Spectra

Documentation

written by Patrik Herman

Before reading anything about Spectra, let's start with a simple project:

1. Click on + to create a new project.
2. Double-click on canvas to create a new note.
3. Press space to play it back.
4. Press T to toggle partials.
5. Select a note. Press Up/Down keys to scroll through partials. Press Shift+Up/Down to move it up/down in current tuning.
6. Try selecting a partial and see what happens!
7. Press Shift+T to add a new tuning change.

Congratulations! A masterpiece is on its way 😉

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1. About Spectra

1.1 What is it?

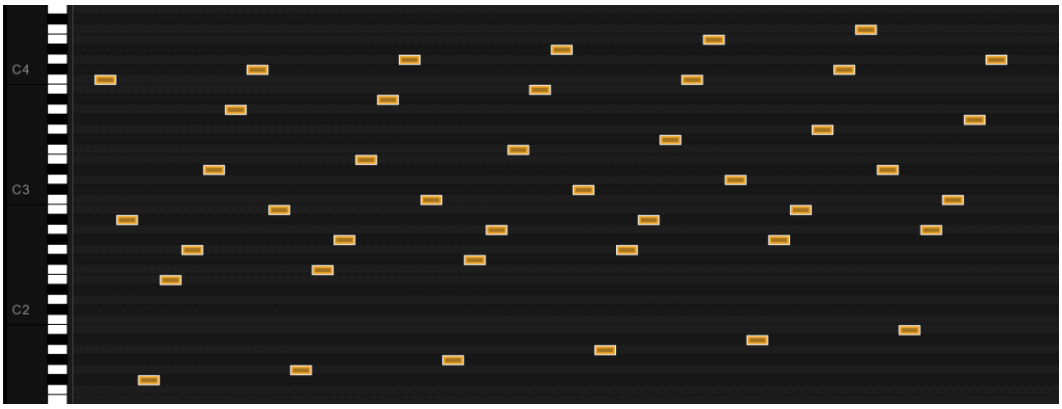
Spectra is a spectral/microtonal sequencer that is based on thinking in partials rather than notes. It is a multi-functional environment that pushes boundaries and makes writing microtonal music much easier and more accessible.

1.2 The history

There are several reasons for why Spectra exists. I have always been fascinated by timbre and connections between tones. I would write lots of little scripts that would test musical limits or they would exist simply to try these ideas out as one-off experiments. Most of them were not meant to be full-fledged tools.

But this changed sometime in November of 2022.

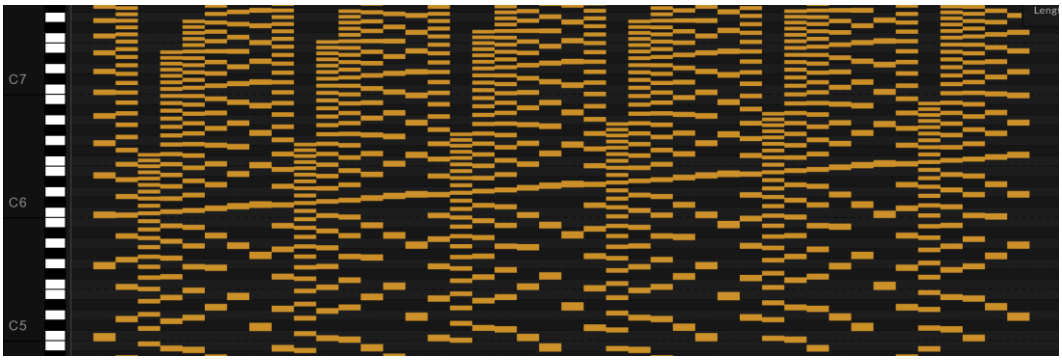
I decided to take the first 10 harmonics of all midi notes numbered 0-127 and sort them out from the lowest to highest frequency. This would, naturally, create a long ascending line; however, that action alone is quite uninteresting. But what if, instead of playing the individual harmonics, we played the notes the harmonics came from?



Seemingly discontinuous notes...

So I played it back – and I was stunned. The notes jumped discontinuously, yet the sound felt continuous. Looking at a spectrogram, there was a clear ascending line, purely made up from the

partials. As you could imagine, this started a whole avalanche of ideas and exploration of possibilities over the years – followed by frustration.



A line created from partials

1.3 The problem with existing tools

Once you start working with current notation software or MIDI in DAWs, you quickly realize they were not made for music that stems from such thinking. Even most capable tools treat timbre as something secondary and notes as the primary source of music. The notation itself becomes a reduction of a complex musical event, and microtonality becomes something you have to work hardly towards.

This creates two practical problems.

The first is cognitive. Making music whlie thinking in partials requires significant amount of mental translation, which quickly becomes overwhelming.

The second is technical. Microtonal or spectral writing can rapidly turn into a convoluted mess of patched up hacks, converters, MIDI workarounds, and Max custom patches just to get to the musical result.

At some point, I concluded that this situation needed to change.

1.4 What is Spectra (and what it is not)

Spectra comes from my fundamental belief that it should be possible for the music to be made from inside-out, not from notes inward. While in traditional sense, each note is represented with its own spectrum, in Spectra, each partial can be treated as a note separately. The fundamental tone is no longer the most important part of the entire

spectrum and the focus is explicitly shifted to active partials instead. In Spectra, relationships between partials matter, and the software reflects that directly.

This does not mean Spectra attempts to replace existing DAWs or audio softwares. Quite the opposite – it is intentionally limited in some areas and meant to be integrated into existing systems. Playback is functional, not ornamental and is left for software that is suited for it.

1.5 Constraints as a design choice

I strongly believe that there are certain DAW conventions that although we take for granted, create restrictions that have a literal effect on the music we produce, and it takes a lot of effort and willpower to break free from these limits.

This type of thinking creates two kinds of problems. On one hand, technical simplification, which is generally beneficial for the musicians in order to focus on other aspects of music and the creative part, however, also means they are literally constrained by the same means that allow them to be creative. The second problem tackles the fact that full control over every single aspect and the limitless possibilities, while inspirational, can quickly become overwhelming or paralyzing. Blockhead, an emerging software/DAW makes a beautiful leap in such thinking (I would absolutely recommend checking it out, colugo is an incredible developer).

Spectra aims to tackle both sides – for the user to be able to have freedom to make music, but also to have some level of a constraint that is considered useful or beneficial in the long run. This will explain some of the designed or philosophical limitations that are inherent to the tool. Intuitive aspect of the design is something that is not taken for granted.

1.6 Accessibility

There is one more aspect which prompted making this software – it stems from one more belief that making spectral/microtonal music should not be gatekept or reserved by academia or musical nerds and should be much more accessible and easier to make.

If you are looking for a tool that does not challenge the way you approach music, this may not be it.

If you are curious about pushing boundaries and exploring ways to make music, this will definitely open some doors to you.

1.7 What can spectra be

- **Composition tool** – either for full compositions or sketches, export to MusicXML
- **Microtonal lab** – quickly change, record, export microtonal ideas with custom/free tunings
- **Analysis tool** – analyze audio files and turn them to timbres/tunings
- **Format converter** – export/import timbres, tunings, .scl, .tun, grids, MIDI/OSC input/output
- **Collaboration/Educational tool** – create live sessions people can join to. OSC output means you can control multiple devices at the same time.
- **Live performance tool** – Spectra can connect to controllers, process and output to software

2. Basics

First, let's go through basic terminology.

I will be brutally quick (sorry, academic nerds! I'll leave a psychoacoustic chapter to you later with proper studies linked – or not >:)). When a human being sings a note, while we hear the note that is sung, it is in fact not just a single pitch, but a complex world of many individual frequencies that are sounding together. Our brains (thanks, evolution!) are pretty good at fusing individual simultaneously sounding frequencies together into a timbre. The lowest frequency is a **fundamental**. The rest are **overtones**. However, because of a terminological mess across languages, I would simply use the term **partial** since it includes the fundamental tone. **Spectrum** (where the name for the software comes from) is these partials sounding together.

If we pretend for a moment that we're spectralists from 70s/80s, we would have an instinct to try to take a sound, extract individual partials from it and try to write them down to each of the instruments such that when played together, the sound would „resemble" the sound the composer analysed. When trying to place notes in a notation program, a paper or a DAW, the composer quickly notices it is not quite straightforward. While the western type of notation is used to twelve equally spaced notes within an octave, these partials are certain multiples of the fundamental tone, which means they wouldn't land nicely to these pre-defined twelve notes. These are what we call **microtones**. Micro suggest something small – while this term is quite questionable, it means nothing else than just notes that don't align with a chromatic scale (12TET/12EDO).

First I will outline the core basics of Spectra's functionalities and will later move on to a more comprehensive explanation of all the functions available.

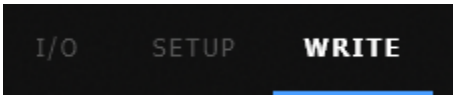
Upon creating your first project (clicking the **+** button, giving it a name and hitting Enter), you will be presented with an interface that resembles classic DAW midi-esque view with several panels.

Top section is reserved for pages (I/O, Setup, Write) basic editing toggles, export button, volume control and help button.

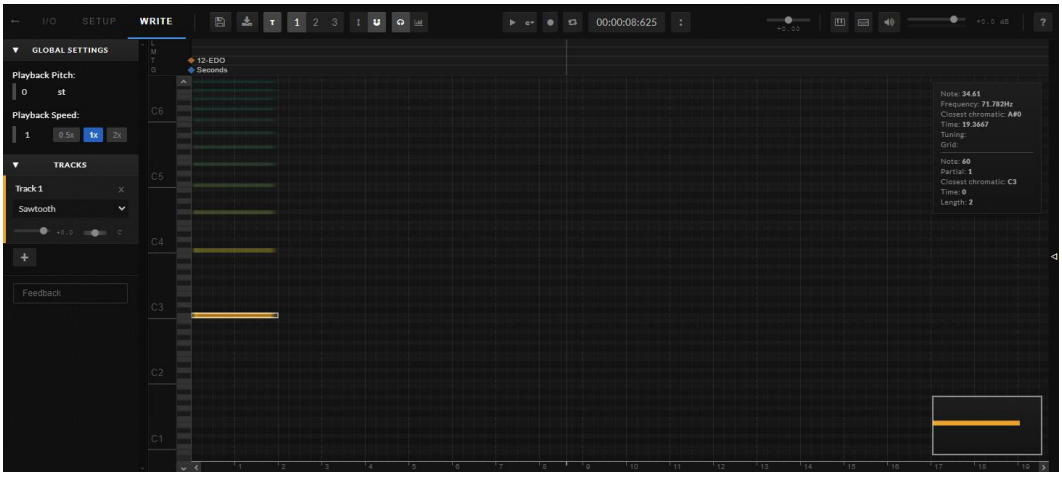
I/O is reserved for configuring your real-time inputs and outputs and synchronization. This includes MIDI/OSC inputs/outputs, selecting whether you would just send fundamentals out to devices or all the partials at once, and so on.

Setup is where you would create your timbres, tunings, grids and tools you can use in writing process. You have an absolute freedom in terms of what kinds of tunings or timbres you want to create – repeating/non-repeating, custom pitches, from a sound analysis and more.

Write is the place where the actual music is written.



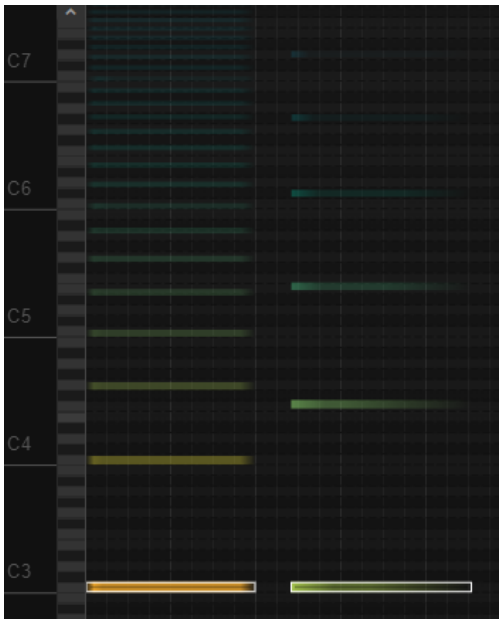
When opening the Write page, you can see that it looks somewhat visually similar to what we are used to – piano roll, clear barlines, and placed notes appear as rectangles. Editing features are quite similar, too – copying, pasting, moving, dragging, resizing, duplicating, all is contained inside.



However, once you add a note by double-clicking, you'll notice that it is created with its own partials included. This is a major shift.

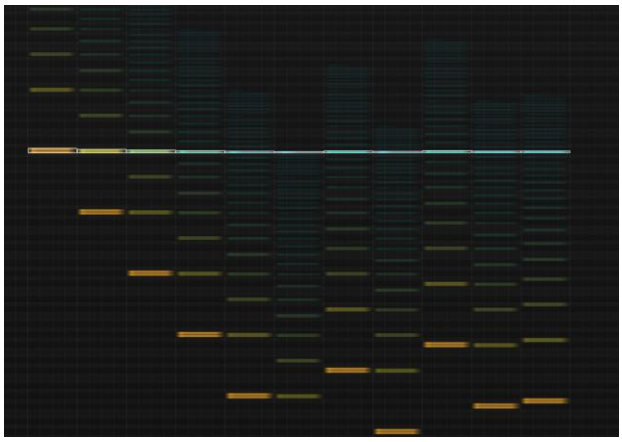
You might also notice it is possible to select the individual partials, too. This software does not hide the fact that relationships between partials are equally important as relationships between fundamentals. In notation, if we play an interval of C-F, where C is played by piano and F by vibraphone, notation doesn't care whether C-F is played by the same

piano or two completely different instruments. Spectra does and it clearly shows this to you.



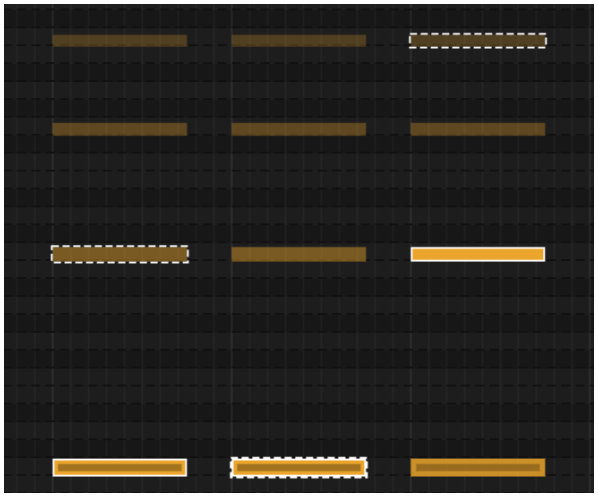
Two notes played by two different instruments – sawtooth + bowl in this example

Upon creating a note and selecting it (visible by showing a dashed outline), try pressing the **Up arrow key**. You'll notice that the selected partial moves slightly upwards, but the fundamental changes. Try pressing Shift+Up next and see what happens.



Screenshot displays first 11 stages on what happens when continuously pressing Up arrow key

The action of pressing Up/Down keys to find next partials is what I call **scrolling through partials**. It allows users to write music via partials while not thinking about the notes these partials came from. When scrolling through partials, you will also notice that the current partial is more visible than others. This partial is called an **active partial** – it is purely a visual feature that has no effect on the resulting sound, but an aid for the user to determine which partial from the note's spectrum is the most important.



Visual difference between an active partial
(marked with thick white outline and bright color)
and a highlighted/selected partial (dashed white outline)

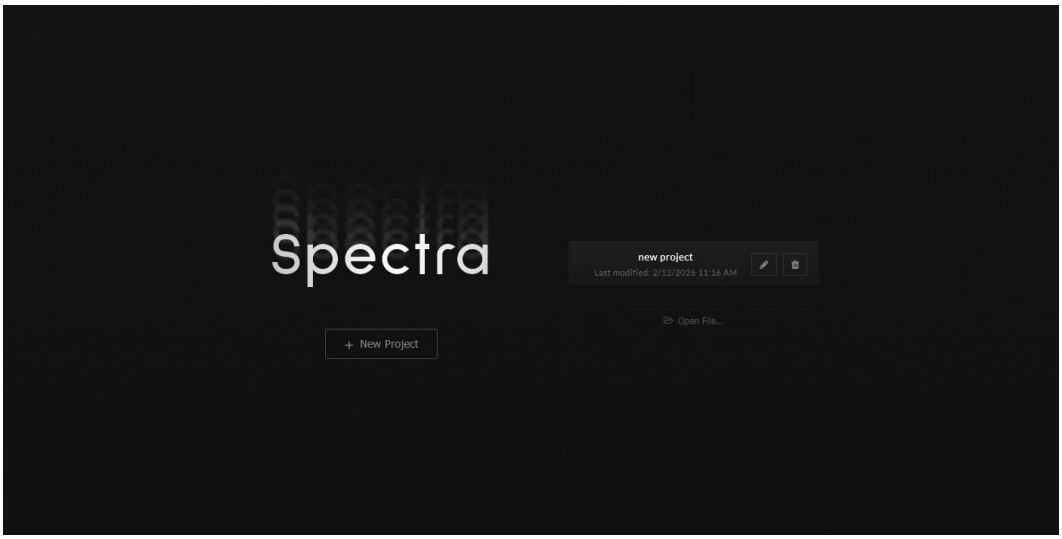
To recap:

- *scrolling through partials* means to find successive partials (slightly lower or higher) while not thinking about notes these partials came from
- *active partial* is the visual representation of the most important partial from the current spectrum
- a *spectrum* is a collection of together sounding partials
- *microtones* are in-between tones on a standard keyboard – in other words, notes that are non-chromatic/non-12TET

Next up, try pressing **T** to toggle inactive partials.

2.1 Project Management

By default, Spectra stores all your projects locally in your browser using IndexedDB. This means your projects persist between sessions without requiring an account or a cloud storage. However, if you wish your projects to be openable on different devices, you can quickly create an account and move the projects to your cloud storage.



Initial Spectra screen

To create a project, click the large **+** icon, enter your project name and press Enter key.

To rename a project, click the pencil icon.

To delete a project, click the trash bin icon.

Importing projects:

- Spectra allows users to import both MIDI and JSON project files as new project.
- In order to import a project, click the **Open Project File...** button.

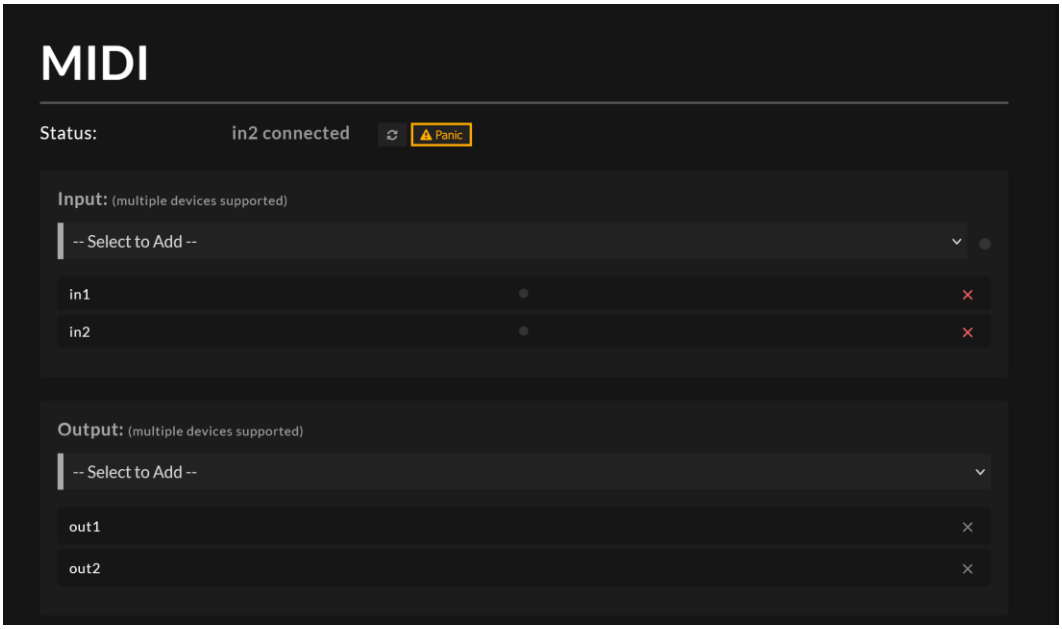
3. I/O Section

Spectra's intention is to be able to not only function as a space where you can import, write and export music, but also as a middleware that lets you connect to other software. Spectra uses MIDI/OSC to achieve this.

In I/O Section, the top section shows the currently active inputs and outputs:

3.1 MIDI I/O

The MIDI section contains several basic options to reload MIDI devices, a Panic button that stops all the played notes, and dropdowns to select MIDI inputs and outputs.



If you want to connect Spectra with your DAW or any software running on the same machine that can input and output MIDI, you need to use

a virtual MIDI port. Each operating system requires a different configuration:

Operating system	Virtual MIDI
Windows	loopMIDI (free)
macOS	IAC driver (built-in) in Audio MIDI Setup
Linux	ALSA virtual port, JACK

When an output device is chosen, upon starting playback, Spectra sends both MIDI noteOn and noteOff messages as well as specific SysEx 12-byte messages with the following format:

Microtonal Note (12 bytes)

F0 7D 01 [trk] [note] [vel] [pitL] [pitH] [sign] [partial] [amp] F7

Byte	Message
F0	SysEx message start
7D	Manufacturer ID
01	Message type (01 = note)
Track	Track index (0 - 127)
Note	Nearest MIDI note (0 - 127)
Velocity	Velocity (0 – 127, 0 = note off)
Pitch L/H	14-bit pitch deviation in decicents (0.1¢ resolution, ±1638.3¢ range)
Pitch Sign	0 = positive deviation, 1 = negative deviation
Partial num	Partial number (1 - 127)
Amplitude	Amplitude (0 - 127)
F7	SysEx message end

Panic / All Notes Off (12 bytes)

F0 7D 02 00 00 00 00 00 00 00 00 F7

Byte	Message
F0	SysEx message start
7D	Manufacturer ID
02	Panic message type
...	...
F7	SysEx message end

Transport Sync (12 bytes)

F0 7D 03 [timeL] [timeM] [timeH] [flags] 00 00 00 00 F7 (Start)

F0 7D 04 [timeL] [timeM] [timeH] [flags] 00 00 00 00 F7 (Stop)

Byte	Message
F0	SysEx message start
7D	Manufacturer ID
03/04	03 = Transport Start, 04 = Transport Stop
Time 0-3	28-bit time in milliseconds (max ~74.5 horus)
Flags	Reserved flags for future use
...	
F7	SysEx message end

Spectra uses manufacturer number 0x7D (non-commercial / educational).

3.2 OSC I/O

Besides MIDI, Spectra also allows for OSC communication. In order to be able to send or receive OSC data, Spectra needs to pair with

a device. The pairing works by Spectra generating a pairing code and waiting for the device to send it either via UDP (with address spectraapp.net:9001) or WebSockets. Once sent, Spectra registers this device and adds it to a list.

This device can be anything that is capable of sending/receiving UDP or Websocket data. Here are the OSC messages sent:

Incoming (to Spectra on port 9002):

```
/spectra/note/on pitch velocity [track]
/spectra/note/off pitch [track]
/spectra/playback playing(1/0) position
/spectra/note/on pitch velocity [track]
/spectra/note/off pitch [track]
/spectra/transport/start playing(1/0)
/spectra/transport/position position
/spectra/transport/loop enabled start end
/spectra/transport/speed multiplier
/spectra/transport/record enabled(1/0)
/spectra/write/note/create time pitch duration track [partial]
/spectra/write/note/delete time pitch track
/spectra/write/track/select id
/spectra/write/track/instrument id instrumentName
/spectra/write/tuning/add time tuningName [global]
/spectra/write/tuning/remove time
/spectra/write/tuning/change time tuningName [global]
/spectra/write/grid/add time gridName [global]
/spectra/write/grid/remove time
/spectra/write/grid/change time gridName [global]
```

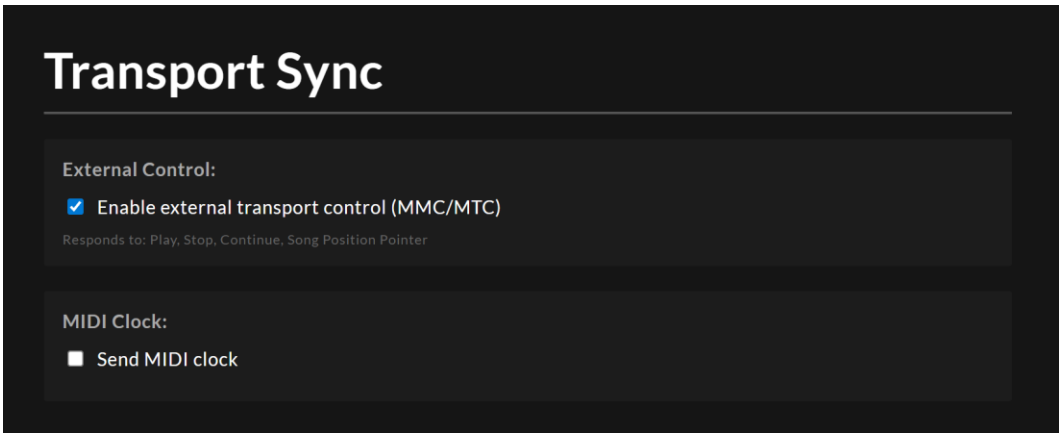
Outgoing (from Spectra):

/spectra/note/on pitch velocity instrument partial

/spectra/note/off pitch instrument

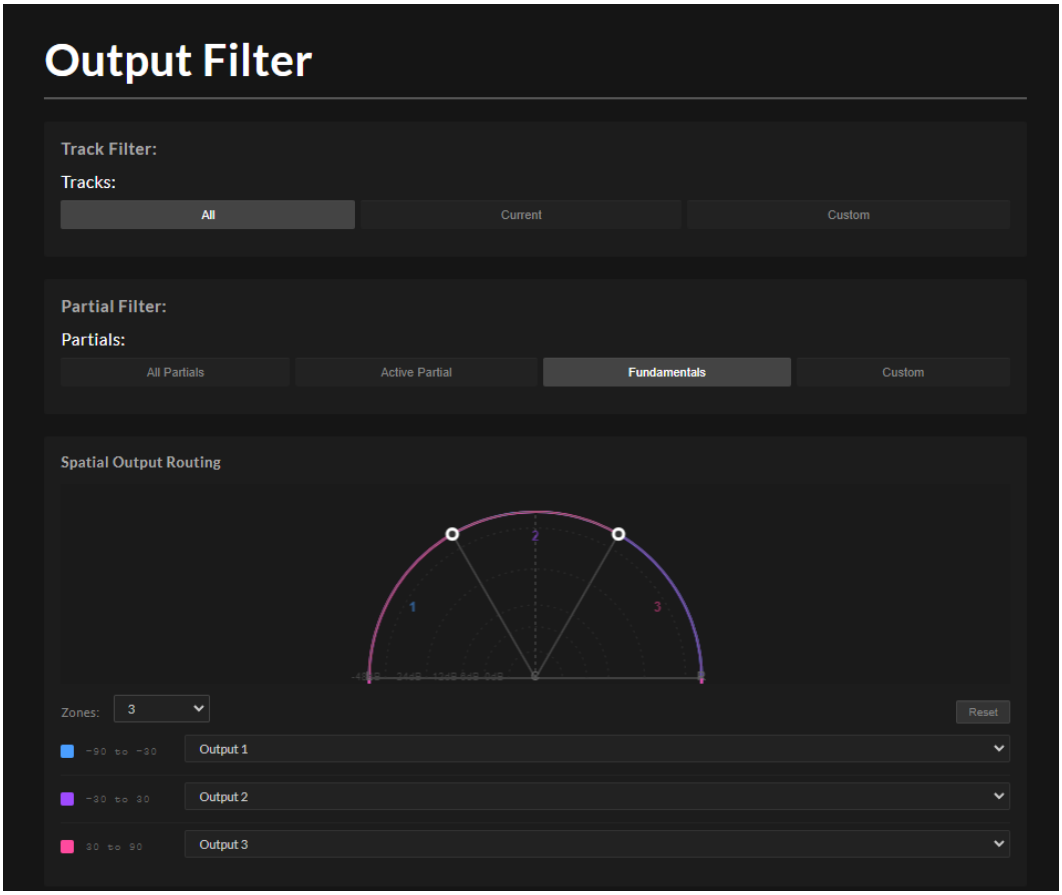
/spectra/playback playing position

3.3 Transport Sync



Spectra is also capable of DAW/device synchronization. By default, it sends MMC/MTC codes, MMC being responsible for sending MIDI states to start/stop/record and MTC sends encoded SMPTE timecode (in format HH:MM:SS:FF). You need to simply enable MIDI sync in your DAW (the MIDI output you choose in Spectra becomes MIDI input in your DAW).

3.4 Output Filter



By default, the software sends fundamentals only to your external devices. However, if you wish to change this, you can send either all of the played partials (including fundamentals), active partials or a custom selection (e.g. only second and fourth partials of each played note).

As an example, if a composer wants to get partials of several retuned gongs, they would create a new timbre from extracted audio of a gong, place some notes down, set the Output Filter to All Partials and record the data being sent.

Spatial output routing is a feature unique to Spectra – because each timbre can have its own panning of its individual partials and every track can be panned to the left and right, you can consequently distribute individual partials in space. With spatial output routing, you can decide what sections of the space get distributed to what outputs. For instance, if a timbre has an evenly distributed partials from lowest to highest and we have three subsections in spatial output routing, lowest partials would always be sent to the first output, middle partials in the second and highest partials into the third output.

3.5 API

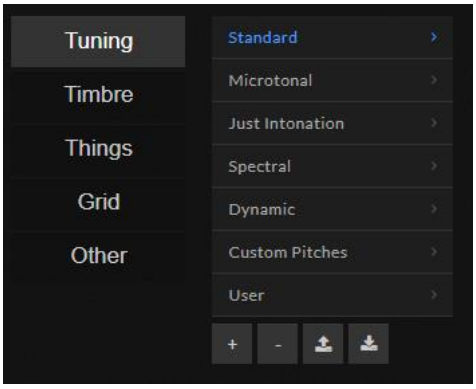
This section is reserved for future development, for users to be able to customize and create their own input and output data being received and sent to devices.

4. Setup

This page is one of the most essential parts of the entire software. Here you can create your own tunings, timbres, grids and edit them however you like. The Setup page contains five tabs: Tuning, Timbre, Things, Grid, and Other. The “Things” tab is reserved for future development (objects, effects, generators).

Spectra comes with several built-in tunings and timbres to showcase its abilities. This includes some known EDO tunings a well as some timbre-based unconventional tunings.

4.1 Tuning



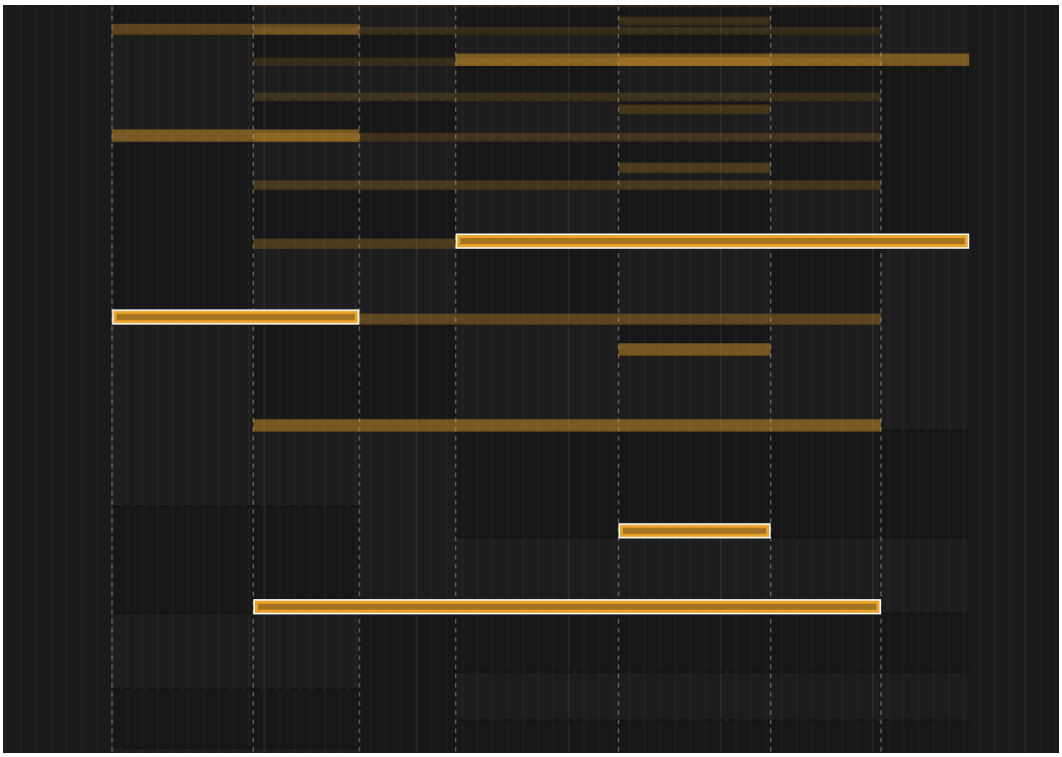
The software comes with several sections to generate your tunings with emphasis on spectral generators. The sections are Mathematical, Spectral, Import and Dynamic. Here are the following types of tuning generators:

1. **Equal Temperament** – equal division – choose the reference A, octave multiplier (default is 2x), and a number of steps/divisions. For instance, 31EDO would have octave multiplier 2 and number of steps 31. An approximation of Carlos Alpha would have an octave multiplier 1.5 and number of steps set to 9.
2. **JI Limit** – generates tuning based on Just Intonation prime limit. Default values are 3-, 5-, 7-, 11- and 13-limit.
3. **Ratio Entry** – create a tuning based on user-selected ratios.
4. **Linear** – generate pitches with a simple linear equation a*n+b. For instance, combination of a=100 and b=10 with 5 steps would generate frequencies 10, 110, 210, 310, 410 and 510.
5. **Harmonic Series** – create a tuning that is based on harmonics of a fundamental. Includes stretch factor.
6. **Subharmonic Series** – create a tuning that is based on subharmonic series of a given tone. Includes stretch factor.

7. **FM / Ring Mod** – create a tuning that is based on a a frequency and ring modulator via carrier frequency, modulator and the number of sidebands.
8. **From Instrument** – Base the tuning on an instrument's timbre.
9. From Audio Analysis – Create a tuning that is extracted from analyzed partials from a portion of an audio file. (Full edition)
10. **File Import (.scl)** – Import a Scala tuning file as a tuning.
11. **Custom Frequencies** – If you want complete freedom, you can choose your own pitches for the tuning.
12. **Adaptive** – tuning that adjusts based on notes played.

4.1.1 Adaptive tuning

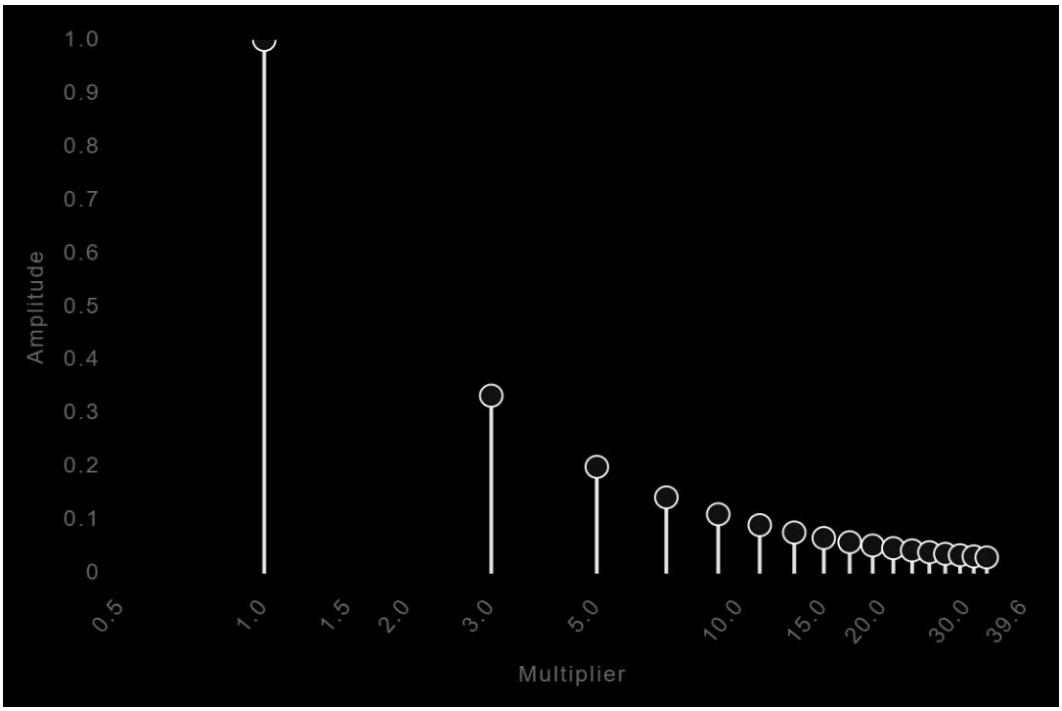
This tuning requires its own section. While we're used to a notation system that lets users first choose a tuning and then place notes within this tuning, adaptive tuning reverses this – the timbre of notes determines the momentary tuning. Adaptive tuning initially appears blank, but upon placing a note, Spectra creates tuning steps that are both coming from the timbre used as well as its inverted version – when using a simple sawtooth timbre, it is a simple Just intonation system, when using an inharmonic timbre, that is what opens new doors.



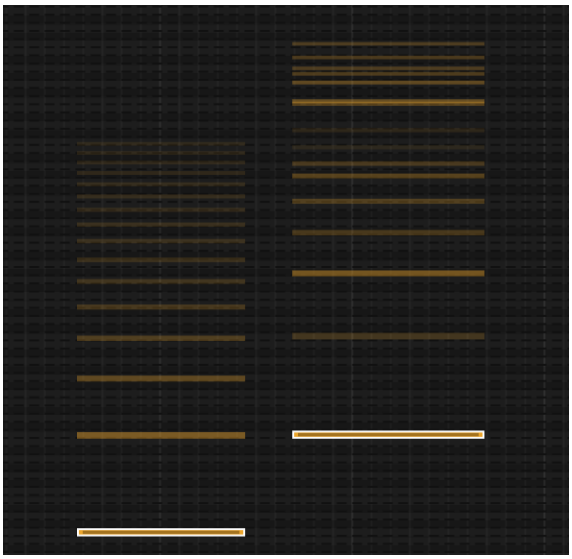
Adaptive tuning in action – notes and their spectra determine momentary tuning

4.2 Timbre

This section is fairly straightforward. You have the option to generate a basic timbre using harmonic series, odd harmonics or a random spectrum using the inharmonic button. The graph below shows the individual harmonics and their amplitudes. You can drag individual points up/down and use Shift+Drag to move them around.



Each timbre contains one **keypoint** by default. A keypoint is a timbre associated with a certain note. When setting multiple keypoints, Spectra automatically interpolates between these timbres depending on the pitch. This, albeit basically mimics how instruments “sound” differently in each of their registers.



Same instrument, two notes – keypoints determine spectrum of an instrument across the range

As an example, create a harmonic timbre at C1 and an inharmonic timbre at C4. When placing notes around, you will notice that all the low

notes would sound harmonious and would resemble a bell-like sound the higher you place or move your notes.

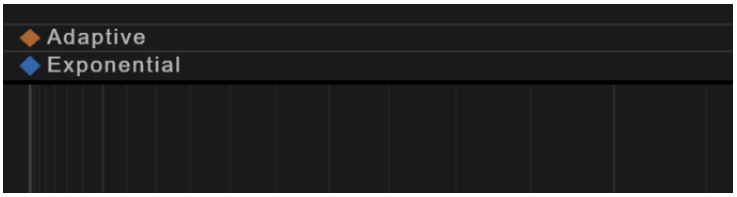
Timbre section also allows you to extract partials from an instrument, a sound, recording or any type of audio – by loading a wave file, selecting a portion of audio you would find compelling and adjusting sensitivity and threshold values, you can save these analysed partials as a custom timbre. Clicking the analysed frequencies or midi notes copies them to your clipboard.

If you wish to be a little more precise in terms of what exact multiplies are the overtones compared to fundamental, you can view the table of partials to adjust the partials manually.

4.3 Grid

This section lets you create your own grids – by default, Spectra comes with a “seconds” grid that creates barlines at every second. Grids are not only a visual aid, but you can choose to snap or quantize notes to them. Here are the following types of grids:

1. **Linear** – Even spacing between gridlines, choose the spacing between bars and the number of subdivisions. Useful when making tuplets,
2. **Exponential** – Type of a grid where the spacing changes progressively with each bar,
3. **From Frequencies** – Choose frequencies that generate the grid (choosing one frequency is basically the same as a linear grid),
4. **From Audio File** – Spectra interprets audio waveform as spacing, where -1 (lowest sample) corresponds to smallest density and 1 corresponds to highest density. If a sinewave is loaded, it creates a grid that gradually slows down and speeds up.



Exponential grid in action

5. Write

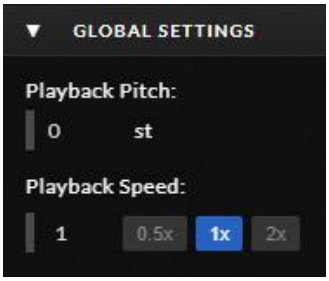
This entire page is where the users would likely spend the most time in. It is a bit hilarious and hypocritical that after all of this philosophical and belief system talk in the beginning we are presented with a fairly standard looking grid and a 12EDO system – but it is in fact a deliberate design choice to make the interface somewhat familiar looking.

The **top panel** contains the most important toggles and switches. First I will briefly explain what each of these controls does and later will return back to them in more detail. These are:

- **Export** – letting the user download their project in various formats (audio, midi, MusicXML, text, JSON)
- **1/2/3** – partial scrolling mode – from tuning / utonal / mixed
- **Headphones** – hearing changed / scrolled partials when editing
- **Magnet – automatic note-snapping (U key)**
- **Fletcher-Munson** – visually adjusting amplitudes based on equal loudness contour standard
- **Play** – Play / Stop playback
- **c / r** – Playback mode – continuous (cursor continues upon pressing play again), return back (cursor returns back to its original position)
- **Record** – record from midi input device
- **Loop** – loop a selected region

- **Time** – show the exact time in format HH:MM:SS:MSS
- **Metronome** – toggles metronome click on/off
- **Volume** – toggle audio on/off
- **Volume slider** – change output volume from -Inf to +6dB – Ctrl+Click resets the value
  Ctrl + M – toggle mute
- **Session** – create an online session for other users to join
- **Sign In** – log in to an account
- **?** – show keyboard shortcuts and other useful links and information

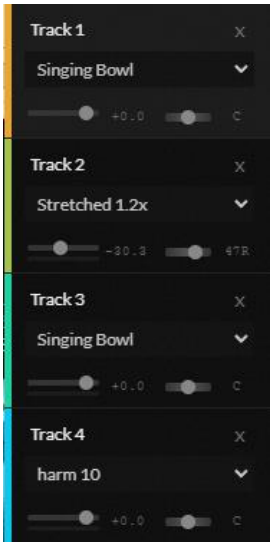
5.1 Global settings



Spectra offers a few global settings for the current project:

- **Playback pitch** – changes the tuning of playback. Defaults to 0.
- **Playback Speed** – changes playback speed. Defaults to 1x, can be set to 0.5x (half the speed) or 2x (twice the speed) or a custom value.

5.2 Tracks



Below Global settings in the left panel is a list of all of the tracks within the project. The plus button adds a new track, x deletes it. Each track is assigned an instrument which determines the spectra of its notes. Clicking on a track highlights notes contained in that track, the rest becomes grey. Shift+Click and Ctrl+Click allows you to select multiple tracks at the same time.

Double-click the track's name to change it.

By default, Spectra uses Oklab color space to choose its track colors for new tracks, and you can choose a custom color by clicking on the coloured strip on the left side of the track.

When changing track's instrument, Spectra attempts to find the closest match for the active partial to still preserve your musical content.

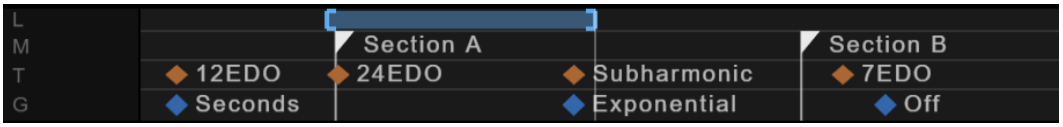
Tracks are independent by default – instruments are not linked, and any tuning / grid changes or markers are track-specific. As an example, your Track 1 can be in 24EDO while Track 2 is in 31EDO.

There are technically no constraints on the track limit, however, MIDI SysEx data supports sending notes from the first 128 tracks.

5.3 Undo/Redo

Majority of functions are linked to an event history (of a size of 100 events) such that you can undo/redo using Ctrl+Z to undo and Ctrl+Y/Ctrl+Shift+Z to redo.

5.4 Tuning / Grid events, Markers



The top four lanes above the main canvas contain all the markers, tuning and grid changes as well as the project's loop region.

Tuning / Grid events are unique to Spectra.

One of the main philosophies of Spectra is to allow users to be unrestrained by basic tuning and grid conventions that DAWs and notation programs provide. Even a basic system like a five-line staff assumes the composer wants to write in a diatonic system. This software solves this not only with free tunings and grids, but tuning / grid events that let user change tunings and grids at any point in the project.

- To add a tuning / grid event, double-click on the corresponding lane and choose your tuning or a grid.
- Events are draggable with mouse by default. Shift+Drag snaps them to the current grid.

5.5 Main Canvas, Note Editing

The main canvas not only contains all the basic note editing shortcuts but also comes with a few useful shortcuts specific to this tool. As mentioned earlier in the text, the main difference in Spectra compared to standard MIDI note editing tools is the way the successive notes are chosen – this is determined based on current partial scrolling mode. The aim of the following shortcuts is to make note editing as smooth and easy as possible. Important shortcuts or shortcuts unique to this software are marked in **bold**.

Creating, Deleting notes

- Double-click – create a note
- Double-click + drag – create a note with custom length
- Del / Return – delete selected note(s)
- D – duplicate selected note(s) (also Ctrl+D)
- **Ctrl + Drag – duplicate selected note(s) while dragging**

Note selection

- Click – select a note or a partial
- Shift + Click – select multiple notes or partials
- Drag empty area – rectangle selection
- Ctrl + A – select all notes in the current track

Note resizing

- Drag left / right side of note – resize selected note(s)
- Shift + Left/Right – resize selected note(s) (when notes selected); skip to timeline event (when no notes selected)

Note dragging

- Drag – move the note forwards / backwards in time or move it to the closest step in tuning
- **Shift + Drag – snap selected note(s) while moving**

Keyboard

- **Up / Down – move to the next partial depending on partial scrolling mode**
- **Shift + Up / Down – move to the next step in the current tuning**
- **Ctrl + Shift + Up / Down – move the note(s) up / down an octave**

Playhead

- Left / Right – move by one grid step (when no notes selected); move selected note(s) in time (when notes selected)
- Shift + Left / Right – skip to next/previous timeline event (when no notes selected)

Quantization

- Q – quantize note(s) to the current grid
- **Shift + Q – quantize note(s) to the current tuning**
  Shift + M – create marker at playhead position

Copy, Paste

- Ctrl + C – copy selected note(s)
- Ctrl + V – paste selected note(s)
- Ctrl + X – cut selected note(s)
  Ctrl + S – save project
  Ctrl + M – toggle mute
  Ctrl + 1 / 2 / 3 – switch to I/O / Setup / Write tab
  Space – play / pause playback
  Ctrl + Space – resume playback from previous position

Visibility

Given that each note is displayed with its own spectra, it can get quickly challenging to be able to discern between important and less important partials. Spectra handles this with couple shortcuts:

- **V – hide / show selected note(s)**
- **Shift + V – unhide all of the hidden note(s)**
- **T – toggle visibility of inactive partials**

Partial Locking

Another feature that is unique to Spectra is the ability to lock partials in place. When a partial is locked, when selecting a different partial from the same tuning, Spectra attempts to find a note where its spectrum contains this frequency of the locked partial while at the same time contains another partial that is slightly above or below the current active partial. In simple terms, if you are writing two-part harmony with partials

but only with a single continuous line of notes, this tool allows you to do this quite easily.

- **L – lock the selected partial**

Magnet mode

This feature was mentioned earlier, but it is worth mentioning again. Magnet mode allows users to snap notes by their edges.

U – toggle magnet mode on / off

- **M – toggle Computer Keyboard Mode (play notes with letter keys)**

Preview while editing

- **P – play the fundamental tone of selected note(s)**
- **O – play the partial of the selected note(s)**
- **H – toggle previewing partials while note editing**
  S (hold) – Spotlight mode: ducks master volume to -30dB and plays the hovered partial in isolation. Releases when S is released.

Partial selection mode

When highlighting partials and pressing Up / Down keys, Spectra finds closest partials depending on a selected mode. These are:

- **1 – finding next partial where fundamental must be coming from the current tuning**
- **2 – scrolling through utonal/subharmonic series - active partial is fixed at its place**
- **3 – combination of both modes**

Full Edition Only Shortcuts

The following shortcuts are available in the Full edition:

R – toggle MIDI recording
F – toggle Fletcher-Munson equal loudness contour
B – toggle scrolling/drag mode
V – hide / show selected note(s)
Shift + V – show all hidden notes

Ctrl + L – toggle loop mode
Alt (hold) – activate magnifier zoom
Tab (while magnified) – reset zoom to saved state

Brightness Offset

Alt + Scroll adjusts the brightness offset of partials, changing which partials are more prominent. Ctrl + Click on the brightness control resets it to the default value.

MIDI Partial Mode

Spectra includes a MIDI Partial Mode toggle that, when enabled, plays ordered partials from the current timbre instead of tuning steps when receiving MIDI input. This is useful for exploring the spectrum of an instrument directly from a MIDI controller.

Mouse navigation

- Scroll – scroll vertically (pitch)
- Shift + Scroll – scroll horizontally (time)
- Ctrl + Scroll – zoom in / out in time
- **Ctrl + Shift + Scroll – zoom vertically (pitch)**
  Ctrl + Alt + Scroll – zoom in / out both in time and pitch

Spectra comes with basic scroll functions. You can also zoom in / out on time area (numbered section at the very bottom of the canvas) as well as keyboard area. Double-clicking resets the zoom level.

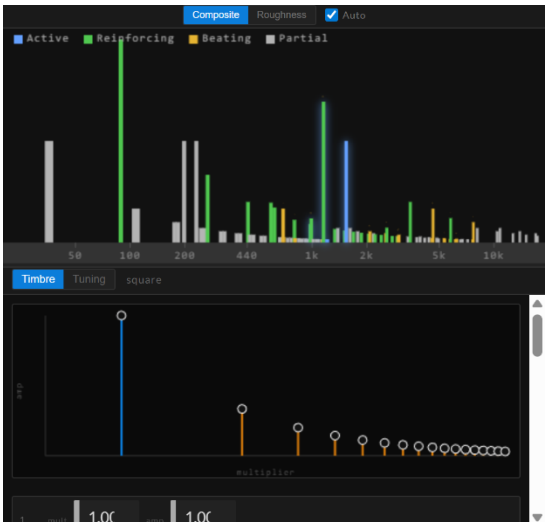
5.6 Timeline

At the bottom of the main canvas is the timeline, showing time in seconds. The playhead (vertical line) indicates the current playback position.

5.7 Loop region

Loop region appears as a highlighted bar at the top of the page. To create a loop region, select an area and press Ctrl + L. Loop regions can be resized and dragged around and Shift + Drag resizes the loop region to snap to the current grid. When playing music, the playhead repeats within the loop region unless the loop button is pressed again.

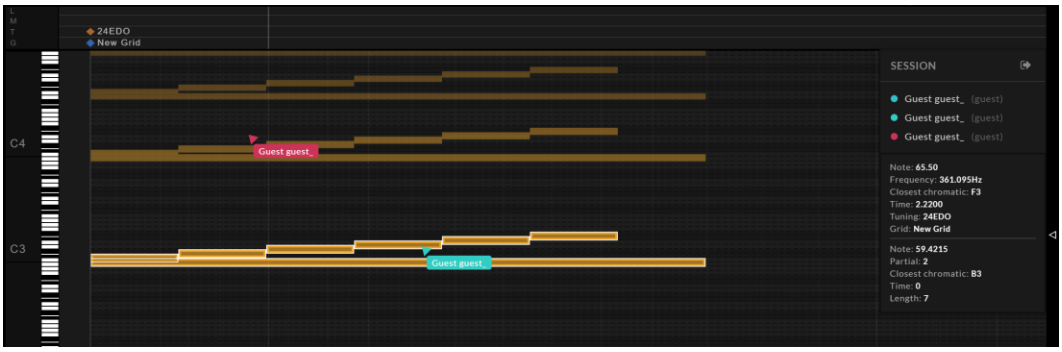
5.8 Right panel



Right openable panel (click the arrow on the right side of the page) contains both the quick analytical as well as editing tools. The top section consists of two tabs:

- **Composite**: showing a composite view of partials with marked beating (yellow, less or equal than 30 cents) and reinforced partials (green, less or equal than 5 cents). Graph is updated in real-time based on the position of the playhead.
- **Roughness**: shows roughness of the composite spectrum
- Timbre: quickly adjust current track's timbre without having to switch to Setup tab
- **Tuning**: quickly adjust current track's tuning

6. Sessions



I do believe that making music shouldn't always be happening in isolated spaces. That is also why sessions have been created. Once creating a session, the user is given a unique shareable link. Once all users leave a single session, the session expires.

A session by default creates a clone of a project as a protection measure.

Creating a session:

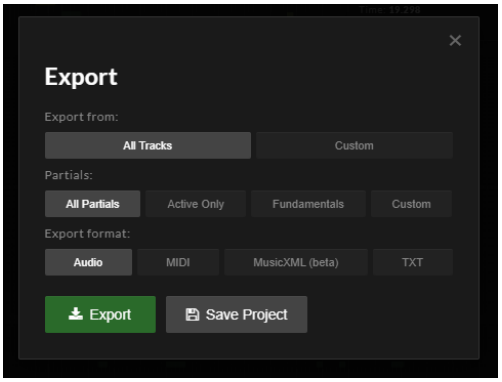
1. Click the Session button in the top panel next to Sign In button
2. Enter a session name
3. Adjust permissions for participants:
    a. can watch – always enabled – guests can see the project
    b. can edit notes – allow guests to add/edit/delete notes
    c. can MIDI input – allow guests to record from their MIDI devices
    d. full control – grant all permissions
4. Copy the session link
5. Click Create Session and share it with other users

Joining a session

- Open the shared session link in your browser
- You'll join as a guest, unless you are signed in, in which case your name is displayed
- Your cursor is visible to other participants

During a session, all the changes sync between all the participants as well as the playback. To leave a session, click the leave button in session panel. If you're the last participant, the session ends.

7. Exporting



To open the export window, either press Ctrl + Shift + E or click the export button right next to Write button in the top menu.

Export window contains several options:

Export from: 1. All Tracks – exported data contains data from all the tracks 2. Custom – choose which tracks get exported

Partials:

From the selected tracks, select which partials get exported.

- All Partials – all partials get exported as notes
- Active Only – only visually highlighted partials get exported
- Fundamentals – Only fundamental tones get exported. For example, if your external synth contains your track's spectrum with a complex sound design, exporting fundamentals gets you to the same result, but with sound design added.
- Custom – choose which partial numbers get exported

Export format:

- **Audio** – exports as .wav file.
- **MIDI** – exports as a .mid file containing the tracks
    - Microtonal pitches are approximated to the nearest semitone
    - Check Pitch bend checkbox to preserve pitch bending in MIDI or leave MIDI quantized to chromatic scale
    - Useful for quick imports to other DAWs and devices capable of reading MIDI
- **MusicXML** – exports as a .musicxml file to be imported by notation software.
    - Supported for Dorico
    - When choosing this option, you have an option to choose pitch quantisation – either Off (exact pitch content is preserved) or other common EDOs for notation.

- **Text export**:
    - Exports as a human-readable text representation
    - Lists all the notes with their frequencies, times and durations
    - Useful for analysis or documentation

JSON Export:

- Save project button downloads the .json file of the entire project.
- This file includes all the notes, timbres, tunings, grids and settings and can be re-imported into Spectra
- Useful to share a project between devices

8. Other

Browser compatibility

Spectra is a web application that runs entirely in your browser. Currently supported browsers include Firefox and Chrome.

Desktop application

Spectra is also available as a standalone desktop application (built with Electron). The desktop version supports full offline usage and native OSC communication via UDP.

Mobile support

Spectra is designed for desktop use. While it may load on tablets, the interface is entirely optimized for mouse and keyboard interaction.

Offline usage

The desktop application works fully offline. The web version also caches itself for offline use once loaded, thanks to service worker caching. However, features requiring server connection (Sessions, cloud storage) need internet access. OSC communication in the desktop app works offline via local network internet access.

9. FAQ

Where are my projects stored?

- Projects are stored in your local IndexedDB with maximum size of 50MB. They persist until you clear browser data or delete them manually.

Can I use Spectra offline?

- Yes! A desktop version is available that works fully offline.

Will you wear wigs?

- Unfortunately no, but we will see what the future holds.

10. Glossary of terms

- **Active partial** - visual representation of the most important partial from the current spectrum
- **Fundamental** – lowest frequency of a given spectrum.
- **Harmonic** – integer multiplier of the fundamental.
- **Overtone** – frequencies above the fundamental.
- **Partial** – individual frequency of a sound.
- **Spectrum** – collection of partials sounding together.
- **Scrolling through partials** – choosing next/previous partials. By pressing Up / Down keys on selected notes makes Spectra choose next relevant partial. In mode 1, it chooses next partial where the fundamental comes from the current tuning. In mode 2, it chooses next partial in utonal/subharmonic series. In mode 3, it chooses next partial from both arrays. When another partial from the same spectrum is locked, it chooses next higher or lower partial such that there is a partial at the frequency of the locked partial while finding the next partial in a row.
- **Keypoint** – instrument's timbre at a specific key.
- **EDO/TET** – Equal Division of an Octave / ...-tone equal temperament.
- **Cent** – 1200th of an octave or 100th of a semitone.
- **Beating** – Interference pattern / amplitude cancellation with an audible pulse that is caused by a combination of two sinewaves with similar frequencies.
- **Reinforcement** – volume sum of two simultaneously sounding sinewaves caused by small frequency difference.