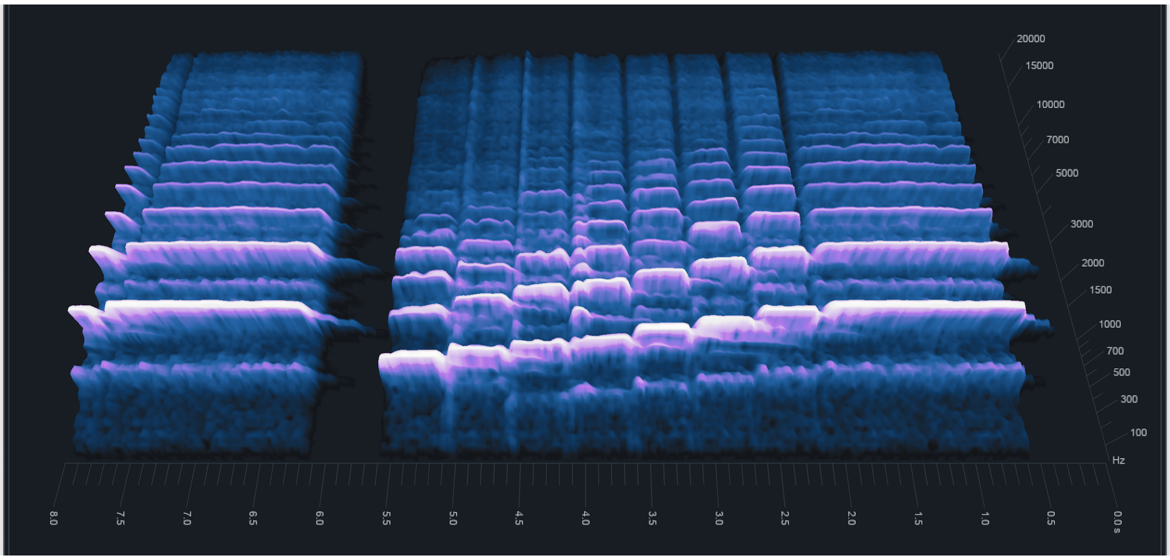

Figure 17: Screenshot of Spectrogram in Insight 2 for flute - Front High view

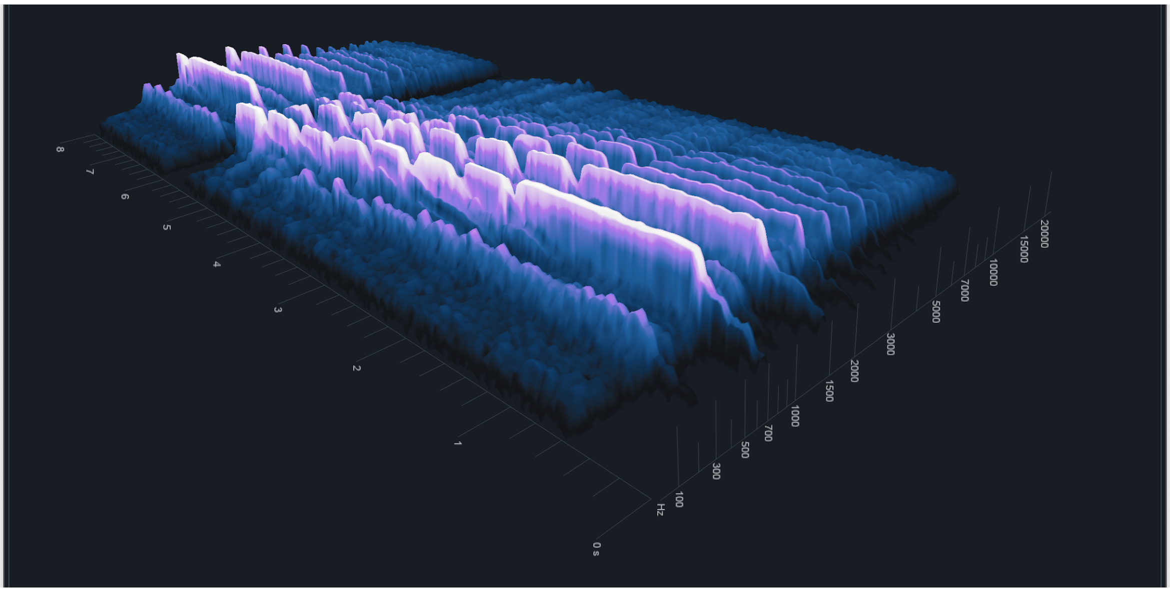

Figure 18: Spectrogram for flute - Diagonal view

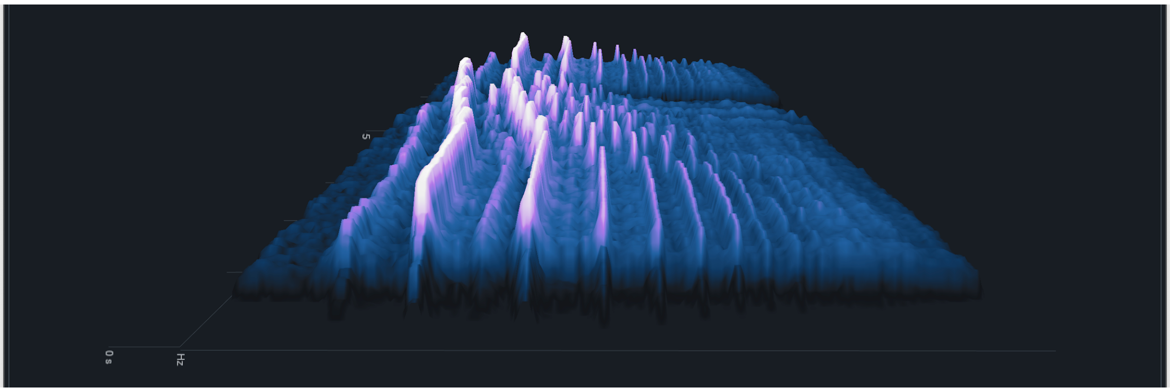

Figure 19: Spectrogram for flute - Side Low view

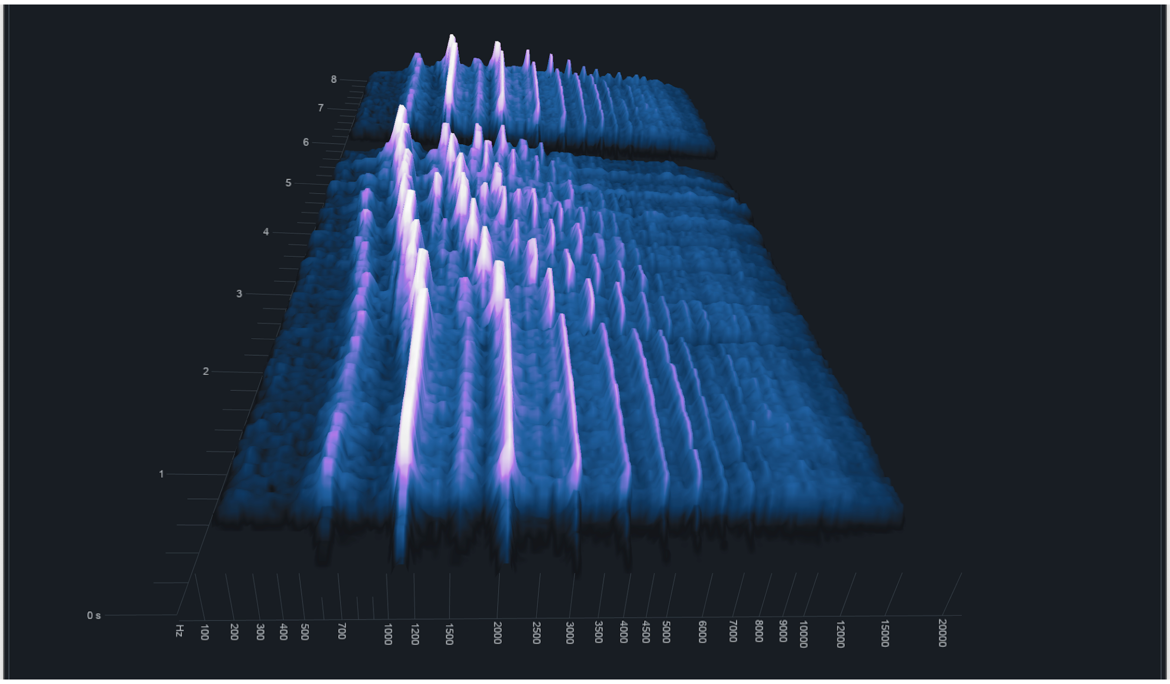

Figure 20: Spectrogram for flute - Side High view

The Spectrogram tool allows us to see the progression of harmonic overtones in real time for the flute, with the peaks and fundamental frequency of each note easily identifiable; however, it also shows that starting at the E note (Figure 17, at the 4.5 second mark), a noticeable bump in amplitude for a lower frequency begins to show, and continues doing so as the player ascends the octave, just like what was shown in Figure 15. These harmonic tones may very well be their own fundamental relative to the actual note being played, which would be what we think is the actual fundamental frequency of the waveform at that time.

Project Conclusions

The Spectrum tool allows us to visualise frequency and amplitude at a glance, with the visualisation changing in real time according to the audio that Insight 2 is attached to. For me, as it can be a little difficult to read the 3D visualisation on the Spectrogram at times, I find it useful when paired with the Spectrogram tools to more easily look at frequencies in real time - particularly when monitoring the audio and listening for harmonic content within a sound.

The waveform display allows us to visualise the envelope of a waveform, and is helpful for knowing where you are in time as a sound is being played back in the audio editor of choice. When expanded, I can look at the envelope in various ways very clearly. I'd use this display if I was needing to analyse a specific section of a recording over and over.

The Spectrogram tool allows us to visualise frequency and amplitude over time, showing passage of time on the X axis and the frequency band on the Y axis, similar to the Spectrum tool. The 3D visualisation, which can be customised to user preference, shows amplitude - though it does so without a precise value like you would see on the Spectrum tool. I find it useful for observing individual frequencies on the envelope of a sound as well as observing harmonics, which can easily be seen in the analysis of the flute recording where the fundamental frequency and overtones are clearly identifiable.

Although all three tools - Spectrum, waveform display and Spectrogram - are very visually helpful in various ways, there's only so much that a single frame of visualisation from each tool can tell you; without any audio reference to go with it (i.e. the actual audio playing on your monitor of choice), there's not a lot of information to gather about the actual noises present in the recording. As such, I feel that it's important to use multiple analysis tools to get a more complete visual of the characteristics of a single sound, especially if the users are overwhelmed by how exactly to navigate the Spectrogram tool's 3D visuals which are able to display lots of different information at once.

Using these tools will allow me to get a better picture of the overall characteristics of an audio recording, and I strive to make it a habit so I can gather as much data as I need, since I will more than likely need it for future work in this industry, especially when it comes to altering a sound or recording.

Mid-Project Reflection

Process: I lack experience in this industry and with this sort of work, and since this is my first time doing this sort of analysis, I believe repetition is the best way to get used to the process. I've also never opened the programs that we will be using before, so I may need to learn the interface itself before I get started.

As things stand currently, I am not used to using industry terminology to describe audio, so one of the actions I'm undertaking is to type up notes so that the knowledge is stored somewhere I can refer back to at a glance. One such term is "harmonics," the word of which I'm particularly interested in as well related terms that surround it, such as "envelope," "fundamental frequency" and "distortion," slowly learning over the few weeks I have undergone this module thus far with pre-class learning and reinforcing that same knowledge in class.

Throughout this module, I have found a particular resource extremely useful: *Practical Recording Techniques : The Step-By-Step Approach to Professional Audio Recording,* by Bartlett & Bartlett. I've been using this resource a lot during this module to reinforce my learning, with Chapter 2: Sound and Psychoacoustics from the 7th Edition published in 2016 being a helpful reminder of the concepts from the module thus far, such as frequency, harmonics and envelopes, as well as some information somewhat beyond the scope of what we were learning.

As an example, I sought out a proper definition for the "coincident pair" technique for microphone orientation, remembering that we used recording devices with microphones set up this way and choosing one of the sounds we recorded using it for analysis in this project. In their Audio Glossary, they define the coincident pair as "A stereo microphone, or two separate microphones, placed so that the microphone diaphragms occupy approximately the same point in space." *(Bartlett & Bartlett, 2016, p. 446)*

Another resource I have found helpful for reinforcing my understanding of audio was this site called Music Theory Academy, which had a helpful article on understanding timbre, a concept I'm still relatively new to. Timbre is defined on the site as "describing the tone-colour or tone quality of a sound" *(Dunnett, B. 2020)* and it contained a chart I found helpful for properly describing the timbre of the sounds I was analysing above.

When the project is finished, reflection will help me identify what went well and what went poorly, so that I can improve for next time; at first I will be focusing on improving weaknesses in my process to improve on my workflow, but over time I should be able to reach a point where I can focus on increasing my overall efficiency, identifying improvements to processes that are currently working but could be better overall.

Person: This project will require the communication of the correct language to demonstrate a proper understanding of audio. I have been using Slack for my other modules to receive feedback, so when we're out of class I will likely use it to communicate with my lecturer and other students to receive peer feedback.

Proficiency: I believe that observation, focus and attention to detail will be key skills to utilise during this project. As I'm still relatively new to learning about the fundamentals of audio, I have much room for improvement in terms of knowledge in general, and as I am more of a hands-on learner, I believe practical application is the way that works best for me to reinforce my learning in the field of audio engineering.

Word count: 552

Project-Completion Reflection

Appraisal: I would say that overall, this project was very successful, though perhaps it fell off towards the end in terms of the amount of material I wrote. My burgeoning enthusiasm for the depth of the audio industry is only really halted by my lack of knowledge, but I would say what I did learn helped point me in the right direction to find useful resources to reinforce my knowledge in the middle of this project.

I deliberately chose three distinct sounds with different types of waveforms to hopefully demonstrate my audio knowledge in different ways, and in that sense, I'm happy with what I've written. Particularly, I was very happy with what I wrote in Audio Analysis 1; I knew that amongst the live recordings we made for this project during Week 4, the traffic noise would be an interesting recording to analyse as there was the potential to identify individual sounds that stood out amongst the ambience.

Challenges: The biggest challenge with this project, arguably, was simply staying on top of the learning material. I've found myself entering my AUD175 sessions lacking sleep, so processing the information we were given was more effort than was really necessary, and in a sense I still feel like I haven't fully grasped certain concepts thanks to this consistency. This causes me to miss even small things that were taught to us during sessions, such as some basic shortcuts for Mac and Pro Tools.

In addition, I feel like I'm not able to reinforce that knowledge very well due to not owning a Pro Tools license, nor a separate computer or laptop in which I can open the program at any time without needing to visit SAE Institute itself. As such, I don't have the freedom to experiment with the program as I wish, and this isn't a particularly easy fix due to my desire to have a more powerful desktop computer at home, as well as a gaming laptop, both of which will incur quite the expense for the sake of a rig I'm confident will be able to handle the multitasking I will be asking of it.

Future Goals: Regretfully, I forgot about the way the Spectrum tool on Insight 2 would allow me to identify harmonics and overtones, as I recall being taught about it in a previous AUD175 session where I could actually see the frequencies as their audible harmonic key using the mouse cursor. Should I need to do a similar project in the future, I think including a couple of screenshots with this information would be a helpful thing to do in the future.

As for other skills and improvements, I would say that learning how to be more efficient with Pro Tools is a high priority - learning more shortcuts, how the tools work and what to do when things go wrong would be helpful. I think that my work ethic of storing my screenshots on Google Drive and organising them into individual folders for each sound I chose worked very well, so I intend to implement a similar ethic for projects in the future, should they necessitate a high amount of screenshots.

Word count: 523

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