FACTORmini
user manual

Introduction

Factormini is a Max For Live device that uses machine learning to decompose sounds into sets of elements. Once these elements have been obtained, you can modify and rearrange them to remix existing clips, remove notes, randomize patterns, and create complex textures with only a few clicks.

Factormini is the introductory version of Factorsynth, which contains several advanced functionalities such as cross-synthesis and detailed editing.

Factormini is a new type of device, and its interface and usage need a bit of time to get used to. Hopefully, this manual will get you started, but please don't hesitate to drop an email with any comments and questions to software@jjburred.com

Installation

To start using Factormini, just drag and drop the factormini.amxd file into the audio effects area of an audio track in Ableton Live 9 or 10. Once the device has been loaded, click on the logo to open the main interface in a new window.

If you're installing an updated version of Factormini, it is recommended that you delete the old factormini.amxd file.

For a quick start guide, click on the "?" icon on the upper part of the main interface.

⚠️ Only a single Factormini instance can be loaded into your Live project.

Main ideas

Unlike traditional audio effect devices, which take the track's audio input and generate output in real time, Factormini is a **clip-based** device. It works on audio clips from your Live set that you have selected and loaded into Factormini. Once an audio clip has been selected and loaded into Factormini, it can then be decomposed into elements. The decomposition process is called **factorization**, because it is based on a technique called matrix factorization.

Factorization usually takes a few seconds, and can be performed while the Live set is playing. Once the factorization is ready, you can modify your sound in real time by modifying or recombining the extracted elements.

Since it is a clip-based device, Factormini will only affect the clip that is currently loaded into the device, even if the track contains other clips. Also, since the device takes its input audio from the loaded clip, it must always be in the leftmost position of an audio effects chain: it will ignore any processing happening before it on the effects chain (you can of course process its output with any other audio device).

The clip that you load into Factormini is called the **master sound**. The position of the master sound in the Live Set determines the time in which Factormini will be outputting sound. In other words: Factormini will be playing whenever the original, unprocessed clip would play (both in Session and Arrangement views).

Interface
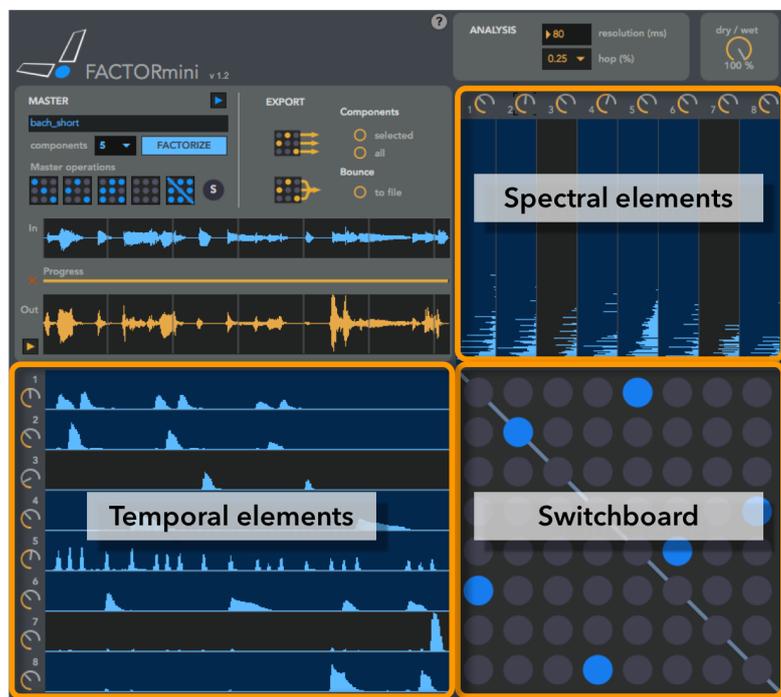
The main interface is organized around several control panels and the following sections:

Temporal elements

Factorizing a sound creates two types of elements: temporal elements and spectral elements. Temporal elements are displayed on the lower left of the interface. They capture the temporal evolution of distinct sound events within the original sound. For example, if you are factorizing a drum loop, one of the temporal elements will probably contain peaks that correspond to hits of the hi-hat, another one will contain peaks when the kick drum plays, and so on.

Spectral elements

They can be understood as the "timbre ingredients" that make up the original sound. They are fixed spectra, displayed vertically, with lower frequencies on the lower part and higher frequencies on the upper part. For example, in the image above, it is possible to distinguish several harmonics as horizontal lines in the first 3 spectral elements.

Spectral elements are sorted by "brightness": the first (leftmost) spectral elements are the richest in high frequencies. For instance, in a drum loop, the spectral element corresponding to the hi-hat will likely be the first, and the one corresponding to the kick drum will likely be one of the last.

Switchboards

Sound output is created in Factormini when you connect temporal elements with spectral elements. These connections are created by the buttons on the switchboard. The connection of a temporal element with a spectral element is called a **component**. The key in understanding how Factormini works is the following: a component is created by a temporal element that *modulates* a spectral component. In other words: a component is a fixed spectrum that changes amplitude in time according to the temporal element, which acts as a modulator. By setting a switchboard button on/off you are adding/removing components to/from the output sound.

You'll notice that the **diagonal** is highlighted on the switchboard. This is because components on the diagonal are special: they are the original components present in the input sound. In contrast, **off-diagonal** components are new, artificial components that were not initially in the sound, created by combining originally unrelated elements. Let's look at a simple example to illustrate this.

The figure below shows the factorization of a simple drum loop into 3 components: the hi-hat, the snare and the kick drum. Clicking on the components on the diagonal, you will add/remove the corresponding original sounds of the hi-hat, snare and kick drum. Clicking on off-diagonal components, you will generate new sound events that were not present in the original drum loop: the figure shows two examples: selecting the lower-left component makes the temporal pattern of the kick drum play the timbre of the hi-hat. Selecting the component just above it makes the temporal pattern of the snare play the hi-hat sound.
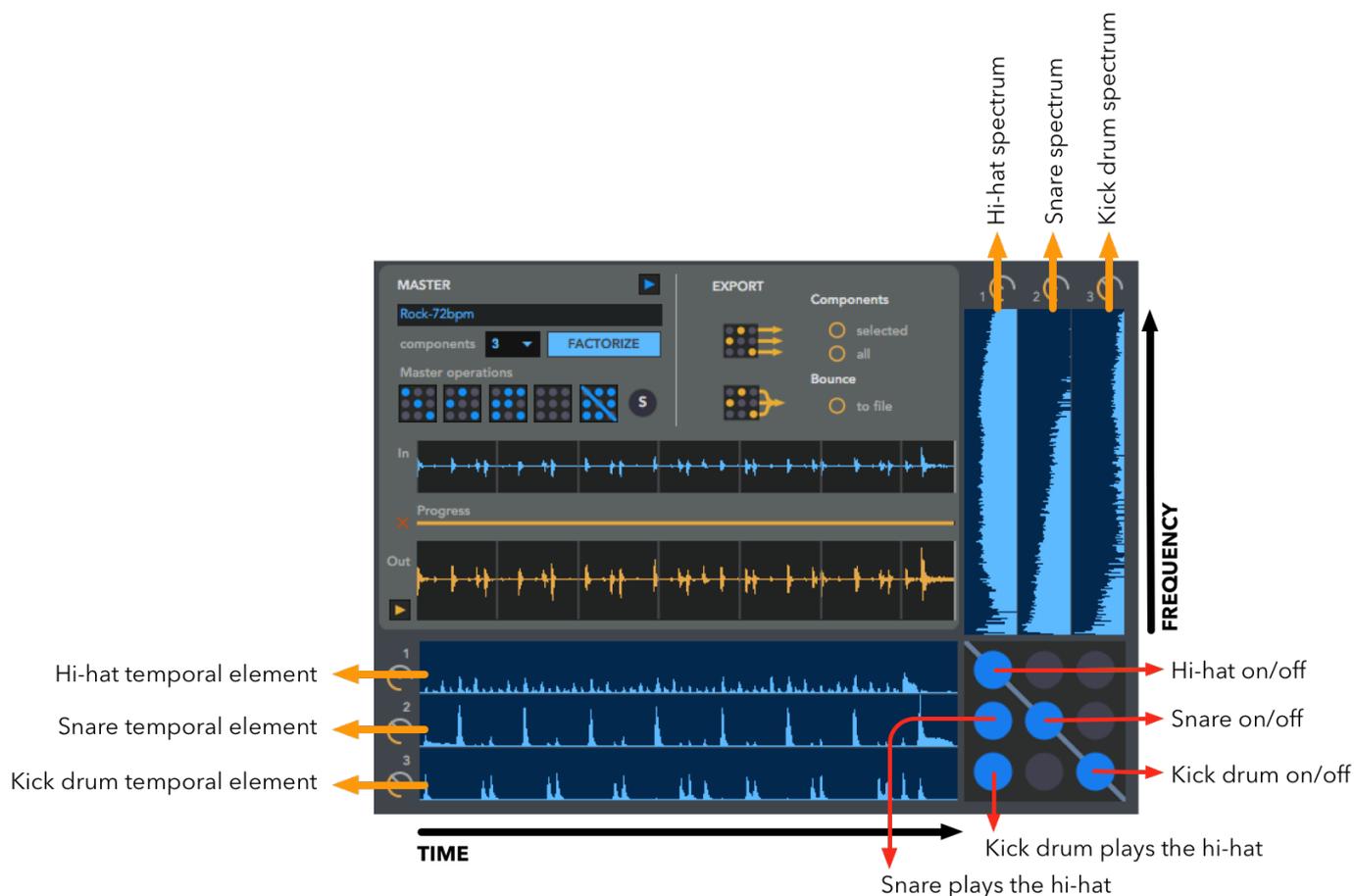
Switchboard connections can also be created automatically via the operation buttons on the control panel (see below).

Main control panel

The main control panel manages sound loading and exporting, launches factorizations, and creates automatic switchboard connections.

- **Master sound name**

  bach_short

  Displays the name of the last clip that has been factorized as master sound.

- **Factorization controls**

  components 8 ▼ FACTORIZE

  Launch factorization of the master sound. The sequence of events must be as follows:

  1. Click on an audio clip that already sits in your Live project. It has to be on the same track than Factormini.
  2. Select the desired number of factorization components (2 to 8). This is the number of temporal elements and spectral elements that will be obtained. This parameter has a strong impact on the sound results (see section "Factorization how-to").
  3. Click on the "FACTORIZE" button. One of the following things should happen:
     - If the selected clip is not warped nor transposed, it will be immediately loaded and factorized.
     - If the selected clip is warped or transposed, the clip will be recorded in real time into Factormini, and factorization will automatically be launched when recording stops. In session view, recording is in sync with global quantization settings and will happen at the next iteration loop.

     If nothing happens or the "factorize" button remains blinking, make sure that a clip is actually selected on Live (it's not enough that the clip is playing on the Live set, it has to be selected by clicking on it - selected clips are highlighted in light blue in Live).
  4. Once factorization is done, the name of the clip, the input waveform and the temporal and spectral elements will be displayed. The switchboard will be empty, so you still need to create components to start hearing any sounds.

If a new factorization is launched, the displayed elements will be updated but the output waveform will still contain the last factorized sound until a new component creation or modification is done. In other words: to switch to a new sound that has just been factorized, a sound modification must be requested. In this way, when using Factormini in live performance, it can keep playing the last sound while a new one is being factorized.

When moving the time position of a clip in arrangement view, or its slot position in session view, it needs to be factorized again.

Since Factormini works by loading the original sound file corresponding to the selected clip, splitting or joining clips in Live won't have any effect, unless you consolidate them (right click on the clip and "Consolidate", or ⌘ J).

> ⚠ When launching a factorization, the previously made connections and element edits are lost. Think about saving your project or saving a device preset before launching a new factorization.

> ⚠ Some clips from official Ableton packs can only be used in Factormini as master sounds if they are warped or transposed.

- **Input waveform**

The waveform of the loaded or recorded master sound, previous to modifications, is displayed in blue.

- **Progress bar**

The progress bar shows the computation progress of the factorization and file export processes. You can cancel computation by clicking on the cancel button to the left of the progress bar.

> ⚠ Factorization can be a CPU and memory-demanding process. For short short clips (less than 30 seconds) and few components, factorization will only take a few seconds. For longer clips with more components, factorization time might be long, and memory can go up to several GBs! In those cases, remember that you can always cancel factorization once started.

- **Playback input sound**

The small play button above the name field play back the original loaded/recorded input sound.

- **Switchboard operations**

As an alternative to creating components by clicking on individual switchboard buttons, the master operation buttons automatically create/remove several components at once:

	Diagonal	Add all the diagonal components. This means: reconstruct the original sound.
	Scramble	Create random connections, but keeping only one connection per spectral element.
	Random	Create random connections, allowing connecting several temporal elemnts to a single spectral element, and vice-versa.
	Clear	Clear all connections.
	Clear diagonal	Clear the diagonal connections. This means: remove all original components and leave the artificial ones.

- **Solo button**

The solo button activate "solo mode", which allows listening to individual components. When in solo mode, clicking on individual components on the switchboard activates that component and clears all the others.

When exiting solo mode, the switchboard connections that were active before entering solo mode are restored.

- **Output waveform**

The output waveform (the sum of all components) is displayed in yellow. There is a preview playback button next to it. Remember that, after a new factorization, the output waveform is not updated until a switchboard connection has been changed or a temporal or spectral element has been modified.

- **Export section**

  - **Export selected components:**
    A WAV file is created for each component that is currently selected on the switchboard. Clicking on the button opens a dialog window to select the saving location. Factormini will create a folder named `fsComponents` at this location, which will contain the WAV files with naming convention `m_i_j.wav`, where `i` and `j` are the row and column coordinates of the components on the switchboards, (1,1) being the upper-left component.

⚠ Tip: once the component WAV files have been exported, you can import them into the Live project as multiple new tracks in arrangement view by selecting them all on the Finder or on Live's file browser, and dragging them into the project while pressing the command key (⌘).

  - **Export all components:**
    A WAV file is created for all components, whether they are selected or not, using the same naming convention as above.

⚠ Be careful when exporting all components. Even a limited number of factorization components can produce a huge number of output files. For instance, having 8 master components would produce 8*8 = 64 WAV files! You can always abort exporting via the cancel button at the left of the progress bar.

  - **Bounce to file:**
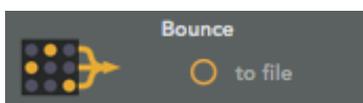
    A WAV file is created containing the current output sound (the waveform displayed in yellow). The default output file name is fs_out`.wav`

⚠ If something strange happens while using Factormini (a file does not load, a factorization takes too long,…) you can have a look at the Max window to see if there are any error messages. You can open the Max window by right-clicking the title bar on the Factormini device window on the audio effects area, and selecting "Open Max Window". If the error message is not self-explanatory, please do contact support.
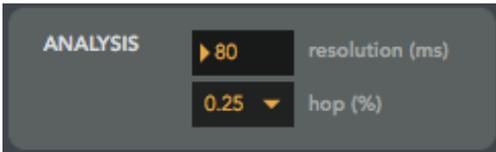
Element mixing

Next to each temporal and spectral element, there is a **dial** that controls its amplitude. This allows static or dynamic remixing of the components (note that changing the amplitude of one temporal/spectral element will affect all components that are activated on the current switchboard row/column).

Analysis panel

The analysis panel contains two parameters that determine the time and frequency resolution used for the factorization:

- **Resolution:** sets the time resolution (in milliseconds) of the analysis window. Possible values: 5-180. Default: 80. Low values mean a high temporal resolution (e.g., attacks and impulses will sound cleaner), but at the cost of a lower frequency resolution (e.g. it will be harder to distinguish individual harmonics).
- **Hop:** sets the hop size (given in % of overlap) of the analysis window. Possible values: 0.25 and 0.125. Default: 0.25. A lower value means a higher temporal resolution without changing the frequency resolution, but at the cost of higher CPU and memory requirements.

Working with presets

You can use Live's integrated preset saving system (clicking on the floppy disk icon on the upper right of the device window in the audio effects area). Saving a Factormini preset stores all the temporal and spectral elements, the switchboard connections, the name of the loaded clips and all the other parameters.

However, when re-loading a preset, factorizations must be manually launched again, right after loading it. When loading from a preset, the factorization button blinks to indicate the need to re-factorize. Click on it to re-factorize.

The same applies when saving and re-loading a Live Set that includes a Factormini device.

⚠️ Saving and re-loading of presets with a warped or transposed master clip that has been recorded into Factormini is not supported.

Automation and MIDI-mapping

The following Factormini parameters are controllable by Live's automation envelopes and MIDI and key mappings: factorization buttons, matrix operation buttons, solo buttons, element levels, dry/wet.

The following are not controllable: number of components, individual buttons on the switchboard and analysis parameters.

Factorization how-to

Choosing the right number of components is crucial for obtaining good factorizations. Of course, this will depend on the complexity of the input sound and on the type of elements you would like to obtain. You'll see that it is mostly a trial-and-error process, but here are some guidelines that might help you:

- If your input clip contains a few simple sound events (for example, a drum loop or a sequence of a few notes), Factormini will likely separate each event into a component. For example, if you have a melody containing 7 different pitches (not counting the repeated ones), doing a factorization with 7 components will often (but not always!) result in one temporal/spectral element pair per pitch.
- In the same scenario of a simple clip with few events, if you factorize into more components than events in the original sound, Factormini will start "delving" deeper to extract more underlying structures. For instance, if your clip contains 3 piano notes and you factorize into 10 components, some components will contain the noisy and impulsive parts of the attack phases, and other will contain the harmonic sustain and/or release parts of the different pitches.
- For complex input clips (loops containing several instruments, song excerpts or full songs), the decomposition is more unpredictable, but can often detect interesting elements such as a rhythmical motif of the bass, a guitar lick, an underlying pad, impulsive noises, etc.
- If you decompose a song excerpt with few components, it is likely that all the drums will end up on one or two components.
- Factormini cannot separate full instruments or voices, except in very simple cases. You won't be able to do things like suppressing a singing voice or guitar solo. That's the job of *source separation,* which is a much harder thing to do!

As you can see, using Factormini is a pretty exploratory process. After a bit of testing, you will a get a sense of how it reacts to the clips in your collection.

Thanks for using Factormini, and have fun!

Support

For assistance, bug reports and any suggestions, please contact software@jjburred.com