

SpatGRIS2



Tools for 2D and 3D sound spatialization

Developed by the GRIS.
(Groupe de Recherche en Immersion Spatiale)
<http://gris.musique.umontreal.ca/>

Director: Robert NORMANDEAU
Programmers: Olivier BÉLANGER
 Vincent BERTHIAUME
 Nicolas MASSON
 Antoine MISSOUT
Assistants: David LEDOUX, Christophe LENGELE, Nicola GIANNINI

Manual

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I. INTRODUCTION

These instructions assume that you are familiar with the following tools:

- Jack OSX (just the basic principles);
- Any DAW that can use AU or VST plugins;
- Your audio interface.

The software has been tested on the following MacOS and DAWs:

- MacOS Mojave™ (10.14.6);
- JackRouter 0.97;
- Digital Performer™ 10; Ableton Live™ 10; Logic Pro X™; Reaper™ 6.

I.1. Groupe de Recherche en Immersion Spatiale (GRIS)

Director: Robert Normandneau

Main programmer: Olivier Bélanger

Former programmers: Vincent Berthiaume, Nicolas Masson

Assistants: David Ledoux, Christophe Lenglé, Nicola Giannini

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Thanks to Simone d'Ambrosio and Raphaël Néron-Baribeau, who contributed to the writing of this manual.

Proofreading: Jamie Dunkle

Thanks to Yohan Brimicombe for the web site:

<http://gris.musique.umontreal.ca/fr/>

I.2. SpatGRIS2 kit

The kit comprises, in different folders:

Kit 1:

- *SpatGRIS2* itself with an installer that includes Jack;
- A Template folder with different speaker setups in DOME or CUBE format. It also includes some examples of *SpatGRIS2* project files.

Kit 2:

- *ControlGRIS* as a compressed folder with the different formats of the plugin.

SpatGRIS2 and *ControlGRIS* will be updated separately. Please subscribe to our newsletter to be informed about the software updates on our web site.

And optional documents pertaining to iPad control of *ControlGRIS*:

- An Open Stage Control patch for iPad™;
- A Lemur patch for iPad™.

I.3. ControlGRIS

ControlGRIS is a new OSC¹ plugin available in Audio Unit, VST, and VST 3 formats² (Mac). This free and open-source plugin sends OSC data to *SpatGRIS2* to spatialize multiple sound sources on a variable set of speakers. Different modes of source links and a trajectory system are provided for spatialization of mono, stereo and multichannel sources.

¹ Open Sound Control

² An AAX version is also planned, but due to Covid-19 situation, it had to be delayed.

1.3.1. History

The development of *ControlGRIS* began in 2019. It was inspired by three older plugins, *OctoGRIS* (2010), *ZirkOSC* (2012) and *SpatGRIS1* (2017). The first version (1.1.0) was released in April 2020.

1.3.2. ControlGRIS Installation notes

- Download the latest version of *ControlGRIS* from SourceForge:
<https://sourceforge.net/projects/spatgris-2/>
- Decompress the downloaded file. A folder will be created containing the different versions of the plugin.
- To install the Audio Unit version, copy it to the following location: ~/Library/Audio/Plug-Ins/Components
- To install the VST version, copy it in the VST folder to the following location: ~/Library/Audio/Plug-Ins/VST
- To install the VST3 version, copy it in the VST3 folder to the following location: ~/Library/Audio/Plug-Ins/VST3
- To install the AAX version, copy it to the following location: ~/Library/Application Support/Avid/Audio/Plug-Ins/³

NOTE: *ControlGRIS* appears under the “UdeM” folder of your host application.

1.3.3. AU or VST

ControlGRIS has been extensively tested on MacOS Mojave (10.14) and appears to work fine on Sierra (10.12) and higher. Here are some particularities:

- Use the AU version in DP and Logic (the VST or VST3 versions don't work);
- Use the VST version in Reaper and Live.
- Refer to the manual of your preferred DAW to determine which version is better.

1.4. SpatGRIS2

SpatGRIS2 is a standalone application that allows the spatialization of sounds on different speaker configurations, in 2D (X and Y-axis) or 3D (X, Y and Z-axis). It is based on the *JackRouter HAL* plugin which is installed with *SpatGRIS2*. It may include up to 128 inputs and outputs⁴. The movements are sent from the *ControlGRIS* plugin, or from any other OSC software⁵. The audio spatialization itself is performed by *SpatGRIS2* and sent to the audio interface.

The main advantage of the combination *ControlGRIS/SpatGRIS2* is that there is no limitation imposed by the DAW's maximum number of outputs per track, which usually varies from 2 to 8. This means that the user is limited to octophonic spatialization at best (hence the name of the original plugin: *OctoGRIS*). Also, most DAWs don't take into account the vertical dimension of the spatialization (2D only). *SpatGRIS2* allows for full 3D spatialization.

1.4.1. History

The development of *SpatGRIS2* began in 2019. It is a rewritten version of *ServerGRIS* (2018). The *ServerGRIS* started to be developed in 2017 as an alternative to the *Zirkonium* designed at the ZKM in Germany. The first official version of *SpatGRIS2* is 2.1.2 and was released in April 2020.

1.4.2. SpatGRIS2 Installation notes

- Download the latest version of *SpatGRIS2* from SourceForge:
<https://sourceforge.net/projects/spatgris-2/>
- Decompress the downloaded file.
- SpatGRIS2 installer puts all the necessary components at the right place including SpatGRIS2 itself and the Jack folder in the Applications folder and all the needed libraries in their correct locations.

NOTE: We recommend that you remove any prior version of Jack, by using the Uninstall JackOSX command in the Jack folder and then restarting your computer. After the first installation, we recommend restarting the computer. This will ensure that all the preferences are properly set.

³ Due to circumstances beyond our control (Covid-19), we didn't have access to the faculty's studios during the writing of this manual. Therefore, we didn't have access to the iLok where Avid had put our key. So, the AAX version was not tested and will be published at a later date.

⁴ Theoretically, it works with 256 channels, but we would not recommend it. Jack is mono-core on the Mac, so even if you have the biggest machine in the world, you'll have to face this CPU limitation.

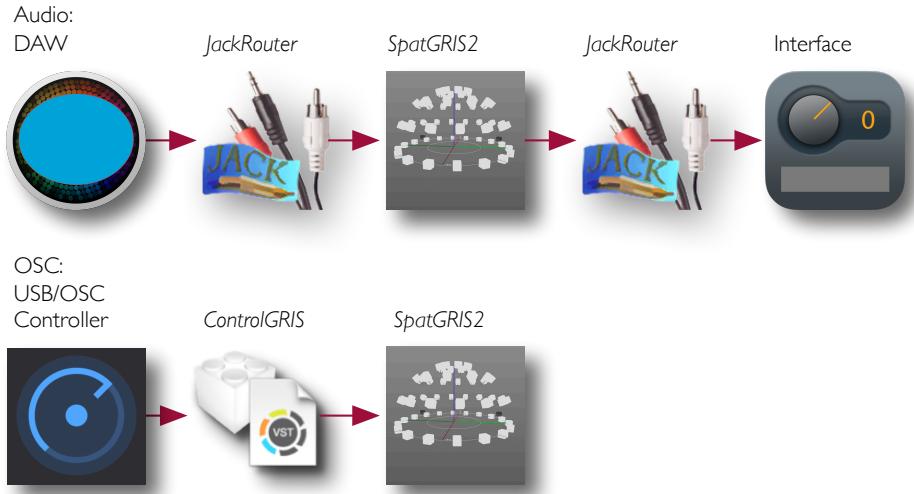
⁵ See the format of the OSC messages in the addendum.

1.5. Architecture

SpatGRIS2 setup is made of two elements:

- The *ControlGRIS* plugin where the trajectories are designed and recorded;
- The *SpatGRIS2* itself that spatializes the sound according to the setup of the speakers done in the Speaker Setup Edition page.

The whole architecture, including these elements (Audio and OSC are working in parallel), looks like this:



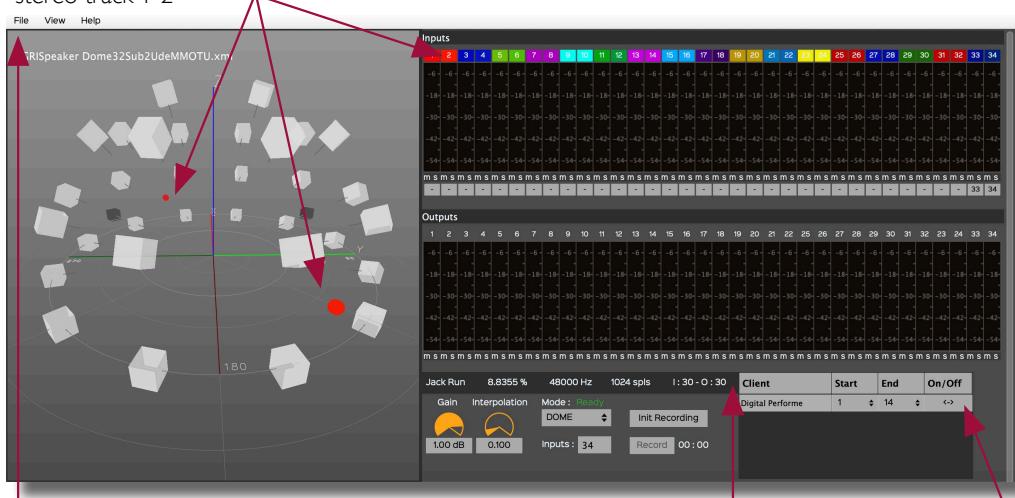
I.6. Quick Start Guide

SpatGRIS2 receives Open Sound Control (OSC) data from *ControlGRIS*, which it uses to spatialize the sounds within a set of speakers. The sound itself is sent from the DAW to *SpatGRIS2* via *JackRouter*.

Don't need/want to read the manual? Here are the basic steps to spatialize e.g. a stereo track on a 30 input/30 output audio interface. **The order is very important.**

1. Assign the Input **and** the Output of MacOS System Sound Preferences to your interface
 2. Open SpatGRIS2
 3. Open a DOME Speaker setup (File menu) or use the default one
 4. Open your DAW
 5. Assign the audio of your DAW to *JackRouter*
 6. Create a stereo track and assign it to *JackRouter 1-2*
 7. Insert a *ControlGRIS* plugin in this track in DOME mode
 8. Number of sources should be already initialized and set at 2 and First Source ID at 1
 9. Select *Circular Fully Fixed* in Source Link
 10. In SpatGRIS2, put your DAW to On mode <->
 11. Play with Source No. 1 and see the result in SpatGRIS2
 12. The colour of the sources are the ones selected in the inputs (red in this example). You are now ready to play and record automation.

12. The red dots represent the stereo track 1-2

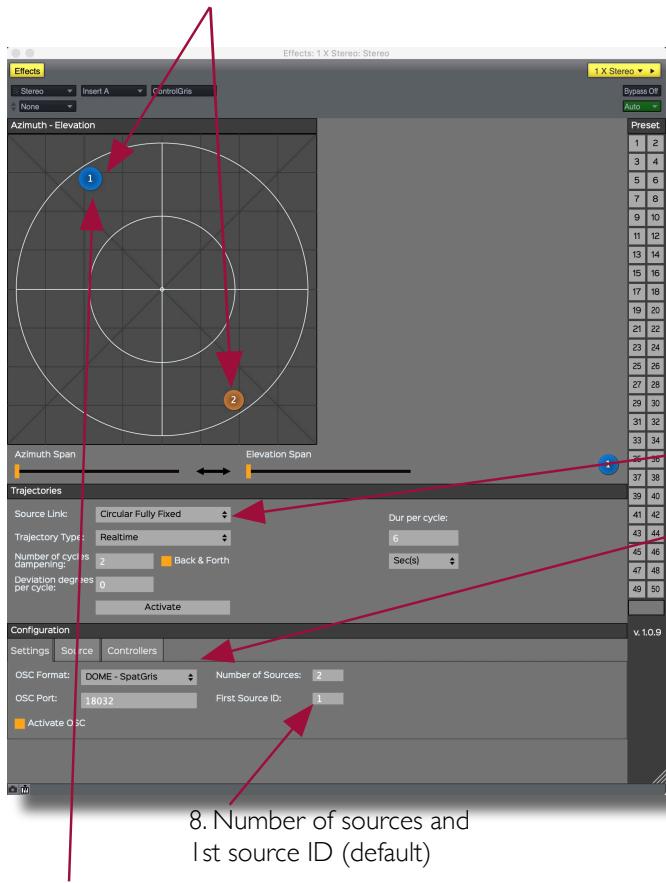


3. Open a speaker setup (File menu)

I. Inputs/Outputs from System Sound Preferences

10. On/Off

6. This is a stereo track



9. Circular Fully Fixed

7. Select the DOME mode (Default)

8. Number of sources and 1st source ID (default)

11. Play with source no 1

Questions? Details? Read the manual!

Here or in the Help menu:

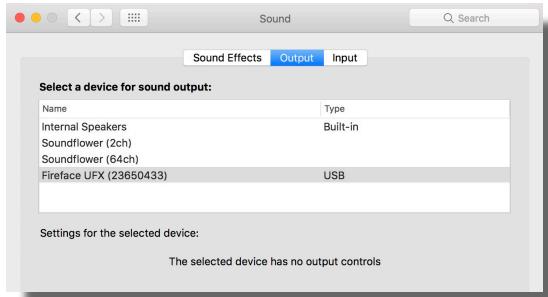


2. Connections

2.1. Connecting the DAW to SpatGRIS2

2.1.1. Assign Core Audio to your interface

In the Sound section of the system preferences, assign the **input** AND the **output** to your interface (if you plan to use headphones, see the warning in [8.6 Bluetooth Headphones with SpatGRIS2](#)):



This setting has two functions:

- To connect Jack to your audio interface automatically;
- To synchronize your audio software over long periods of time.

2.1.2. Opening SpatGRIS2

The first time you open *SpatGRIS2*, you'll have to:

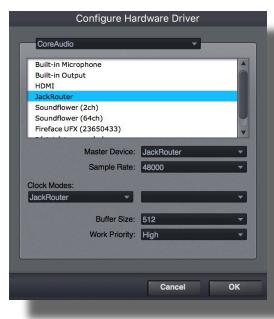
- Determine the numbers of inputs (up to 128). 64 would be enough in most cases. But fewer inputs mean less CPU load;
- Design a Speaker Setup.

After these first two steps, save the Speaker Setup and the Server document. Following sessions will automatically open the last saved Speaker Setup and Document at the start-up of *SpatGRIS2*.

2.1.3. Adjust the output level

By default, the output level of the *SpatGRIS2* is set to unity gain: 0.00 dB. It may need to be attenuated, especially the first time you try the system!

2.1.4. Assign your DAW to Jack



In the audio setup of your DAW, assign the outputs to *JackRouter* (here's an example in DP).

JackRouter should be seen like any other audio interface. *SpatGRIS2* will automatically detect the presence of the audio software connected to Jack and will allocate a certain number of active channels. It will also automatically allocate the proper number of channels to each client in the order which they were opened.

2.1.5. Audio On/Off

Before you can hear any sound, you have to press the audio *On/Off* button: <->. By default, the system is set to *Off* (<X>):

Client	Start	End	On/Off
Digital Performe	1	8	<X>

NOTE: If you make changes in your setup, you might have to set the Server to Off <X> and then to On <-> again, in order to activate the new connections.

2.1.6. Multiclient

SpatGRIS2 is a multiclient software, which means that it can connect to multiple audio software instances at the same time. Keep in mind, though, that its primary usage is to spatialize sounds coming out of a single DAW. The Server receives two types of information:

- Audio signals from Jack;
- OSC data from ControlGRIS.

If you use only one DAW, there is no problem, and we recommend that the audio channels and the OSC channels correspond and are labelled with the same numbers. Things become a little bit more complicated if you intend to use more than one software at a time.

• Audio signals from Jack will always start at number 1 in the DAWs which are limited, most of the time, to 64 outputs in total. Consequently, you might think that the channel numbers as represented in your DAW correspond to the ones displayed in SpatGRIS2, when in fact their real numbers will be organized according to the Start and End numbers allocated to each DAW.

Client	Start	End	On/Off
Digital Performer	1	20	<->
REAPER	21	84	<->

In the example shown above, inputs 1 to 20 are assigned to DP and inputs 21 to 84 to Reaper.

• OSC channel numbers, on the other hand, must be absolute. Therefore, in this example, DP will use OSC numbers from 1 to 20 and Reaper from 21 to 84. Since DAWs are using their own numbering for audio channels then in Reaper, the audio channels (1 to 64) and the OSC channels (21 to 84) won't have the same numbering. Be careful with this!

2.1.7. Start/End

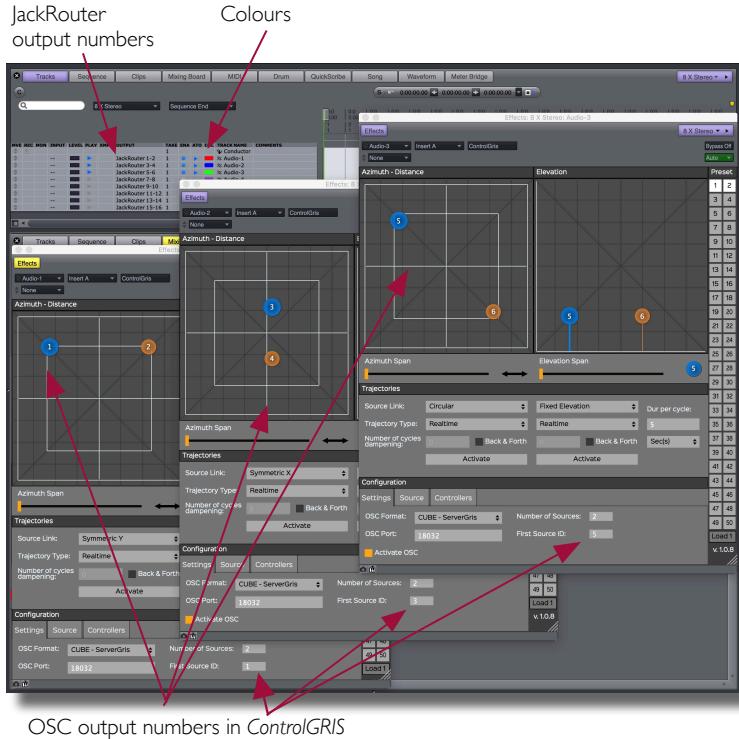
Start/End defines the numbers (from the outputs of the DAW) that SpatGRIS2 is receiving. The default value is 64 channels per client. However, this can vary since some DAWs indicate only the channels they actually use (like DP). You can change the default *Start* and *End* ordering values according to your needs. The maximum number of channels is 256.

NOTE: The End value is relative to the client(s) connected and therefore can't be saved or memorized. Manual adjustments may be needed every time a SpatGRIS2 is open, especially with big projects.

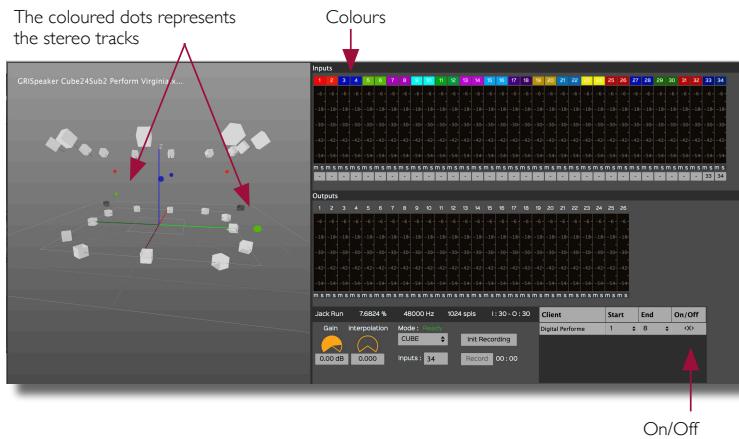
2.2. Connecting ControlGRIS to SpatGRIS2

2.2.1. Numbering

The spatialization is handled by *SpatGRIS2* which receives OSC data from *ControlGRIS*. To avoid confusion, it is better to synchronize *JackRouter* output numbers in the DAW with the OSC numbers in the *ControlGRIS/SpatGRIS2* combination. In the following example, three stereo tracks (red, blue and green) are assigned to *JackRouter* 1-2, 3-4 and 5-6. The three instances of *ControlGRIS* use the same OSC numbering: 1-2, 3-4 and 5-6. A clear relationship between audio and OSC numbering helps to maintain cohesion in complex projects.



To help to keep things clear, it is best to use the same colour scheme in the DAW and in *SpatGRIS2*.



NOTE: If by mistake, you are using the same OSC numbers in different tracks, the sources in *SpatGRIS2* will oscillate because they will receive two (or more) positions from different *ControlGRIS*. It's a good indicator that something is wrong.

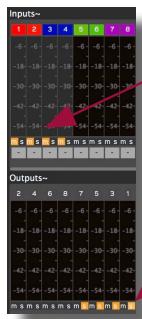
2.2.2. Input Colour

The colour of the inputs can be set to any value by double-clicking in the colour panel. It opens a window where you can set the parameters of the colour. Keep in mind that this is the colour you will see in the 2D or the 3D window. If you use a lot of sources, it is recommended that you design your colour set carefully. By using the right-hand click on a colour, you will set the same colour to a stereo pair.



2.2.3. Mute and Solo

All inputs and outputs can be muted (m) or soloed (s).



3. ControlGRIS

ControlGRIS is an OSC plugin that offers two modes:

- DOME
- CUBE

3.1. General Presentation

ControlGRIS is an OSC sound spatialization plugin. This plugin allows movements of multichannel sound sources on a variable set of speakers. A number of source link modes and a trajectory system are provided to allow the spatialization of mono, stereo, quad, 5.1 or multichannel sources up to eight channels. *ControlGRIS* doesn't handle audio, only data which is sent to *SpatGRIS2*. Audio is sent from the DAW directly to *SpatGRIS2*.

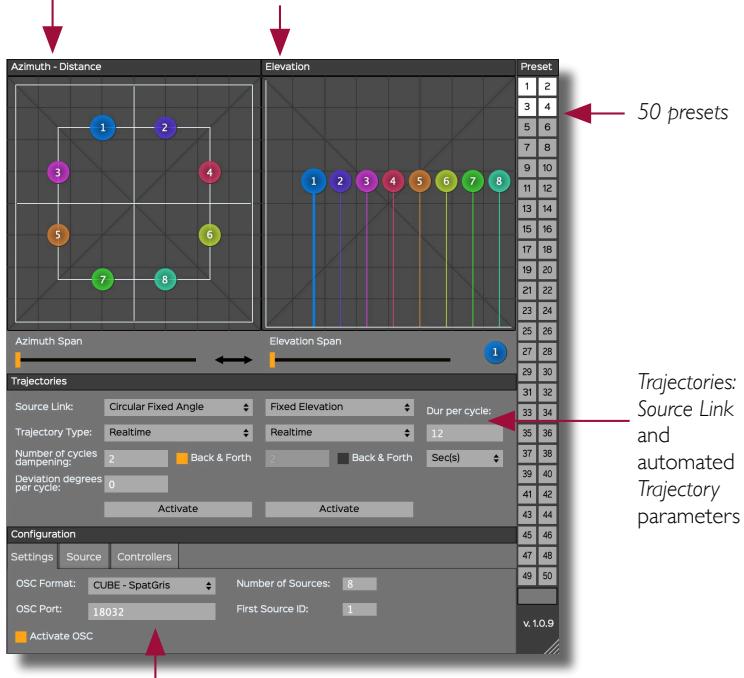
This document describes the operating instructions and functions specific to *ControlGRIS*. This new plugin was inspired by a former plugin called *SpatGRIS1* but their parameters are not named exactly the same⁶. It is assumed that the user has a working knowledge of the host software and can perform basic functions in order to configure it.

⁶ In some DAW like Digital Performer, it is possible to change or reassign some Continuous Data from one plugin to another.

3.2. Graphical interface

The graphical interface allows the placement of the sound sources. It has two sections:

- Azimuth-Distance (DOME)
- Elevation (CUBE)



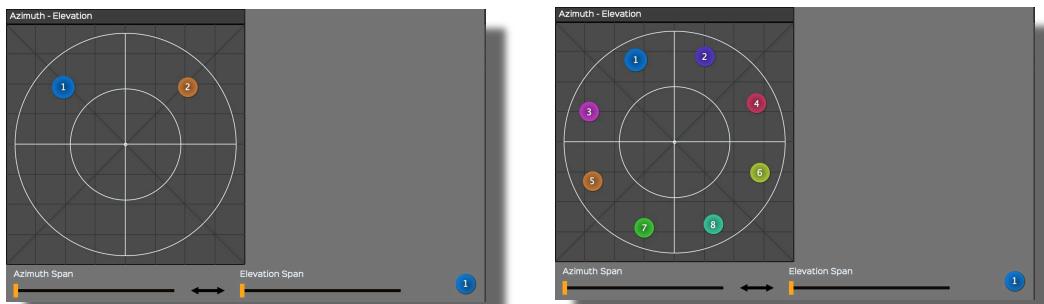
Configuration panel of the plugin, subdivided in tabs:
Settings, Sources, Controllers

Trajectories:
Source Link
and
automated
Trajectory
parameters

3.2.1. Spatialization views

ControlGRIS works in two different modes: DOME and CUBE⁷.

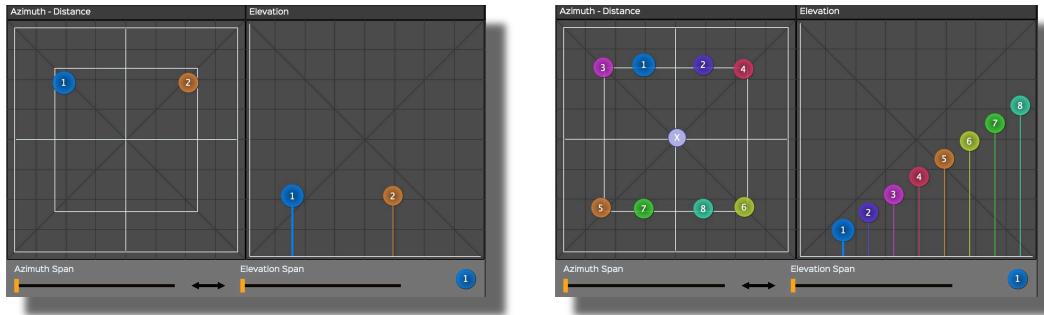
In DOME mode, the graphical interface is limited to Azimuth-Elevation. The dome is represented here from the top, examples with stereo sources on the left, octophonic sources on the right:



In this mode, the sound is spatialized on the surface of the dome. Whereas a source placed in the centre is at the top of the dome, a source placed at the periphery is at the bottom of the dome.

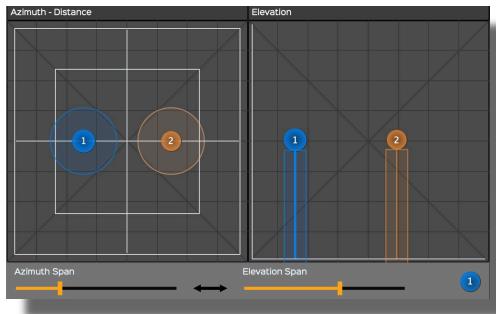
In CUBE mode, the graphical interface is divided between two screens: Azimuth-Distance and Elevation. The CUBE mode adds distance and allows moving a sound to the centre. The CUBE is represented from the top on the left and in profile on the right (the 3D view shows only in SpatGRIS2):

⁷ These two modes will be explained in detail in the SpatGRIS2 section.



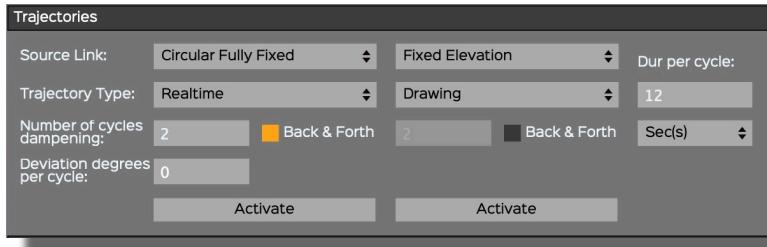
3.2.2. Spans

In both modes, Span parameters are available for azimuth and elevation. Span spreads the signal to a larger zone than just the source itself.



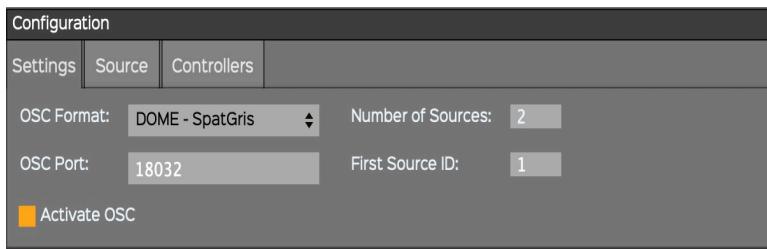
3.2.3. Trajectories

It is possible to automate the movement of the sources using predefined trajectories. Under the *Trajectories* control panel, you can set and adjust these movements to the musical context. See section 4.3. *Trajectories* for details.



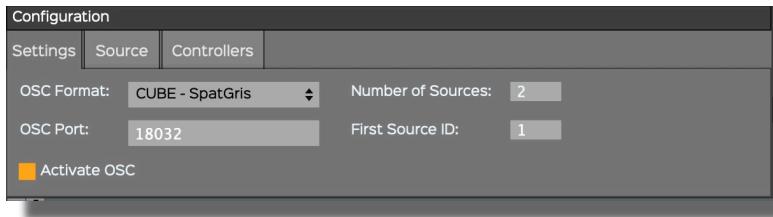
3.2.4. Configuration panel

The configuration panel gives access to different plugin parameters. These settings are grouped under three tabs: Settings, Sources and Controllers.



3.3. Configuration

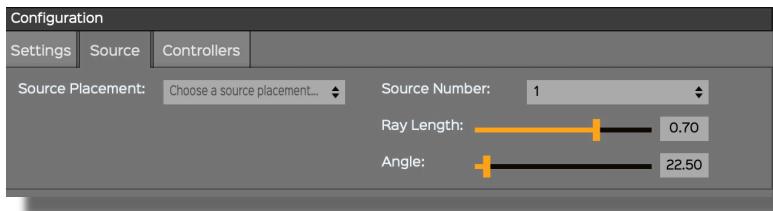
3.3.1. Settings



This is where you choose:

- The OSC format: DOME or CUBE.
- The OSC port (default: 18032). If you change this value, you'll have to change it also in *SpatGRIS2*.
- The number of sources
- The First Source ID: every source should have a different ID.
- Activate or Deactivate OSC.

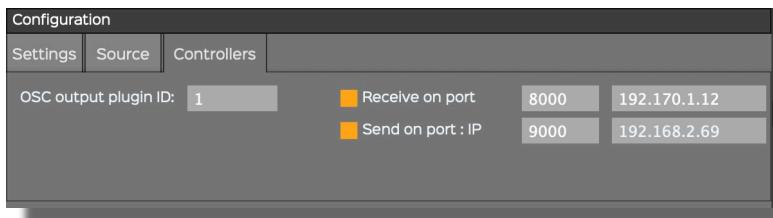
3.3.2. Source



Under the Source tab, it is possible to accurately position sources by using the graphical interface. Using Source placement, it is possible to position sources equidistantly, following a clockwise or alternate order. To do so, simply select the desired layout from the drop-down menu.

Moreover, it is possible to manually adjust the position of the sources by entering their polar coordinates. From the Source Number drop-down menu, first select the number of the source to be moved. Then, enter its new coordinates. The Ray Length and Angle correspond to the current polar coordinates of the selected source.

3.3.3. Controllers



ControlGRIS can be manipulated via an external Open Sound Control⁸ (OSC) controller. There is an interface made in Open Stage Control and one made in Lemur to manipulate *ControlGRIS* parameters from an iPad⁹.

- OSC output plugin ID: to control different instances of *ControlGRIS*, each one should have a different ID;
- Receive and Send should be set accordingly to the proper OSC channels (Default: 9000 and 8000).
- IP ports addresses should be set accordingly to your Wi-Fi network, either public or local¹⁰. Both the Mac and the controller should be on the same network.

⁸ <http://opensoundcontrol.org/introduction-osc>

⁹ See the Addendum for more information.

¹⁰ See the Open Stage Control manual for that: <https://openstagecontrol.ammd.net/docs/getting-started/>

3.4. How to use ControlGRIS

ControlGRIS is a plugin that can be inserted on any audio or auxiliary tracks that require spatialization. Source spatialization can be performed directly with the GUI plugin or with an external OSC controller. *ControlGRIS* comprises a trajectory system that can write predefined movements quickly and efficiently. The automation function of the host software assures the recording and playback of the source's movements. It is therefore essential to understand the various automation modes in your preferred host.

3.4.1. Loading the plugin on a track

ControlGRIS is loaded similarly to any other AU or VST plugin. Be careful to match the output numbers of the audio tracks with the OSC numbers in the plugin. This will help to make things easier. Most often, *ControlGRIS* is loaded at the end of the insert chain of the track.

3.4.2. Saving presets

It is possible to save some of the *ControlGRIS* plugin parameters within the 50 provided presets. The shortcuts are:

- Shift-Click Preset number: Save
- Click Preset number: Load
- Opt¹¹-Click Preset number: Delete

These functions appear below the row 49-50:



Creating such presets allows you to save and recall the following parameters:

- Source positions (Azimuth-Distance-Elevation). These can also be automated.

Parameters that are not saved but can be automated:

- Spans
- Source Link and Source Link Alt
- Presets
- Bypass

Parameters that are not saved and not automated, because they are used to automatically generate a trajectory that will be written by the DAW itself:

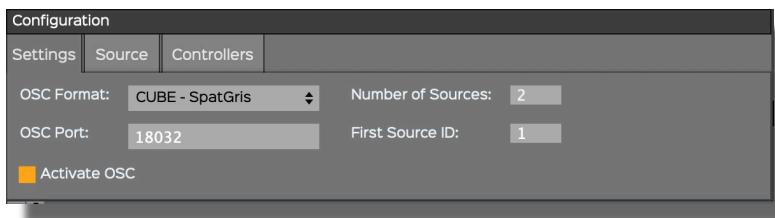
- Spans link
- Trajectory Type
- Dur per cycle
- Sec(s)/Beat(s)
- Number of cycles dampening
- Deviation degrees per cycle
- Back & Forth
- Activate

Configuration tab

- The whole Configuration tab is not saved in the preset (this one is saved with the DAW project). It is not a good idea to change these settings within a track.

¹¹ On the Mac, most keyboards use Option (Opt), and other use Alt. Opt will be used in this manual.

3.5. Configuration parameters



3.5.1. DOME

The DOME mode is based on the VBAP algorithm designed by Ville Pulkki. In this mode, the space is represented by a dome where the distance between every point of the surface of the dome is equal to one.

3.5.2. CUBE

The CUBE mode is based on an original LBAP¹² algorithm designed by Olivier Bélanger. In this mode, the space is represented by a cube within which it is possible to design any kind of speaker setup.

3.5.3. OSC Port

This is the OSC port for communication between ControlGRIS and SpatGRIS2. Needless to say, they should be set to the same one.

3.5.4. Number of Sources

The number of sources per track corresponds to the number of audio channels in the track. The number is limited to eight channels, however (as it is in most DAWs).

3.5.5. First Source ID

This number should be unique and different for each track. We recommend that you set the same numbers for audio and for OSC to avoid confusion.

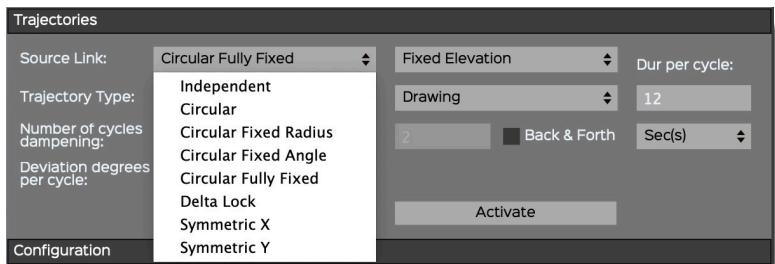
If you have only mono tracks, the numbers are successive. If you have stereo tracks, you'll have only odd numbers to put here: 1, 3, 5, etc. because the even numbers are set automatically to the right channel of each stereo track. And if you work with octophonic sound files, the first source ID will be 1, the second octophonic track will start at 9, etc.

3.6. Source Links

3.6.1. Azimuth-Distance links

Within the Trajectories section, under the Source Link drop-down menu, it is possible to choose different ways of linking sources together. Depending on the number of channels, some links may not be available:

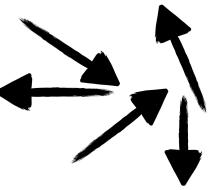
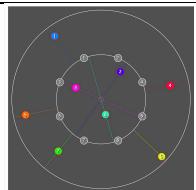
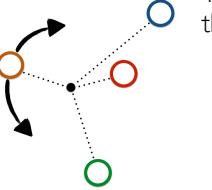
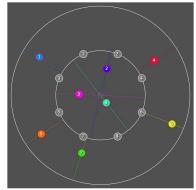
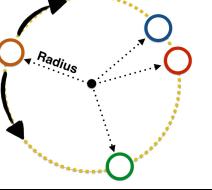
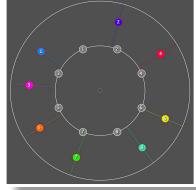
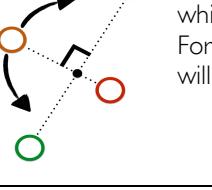
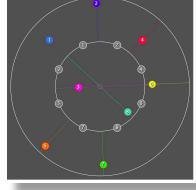
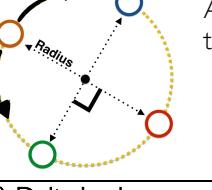
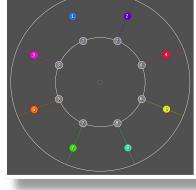
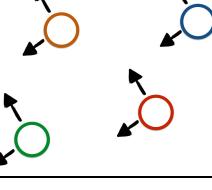
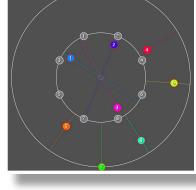
- Mono: Independent only
- Stereo: all links
- Multichannel: all but Symmetric X and Y.



NOTE: The Independent mode in multichannel is available only to place the sources independently. But the position of sources can't be automated independently. Only Source 1 is recorded. Therefore, after placing

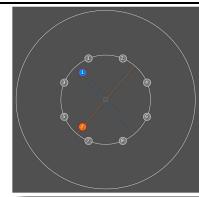
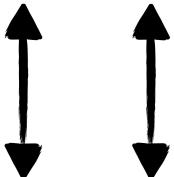
¹² Layer Base Amplitude Panning. Distinct from the LBAP by Ivica Ico Bukvic.

the sources, a different link should be chosen before recording the automation.

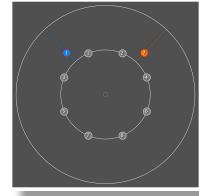
1) Independent MONO + STEREO + MULTIPHONIC	This mode is selected by default. The sources can be moved independently from one another.		
2) Circular STEREO + MULTIPHONIC	This mode enables the circular grouped movement. The angles between the sources remain constant while the radius adjusts proportionally.		
3) Circular Fixed Radius STEREO + MULTIPHONIC	The sources are linked in a circular motion by the RADIUS parameter, which remains fixed and equal. The relative distance between each source and the centre is the same for all sources.		
4) Circular Fixed Angle STEREO + MULTIPHONIC	The sources are linked in a circular motion with the ANGLE parameter, which remains fixed and equal. For example, in octophony the opening angle between each of the sources will be fixed to 45°.		
5) Circular Fully Fixed STEREO + MULTIPHONIC	The sources are linked in a circular motion by both the RADIUS and ANGLE parameters, which remain fixed and equal. The opening between the sources and their radius is therefore always identical.		
6) Delta Lock STEREO + MULTIPHONIC	This mode locks the position of the sources in relation to others along the X and Y axes, without the possibility of rotation.		

7) Symmetric X STEREO

This mode enables the symmetry between two sources following the X axis.

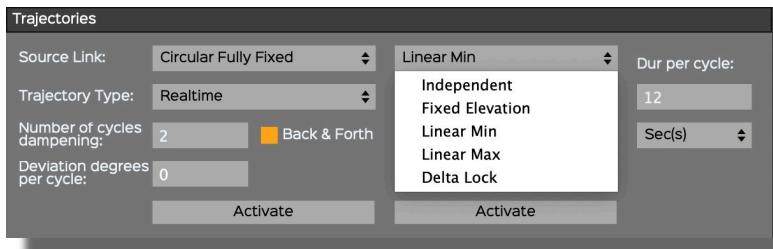
**8) Symmetric Y STEREO**

This mode enables the symmetry between two sources following the Y axis.



3.6.2. Elevation links

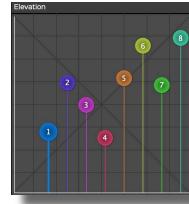
In CUBE mode, the Elevation between sources are independent from the Azimuth-Distance.



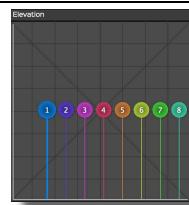
NOTE: Independent in multichannel is available only to place the sources independently. But their positions can't be automated independently. Only Source 1 is recorded. Therefore, after placing the sources, a different link should be chosen before recording the automation.

1) Independent MONO + STEREO + MULTIPHONIC

This mode is selected by default. The sources can be moved independently from one another.

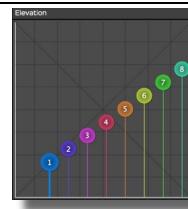
**2) Fixed Elevation STEREO + MULTIPHONIC**

Same elevation for each source.

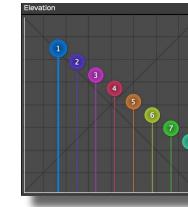


3) Linear Min STEREO + MULTIPHONIC

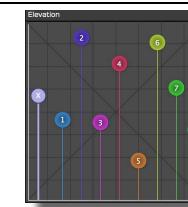
This mode locks the position of the sources from a minimum to a maximum value in a linear relationship.

**4) Linear Max** STEREO + MULTIPHONIC

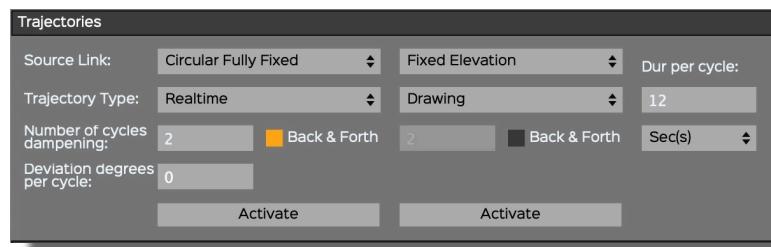
This mode locks the position of the sources from a maximum to a minimum value in a linear relationship.

**5) Delta Lock** STEREO + MULTIPHONIC

This mode locks the position of the sources in relation to others.



3.7. Trajectories



It is possible to automate the movement of the sources using predefined trajectories. Within the *Trajectories* control panel, you can set and adjust these movements to the musical context. The concept behind the trajectories is that there is a source master while the others are slaves. Only the source No. 1 can be the master.

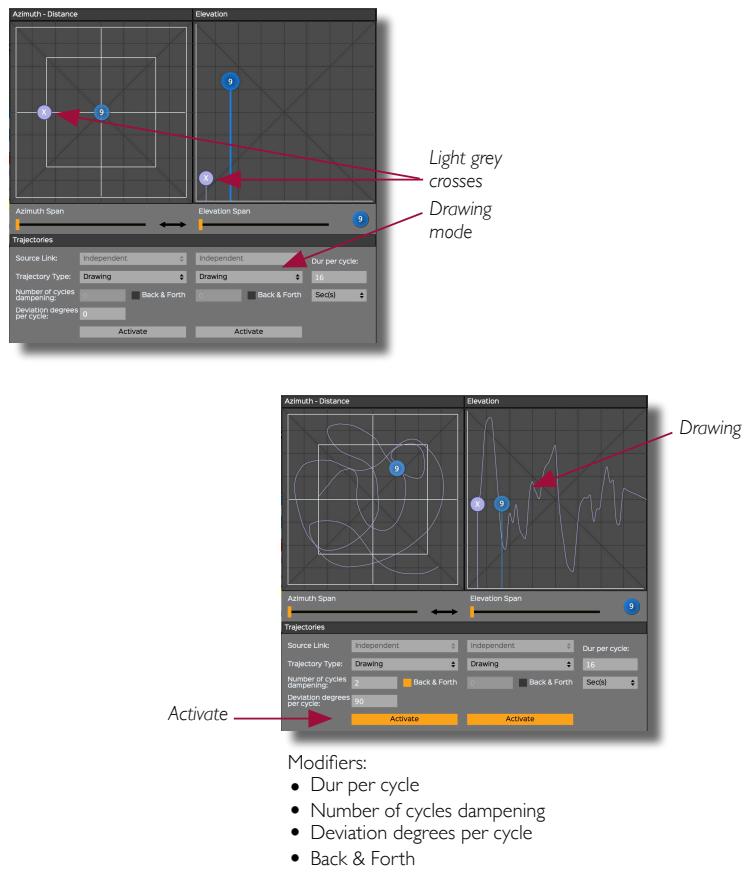
3.7.1. Realtime

Azimuth-Distance and Elevation share two types of trajectories: Realtime and Drawing.

This is the usual automation recording: you move a parameter (or several parameters) and it is recorded in the DAW.

3.7.2. Drawing

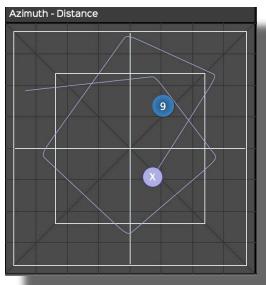
The Drawing mode allows you to draw a trajectory directly into the plugin itself. This trajectory can then be modified by editing the duration, dampening and deviation. When the desired settings are found, they can be recorded in the DAW itself.



The Drawing mode is a freehand mode. When you select it, a light grey cross will appear with which you draw a trajectory. The timing of the trajectory and the design are stored within the plugin. In Azimuth-Distance, it's the position that is recorded. In Elevation it's the position over time. Both windows share a cycle that can be modified with the regular parameters. To see the trajectory in action, you can activate it (or both) and play the sequence. When the sequencer stops, the Activate buttons return to off. Changes can be made and then it's possible to switch Activate to On again. Once satisfied with the results, you can then record the trajectory in the DAW.

• Shift-Click in Drawing mode

If Shift is pressed at the same time as the armed cross in the Azimuth-Distance window, it's possible to design straight lines or irregular geometrical figures. Every time you click, a new angle is created. Don't forget to click one last time once you're finished!

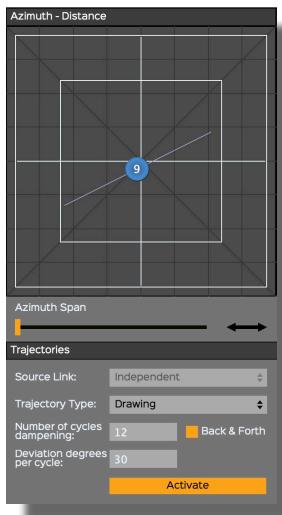


NOTE: Be careful with the freehand trajectory. If you click anywhere in the window after drawing a

trajectory, it will automatically be erased. Only one gesture can be recorded at a time.

3.7.3. The pendulum

A specific use of the Shift-Click in Drawing mode can be used to design a pendulum. If a simple line is drawn with Shift-Click, it constitutes the basic element of a pendulum. Then the Dur per cycle, Dampening, Deviation and Back & Forth can be used to make this pendulum very interesting. It can be placed anywhere in the space.

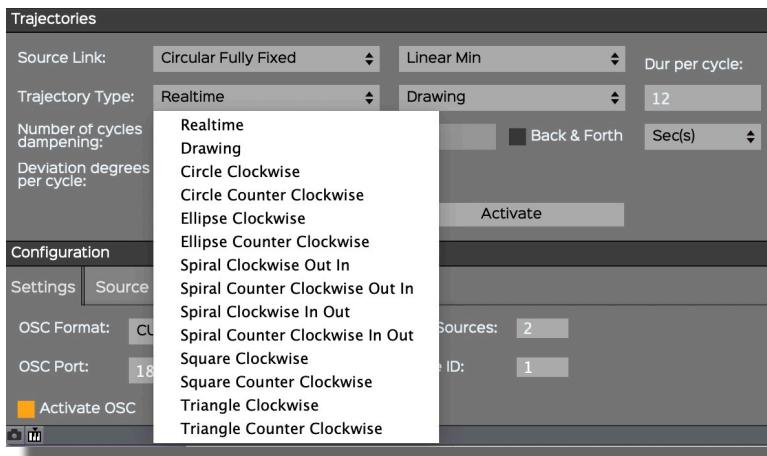


3.7.4. Automatic Trajectories

Automating the movement of a source is quite simple.

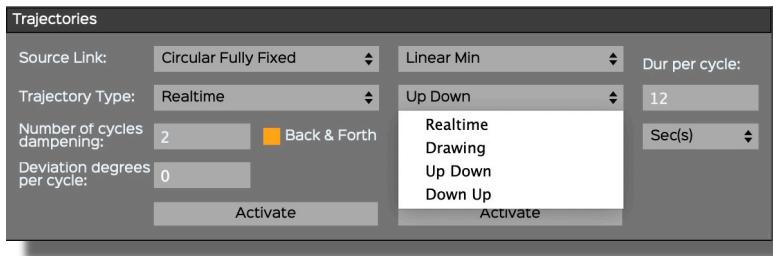
• Azimuth-Distance

A drop-down menu with different types of trajectories allows you to select a variety such as *Circle*, *Ellipse*, *Spiral*, *Square* and *Triangle*, either in *Clockwise* or *Counter Clockwise* mode.



• Elevation

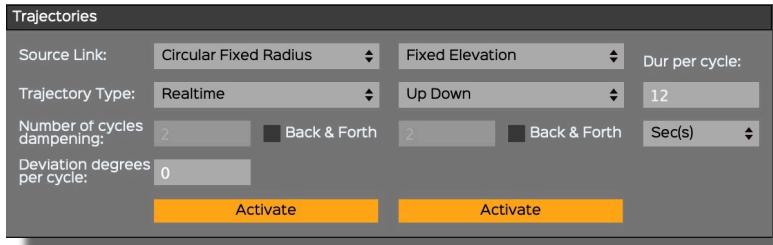
A drop-down menu with different types of trajectories allows you to select a variety such as Up Down, Down Up



Other settings of the trajectories include:

- The duration of the trajectory in second(s) or beat(s) (linked to the MIDI tempo of the host sequencer);
- The Number of cycles dampening: the total duration = Dur per cycle × Number of cycles × 1,5
- The Back & Forth option;
- The Deviation degrees per cycle.

• Activate



Pressing the Activate button arms ControlGRIS to wait for the start of the sequencer. When the sequence is initiated, the plugin will start the trajectory according to the specified settings. The movement produced can be recorded — X, Y and Z coordinates of the source No. 1 — like any other automation. When the sequencer stops, the Activate buttons return to off. It's important to put the play head at the right position before pressing on the activate button and putting the sequence into play.

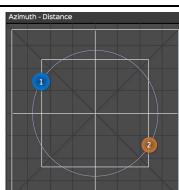
NOTE: There is an exception to this in Logic X. If there is no more audio in the track at stop, the Activate buttons will not turn to off. They will have to be deactivated manually.

• Trajectory recording in the DAW

As explained above, ControlGRIS waits for the host sequencer to start before starting a trajectory. The tracks that contain ControlGRIS as an insert can be set in a write mode (Touch, Latch, or Write) in order to record the sources' movements as automation. This automation is then available for playback and editing.

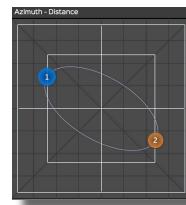
NOTE: Only the source No. 1 (master) is recorded, the other sources being slaves. It is always preferable to record the automation of trajectories in the DAW after you have found the right settings, because it frees up the CPU used by ControlGRIS.

3.7.5. Azimuth-Distance Trajectory types

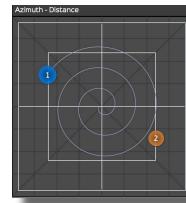
I) Circle	Circular motion around the centre. Options: CW/CCW, Back & Forth, Dampening, Deviation. 
-----------	--

2) Ellipse

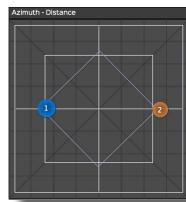
Elliptical motion around the centre.
Options: CW/CCW, Back & Forth, Dampening, Deviation.

**3) Spiral**

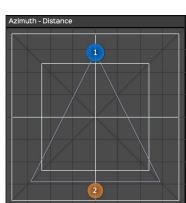
Concentric motion around the centre.
Options: CW/CCW, Back & Forth, Dampening, Deviation.

**4) Square**

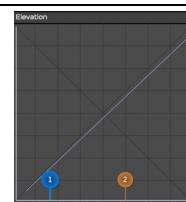
Square shape around the centre.
Options: CW/CCW, Back & Forth, Dampening, Deviation.

**5) Triangle**

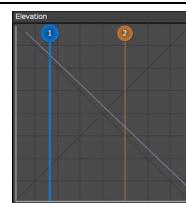
Triangle shape around the centre.
Options: CW/CCW, Back & Forth, Dampening, Deviation.

**3.7.6. Elevation Trajectory types (CUBE mode only)****1) Down Up**

From the bottom to the top.
Options: Back & Forth, Dampening.

**2) Up Down**

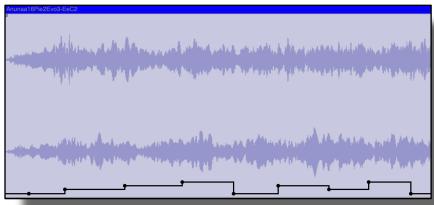
From the top to the bottom.
Options: Back & Forth, Dampening



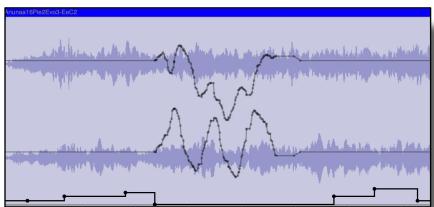
3.7.7. Automated Trajectory and Presets

It's possible to record the Presets in the sequencer. But to avoid contradictory information between automated trajectories and automated presets, the latter is replaced by a 0 value (no preset) during the recording of a trajectory.

Presets recorded:



Presets left after trajectory recording:

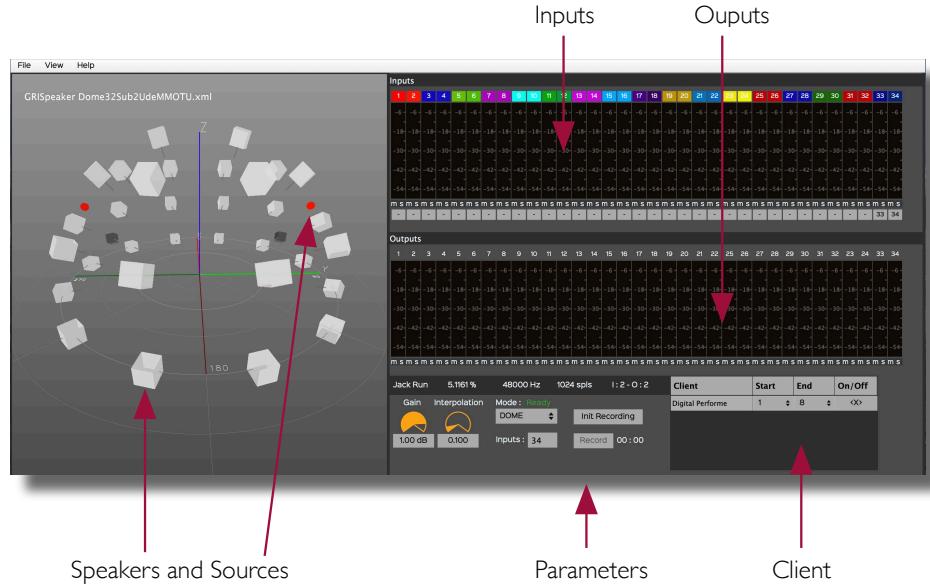


4. SpatGRIS2

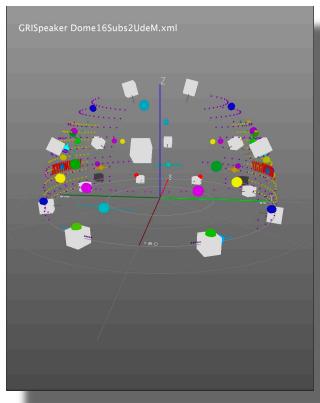
4.1. Introduction

The SpatGRIS2 window is divided into 4 zones:

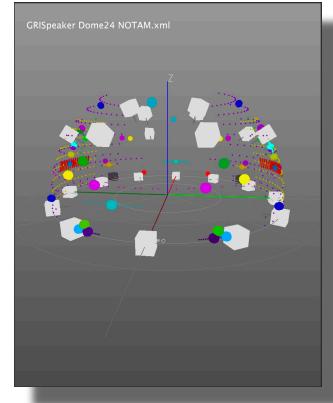
- Speakers and Sources
- Inputs/Outputs
- Parameters
- Client



The most interesting feature in SpatGRIS2 is that the *Inputs*, which come from the DAW and represent the audio and the spatialization of your work, are independent of the *Outputs*, the speaker setup. So, if you initially defined a very complex spatialization structure for a specific speaker arrangement, you can play it on any other speaker setup afterwards. You just have to change the speaker setup from one situation to the next.



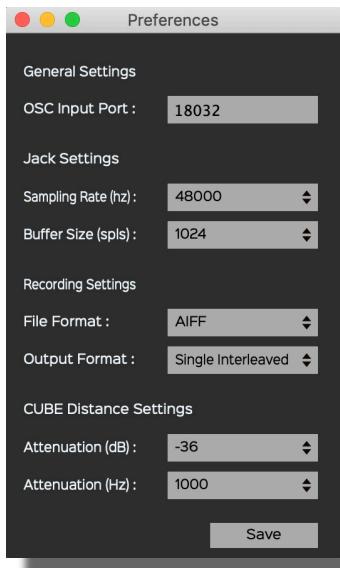
Here's an example of a piece designed for a 16-speaker setup (on the left), and then played on a 24-speaker system (on the right), quite different from the original, just by switching from one setup to the next. As you can see, all the sources remain at the exact same coordinates. They will be played by different speakers but heard at the same location in the concert hall.



4.1.1. 2D and 3D

SpatGRIS2 is capable of 2D and 3D spatialization either in DOME or CUBE mode. It can be useful to use SpatGRIS2 in 2D with DAWs that are stereo-only like Ableton Live and Pro Tools native. Doing so gives these stereo DAWs the possibility to manage multispeaker environment. But of course, the real power of SpatGRIS2 lies in its 3D capabilities.

4.2. Preferences



General Settings:

- The value by default of the OSC port is 18032 which is the same as ControlGRIS. If you want to use another incoming OSC device, you have to change this number accordingly.

Jack Settings:

- Changes in Sample Rate and Buffer Size will require closing and reopening SpatGRIS2.

Recording Settings:

- The recorded file format, AIFF or WAV;
- Output Format: Multiple Mono or Single Interleaved.

CUBE Distance Settings:

- In CUBE mode, there is a white square in the middle of the space. Within this square, there is no attenuation or filtering. Outside this square, attenuation and/or filter can be applied to simulate the vanishing of a sound at a faraway distance. The numbers entered here are the values at the external square:
- Attenuation (dB): from 0 to -72, by -12dB steps;
- Attenuation (Hz): from 125 to 16000, by exponential steps.

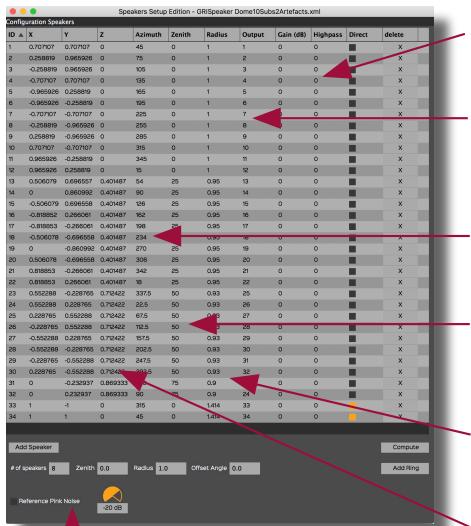
NOTE: Changes in Sampling Rate and Buffer Size should be done only when there is no DAW opened in your computer. SpatGRIS2 has to be closed and reopened before the changes take effect. Once this is done, you can open the DAW which will now be locked to these values.

4.3. Speaker Setup

Designing a speaker setup is the first step of the process. It is done in the Speaker Setup Edition window (View menu, Opt-W).

4.3.1. Speaker Setup Edition

A speaker configuration is created by determining the number of speakers in each level and their location (Zenith, Radius and Offset Angle). By using the Add Speaker button, individual speaker can be added to the setup.



- You can adjust the output **Gain (dB)** and put a **Highpass** filter (0 is off, value in Hz) on each speaker to calibrate the setup.
- An **Output** patch connects the speakers to the output number of your audio interface (a 32-speaker dome plus 2 subs (direct outs) in this example).
- Azimuth** is the plane angle, from 0° to 360°. If you put a number greater than 360, it will be adjusted to a real value.
- Zenith** is the elevation angle from 0° to 90° (or to -90, if you use a complete sphere). If you put a number greater than 90, it will be adjusted to a maximum of 90°.
- Radius** is the distance from the speaker to centre of the sphere. In DOME mode, the radius is set at 1.
- In CUBE mode you can also enter the values with X, Y and Z coordinates.

- Reference Pink Noise: On/Off,
- Default -20 dB, to calibrate the outputs.

4.3.2. Direct outputs

It is possible to add speakers that are assigned to direct outputs, which means that they are not part of the spatialization algorithm, like the subwoofers. These speakers are identified with an orange rectangle in the setup and can be put anywhere, since they are independent of the spatialization. As the direct outs are assigned to specific outputs, if you open a project with direct outs different from the actual speaker setup, you'll be warned for this mismatch:



4.3.3. Show Numbers and select/deselect speaker(s)

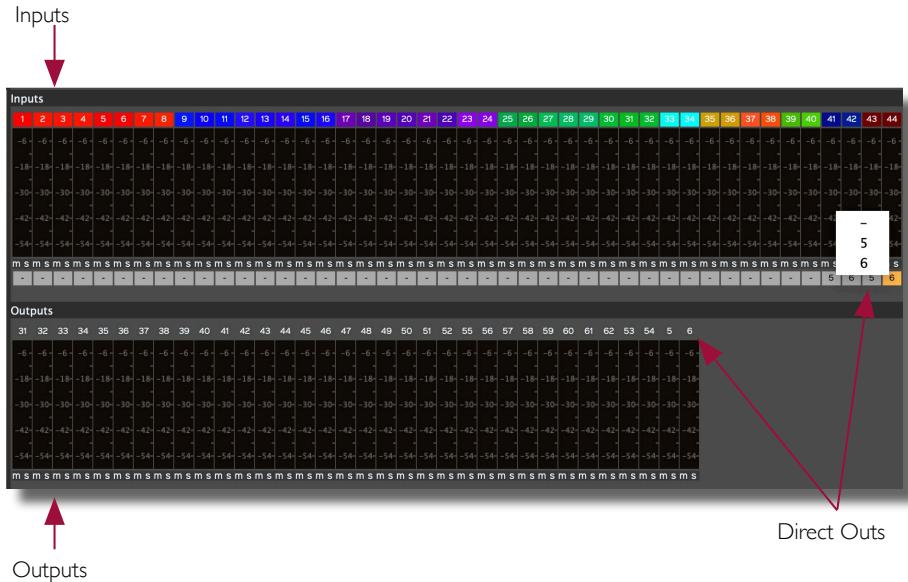
- The location of the speakers and their numbers can be viewed in the 3D window by choosing the *Show Numbers* option (Opt-N¹³). Direct outputs are shown in black. Clicking on a speaker or its number selects it; Right-clicking deselects it.
- It is possible to make a multiple selection in the Speaker Setup Edition. You can then click-scroll any parameter and change the values of all the selected speakers at the same time. In this example, Elevation is set to 14 for speakers 1-6:

Speakers Setup Edition - DOME - GRISpeaker Dome10Subs2Artefacts.xml													
Configuration Speakers		ID	X	Y	Z	Azimuth	Elevation	Distance	Output	Gain (dB)	Highpass	Direct	delete
1	0.8964	-0.3713	0.2419	337.5	14	1	1	0	0			X	
2	0.8964	0.3713	0.2419	22.5	14	1	2	0	0			X	
3	0.3713	-0.8964	0.2419	292.5	14	1	3	0	0			X	
4	0.3713	0.8964	0.2419	67.5	14	1	4	0	0			X	
5	-0.3713	-0.8964	0.2419	247.5	14	1	5	0	0			X	
6	-0.3713	0.8964	0.2419	112.5	14	1	6	0	0			X	
7	-0.9239	-0.3827	0	202.5	0	1	7	0	0			X	
8	-0.9239	0.3827	0	157.5	0	1	8	0	0			X	
9	0	-0.5	0.866	270	60	1	9	0	0			X	
10	0	0.5	0.866	90	60	1	10	0	0			X	
11	0.9899	-0.9899	0	315	0	1.4	13	0	0			X	
12	0.9899	0.9899	0	45	0	1.4	14	0	0			X	

¹³ It seems that on some Azerty keyboard, this key combination is not working. The function is still available though.

4.4. Inputs and Outputs

SpatGRIS2 receives signals from the DAW and sends them to the speakers. The two main sections are the *Inputs* (from the DAW through *JackRouter*) and the *Outputs* (to the speakers — via the audio interface— also through *JackRouter*). There are also the direct outs that are sent directly from the inputs to these outputs (for subwoofers, for instance).



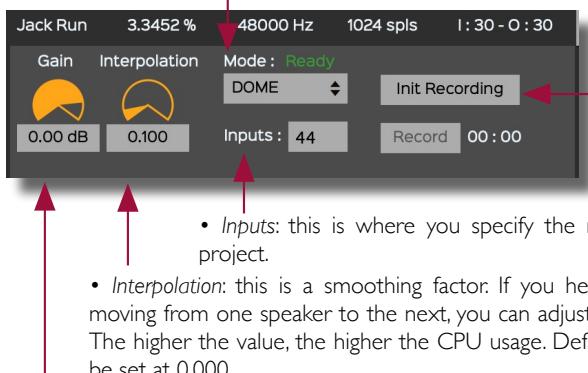
In this example, the inputs are made of 4X octophonic tracks (1-32), plus 4X stereo tracks (33-40) and 4X direct out tracks (41-44, assigned 5-6) for a total of 44 tracks identified by different groups of colours, distributed on a 32-speaker dome with 2 direct outs (5-6). Each input and output have a *Mute* and a *Solo* button.

4.4.1. Peak indicators and Reset

The meters are calibrated in peak. There is a general reset with Opt-M shortcut.

4.5. Parameters

- Mode: A set of different spatialization modes is accessible here: DOME, CUBE, BINAURAL and STEREO.



- *Init Recording*: this is where you set the recording of your project.

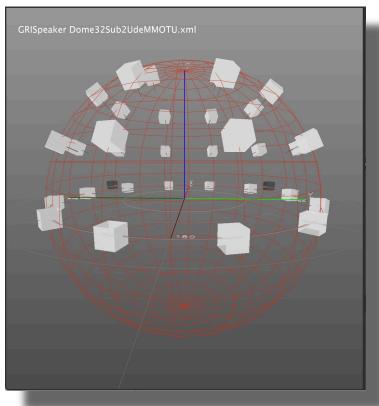
- *Inputs*: this is where you specify the number of inputs needed for your project.
- *Interpolation*: this is a smoothing factor. If you hear some glitches when a sound is moving from one speaker to the next, you can adjust this value for smoother transitions. The higher the value, the higher the CPU usage. Default at 0.100. In most cases, it could be set at 0.000.
- *Gain*: the default value is the unity gain of the outputs at 0.00 dB. It can be adjusted here. The maximum gain is +12 dB.

4.5.1. Interpolation

- Keep Interpolation value as low as possible in order to get precise localization of the sources. The higher the number, the blurrier the sound image.

4.5.2. DOME

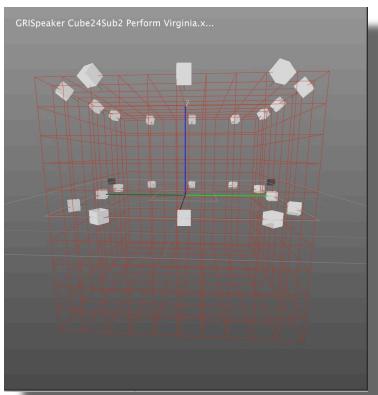
The DOME is based on VBAP (Vector Base Amplitude Panning), an algorithm created by Ville Pulkki in 2001. It allows the user to spatialize the sound under a dome of speakers by placing it according to the relative amplitude of three speakers (instead of two in stereo panoramisation). Therefore, the dome is made of triangles of speakers. This way, the sound can travel smoothly within the dome, with no bumps or holes. It is possible to see the triangles by choosing *Show Speaker Triplets* (Opt-T) in the View menu. If you have the chance to use a sphere, it is also available!



4.5.3. CUBE

The CUBE is based on LBAP (Layer Base Amplitude Panning), an algorithm developed by Olivier Bélanger. It allows the placement of a source anywhere in a space represented by a cube. But it is not limited to the shape of a cube. Actually,

any speaker setup can be placed within a cube. Therefore, any sound installation or concert situation can be simulated here. In CUBE mode, the distance is taken into account according to the placement of the sound so simulate the natural behaviour when a sound is moving away. From the middle square (in the 2D view of the CUBE), attenuation (in dB) and filter (in Hz) can be applied. The values are set in the Preferences.



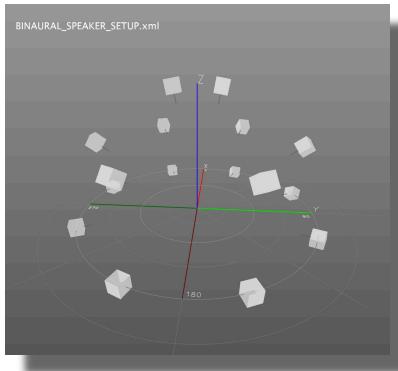
Like its name suggests, the algorithm is based on superposed layers composed of multiple points, registered on tables, that are triggered by the sound as it moves. The location of the layers is determined by the speakers' location.

4.5.4. Converting from DOME to CUBE

In the case of going from DOME to CUBE, SpatGRIS2 uses XYZ coordinates of the setup to maintain the integrity of the setup. This does not apply to the transition from CUBE to DOME, since in VBAP there is no choice except to adjust the distance to 1. Elevation and Distance do not have the same behaviour in the DOME and CUBE algorithms. A speaker setup retains its appearance and XYZ coordinates during transition from the DOME algorithm to the CUBE algorithm, but not in the opposite case.

4.5.5. BINAURAL

This algorithm was implemented to help users to work on 3D spatialization from home when access to a speaker dome is limited or not available. It is based on a *Head Related Transfer Function* (HRTF). HRTF is a function that reproduces the way we perceive the localization of sounds in the space. It is a set of phase and amplitude calculations for listening on headphones. Primarily, it is designed for 5.1 reproductions or immersive listening on headphones, situations found in the gaming and the VR industries. In order to minimize the number of calculations (HRTF can be very demanding in terms of computing power), SpatGRIS2 first calculates a VBAP spatialization over 16 speakers (with the BINAURAL_SPEAKER_SETUP) and then transfers the result to HRTF. Don't worry, even if your speaker setup is bigger than 16 speakers, no information is lost in the process. BINAURAL modes use the outputs 1 and 2 of the selected audio interface (even if these outputs are not used in the Speaker Setup). The Spans are not used in BINAURAL mode.



4.5.6. STEREO

There is a simple stereo mode to listen to a complex project on a pair of speakers. All the sounds are sent to the corresponding speakers depending on their location (left to left, right to right, no elevation). STEREO mode uses the outputs 1 and 2 of your system (with the STEREO_SPEAKER_SETUP). This mode can be used to downsize a multichannel project to stereo. The Spans are not used in STEREO mode.

4.5.7. Recording

When the automation of the spatialization is completed, you have two options:

1. To play the piece "live" with your DAW and SpatGRIS2.
2. To record the spatialization in audio channels that correspond to the number of speakers in the setup.

SpatGRIS2 records mono files (AIFF or WAV according to your preferences) or one interleaved file.

To record: press *Init Recording*. A popup window will then open, allowing you to specify the location of the recorded



files and the name of it. Afterwards, pressing the *Record* button (once) will start the recording and the timer and it will change the Record button to a Stop button; then you can press the Stop button when you're finished. You can then import the separate mono files into any DAW to play your piece in concert.

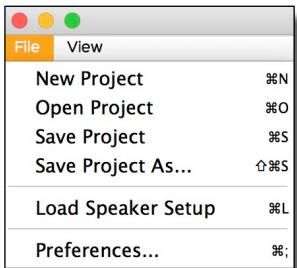


These two strategies are suited to different applications — the first creates a fixed (and perhaps safer) version, such as in the case of a recording, while the second creates an adjustable version, with greater flexibility for the purposes of a concert.

5. Menus

5.1. File menu

In the File menu you will find all the project-related functions, hence you can:



- Create a New Project;
- Open an already existing one;
- Save or Save As — make a copy;
- Load a Speaker setup;
- Set the Preferences.

NOTE: Loading a Speaker Setup that includes 64 speakers or more could take a while (several minutes for a 128-speaker setup). Be patient!

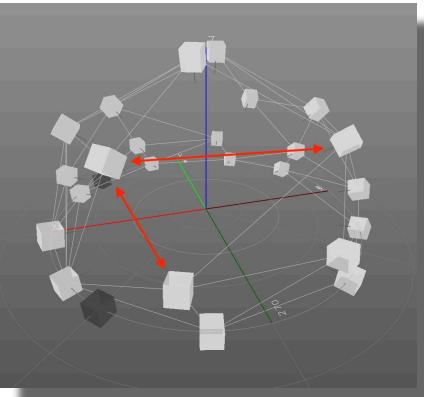
5.2. View menu

Under the View menu, you can choose from different perspectives to visualize the speakers and sources in real time. The key modifier in this menu is Option (Opt) (that shows as Alt on some external keyboards).

The symbol is:

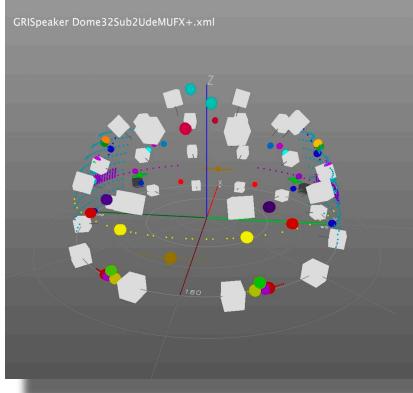


- Show 2D view: A 2D view from the top of the space is given with only the sources showing.
- Speaker Setup Edition: Opens a window to access all of the given parameters for a valid configuration of speakers.
- Show numbers: Show or hide the numbers of sources and speakers.
- Show Speakers: Show or hide the speakers in the 3D view.
- Show Speaker Triplets: Show or hide the triplets in the 3D view in DOME mode. Triplets reveal how the speakers are connected to each other, a very useful tool for troubleshooting. There are no triplets in CUBE mode.

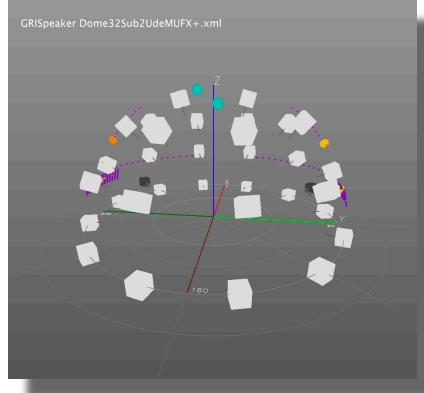


NOTE: If there is no line between two adjacent speakers or if a line is drawn from non-consecutive circles of speakers, then your speaker setup is not well designed. There could be silences when sounds move from one level to the next. You then have to move slightly the speakers one from another and to recompute your setup to see if the problem is solved.

- Show Source Activity: This option allows you to see the trajectories of the sources (big dots) as well as their activity, displayed according to the Azimuth and Elevation Span (small dots) sent from the ControlGRIS plugin. Note that there is nothing to see when the DAW is stopped. The threshold is set at -70 dB. When not selected, all the sources are shown in a static 3D view, even when the DAW is stopped.



Show Source Activity Off: shows the static position of all the sources in stop position



Show Source Activity On: shows only the real activity of the sources in play mode

- Show Speaker Level: Shows how much energy each speaker delivers. From grey (nothing) to white (maximum).
- Show Sphere/Cube: If you have the chance to play in a full sphere or cube!
- Colorize Inputs: This option allows you to set all the inputs to a different colour within the visible spectra from red to purple. Be careful, it erases all the custom colours already in place.
- Reset Input Position: When switching from a project to another, SpatGRIS2 could still show the sources from the first project. Use this option to clear up the 3D view.
- Reset Meter Clipping: clipping indicators can be reset individually by clicking on them, or globally with Opt-M shortcut.

5.3. Naming and Saving

Speaker setups and server documents are saved under the .xml format. There is no distinction between them. The server document doesn't include the Speaker setup and they are therefore independent. Consequently, we strongly recommend two things:

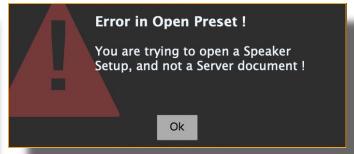
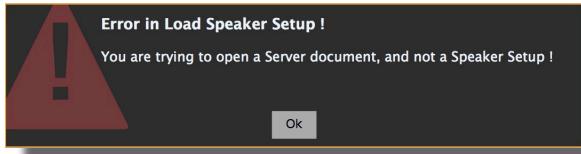
- Add the word "Speaker" to the name of your speaker setups and "SpatGRIS2" to the name of your documents;
- Save the DOME and the CUBE setups as two separate folders in a folder called Speaker;
- Save SpatGRIS2 documents inside a folder named SpatGRIS2.

The Template folder we provide with SpatGRIS2 is a good example of the right classification.

- Document format warnings

SpatGRIS2 always remembers the last opened speaker setup and the last document.

If you try to open a SpatGRIS2 document with the command Load Speaker Setup (or the opposite), you'll be warned:

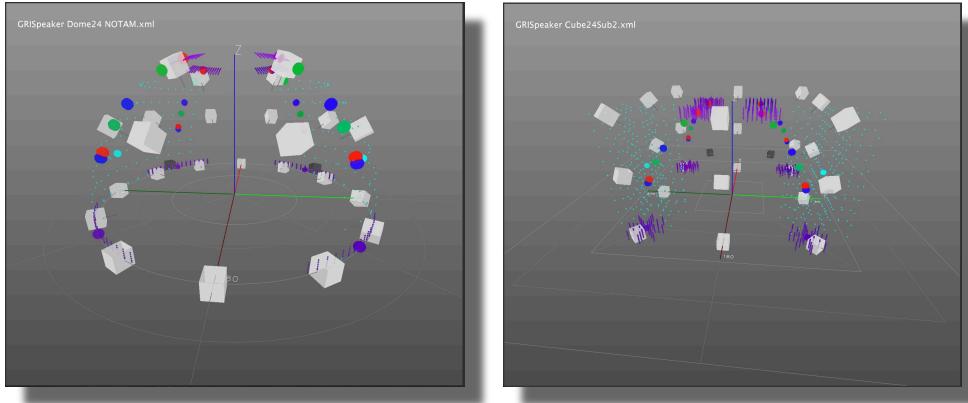


5.4. Representations

The 2D and 3D views in *SpatGRIS2* are available for both DOME and CUBE modes. The sources on the DOME are on the surface and the Spans spread along that surface. In CUBE mode, the sources can be placed anywhere in the space and the Spans spread locally around the sources.

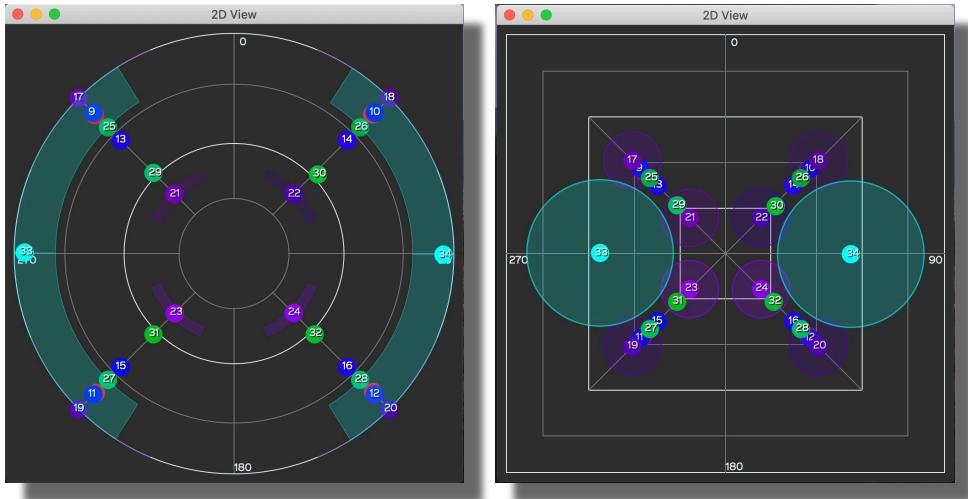
5.4.1. 3D Representation

The 3D window in DOME mode (left) or in CUBE mode (right) of the same session:



5.4.2. 2D Representation

The 2D view (sources only) in DOME mode (left) or in CUBE mode (right) of the same session:



5.5. Performance

The performance of *ControlGRIS/SpatGRIS2* combination depends a lot on the different settings in your project. As a general rule, a project with 64 audio channels sent to 64 speakers will work perfectly well, on recent computers. That being said, we have tested projects with 92 audio channels (46 stereo tracks) or 96 audio channels (12 octophonic tracks) over a 128-speaker setup that was still working well (in DOME mode, but it was close to the limit...).

The factors which will significantly reduce the number of channels that can be processed by our tools are, in order of importance:

- The Mode: CUBE is more demanding than DOME, since the former uses more speakers than the latter.
- The Spans: they distribute the signal to more speakers than the normal settings, and therefore the CPU demand increases very rapidly as their values increase. A setup with no spans will require only a half or a third of the performance

of the same setup with active spans.

- The Interpolation: the interpolation factor helps some sounds to achieve a better transient time as they move from one place to the next. Therefore, the higher this parameter, the higher the number of speakers involved in the process, since a sound will reach a given speaker earlier and take more time to leave it (not to mention, it also blurs the localization).
- The number of speakers used in *SpatGRIS2*: actually, the limit here is imposed by *JackRouter*, which is single core. We measured comfortable performance with a 96-speaker setup, which is largely enough in most realistic situations!
- The number and the kinds of tracks: multiplying the number of tracks by the number of speakers actually determines the reliability of the setup. Few tracks over a big speaker setup will give the same result as many tracks on a small speaker setup. Also, stereo tracks are more demanding per channel than octophonic tracks.
- In CUBE mode, silent sections of an audio file are treated like normal files. Therefore, it's better to erase these sections to avoid CPU bursts (in DOME mode, it doesn't make any difference).
- Other factors: CPU speed, memory, computer/system version, etc.

Want to know what to expect? Try it for yourself!

5.6. Help Menu

The Help menu comprises information about the GRIS and this manual, under the Open Documentation option.



Take the plunge and have fun!

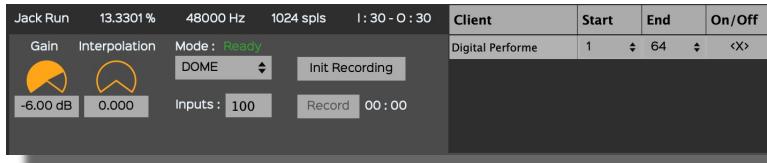
6. Known issues and warnings

There are so many different situations and setups that is impossible for us to cover them all. So far, we haven't found any situation where the system does not work at all. But we have found situations where some parameters have to be adjusted before the system works properly. Here are a few of them.

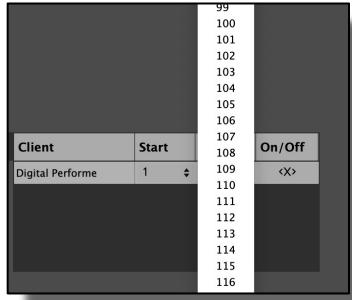
6.1. Number of channels Inputs and End

The number in *Inputs* and the number in *End* should be set accordingly. *Inputs* is the total number of inputs needed for all the client and *Start* and *End* specifies the inputs dedicated to a specific client. By default, 64 is the maximum number allocated per client. Therefore, you have to adjust manually the number in *End* to be synchronized with the number of *Inputs*.

In this example, the sequence in Digital Performer needs 100 inputs, but SpatGRIS2 allocated only 64 channels (the Default value):



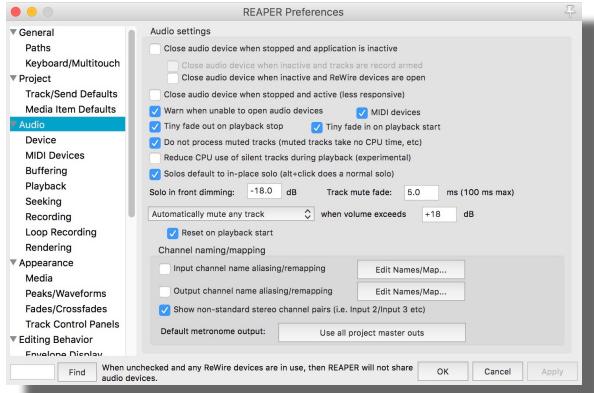
You will have to manually adjust the *End* number to 100 (or to any number that the session needs):



6.2. Reaper:

6.2.1. Device Preferences

In the Preferences of Reaper, under Audio of the Project tab: uncheck *Close audio device when stopped and application is inactive*. Otherwise, JackRouter will lose contact with Reaper when it is inactive, and the system will never work.



6.2.2. Mono tracks

There are no mono tracks in Reaper, in the sense that only stereo outputs are available. To use mono tracks, you put a mono sound file in a track, assign this track to a stereo output and set the pan to the left. Repeat this operation with a second track assigned to the same stereo output but set the pan to the right. Insert a *Control/GRIS* in each track in mono with two different OSC numbers.

6.3. Digital Performer and Logic

6.3.1. Assign Digital Performer or Logic to anything but your audio interface

When *SpatGRIS2* and *Digital Performer/Logic* are both independently assigned to the same interface, they will crash each other. Prior to opening *SpatGRIS2*, open DP/Logic and assign it to anything but your audio interface, then close DP/Logic. Now, open *SpatGRIS2* first, then open DP/Logic, assign it to *JackRouter* and everything should work fine.

6.4. Logic Pro X: Lack of Surround outputs

In *Logic Pro X*, there is only one possible *Surround* instance. This means that it is not possible to have multiple multichannel tracks in *Logic* while using *SpatGRIS2*. To avoid this restriction, use only mono and stereo tracks in *Logic*.

6.5. Digital Performer

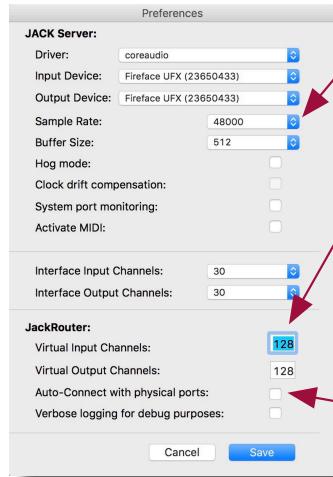
6.5.1. Enable/Disable

DP has a feature called *Enable/Disable* track. It is used to reduce CPU usage by removing the track and all of its plugins from the calculation. But this has a direct consequence on *SpatGRIS2*: the disabled tracks are not seen by *JackRouter* anymore, and DP reallocates the following tracks to the number previously used by the disabled tracks. Let say that you have 32 mono audio channels. Then you disable channels 9 to 16. The resulting channels will be named 1 to 24 and not 1 to 8 and 17 to 32. Therefore, since you spatialize the sound with OSC data, there will be a mismatch between the audio channels and the OSC channels, which are absolute, meaning they still will be named 1 to 8 and 17 to 32.

NOTE: We recommend that you don't use the disable function in DP with SpatGRIS2.

6.6. Warning about Jack

Some of the Jack's Preferences are not accessible from *SpatGRIS2*, but the installer will set them to the right values by default. If for some reason, you need to access the Jack Preferences, you can do so by opening *JackPilot* (in the Jack folder) and going to Preferences in order to adjust them as follows.



Sample Rate and Buffer Size

These settings are available directly in the Server. The default values are 48kHz and 1024.

Number of virtual inputs and outputs

The default value is 128 channels each (unused outputs don't take any CPU). Since the amount of channels may vary according to your project, simply ask yourself how many audio channels will be needed to make your project work; or how many channels are going out of your sequencer and/or how many speakers are connected to your system.

Auto-Connect with physical ports

Uncheck this option. If it is checked, the DAW will connect directly to the interface on top of the *SpatGRIS2*.

NOTE: Only experienced users should change these settings here. This could lead to strange behaviours in the setup.

6.7. Conflict with IP addresses

When using an external device to send OSC data to *ControlGRIS*, there could be a conflict between IP addresses. In the Controllers tab of the *ControlGRIS*, the IP port of the Mac is automatically recognized. But *ControlGRIS* will respect the hierarchy of IP addresses on the Mac, and, if a Mac is connected to the internet (or another external device like an Artist Mix) through an Ethernet cable, it will have precedence over the Wi-Fi connection. Thus, it won't be possible to connect an iPad to *ControlGRIS*, because the incoming port address is set automatically, and it is not editable. In this case, the only way to use the iPad is to deactivate the Ethernet connection and leave only the Wi-Fi connection.

6.8. Bluetooth headphones with *SpatGRIS2*

In BINAURAL and STEREO mode, it is possible to work with headphones. Bluetooth headphones need special attention, though. Contrary to that is written in the section, *6.1.1. Assign Core Audio to your interface*, in the Sound section of the system preferences, you **MUST NOT** assign the input AND the output to your headphones. Since headphones have no input, it will lead to an immediate crash of *SpatGRIS2*. Assign only the output to your headphones and assign anything but your headphones to the input. Then it should work properly.

7. Addendum

7.1. OSC messages in *SpatGRIS2*

OSC input port number: 18032 by default (can be changed in the preferences)

OSC server address: "/spat/serv"

Source position control messages

- The server is waiting for a list of the type iffffff (an integer and six floating-point numbers)

The elements of the list:

1. (i) The source number starting at 0.
2. (f) The azimuth value between 0 and π^*2 .
3. (f) The elevation value between 0 and π .
 - 0 = top vertex of the dome.
 - $\pi/2$ = center of the sphere (the height of the lower circle of a half-sphere).
 - π = lower vertex of the dome (under the floor).
4. (f) The span in azimuth between 0 and 2.
5. (f) The span in elevation between 0 and 0.5.
6. (f) The distance (l is the surface of the dome)
 - Not used with VBAP.
7. (f) The gain of the source.
 - Not used at the moment.

Reset messages of the position of a source

- The server is waiting for a list of type si (a string and an integer)

The elements of the list:

1. (s) The string "reset"
2. (i) The number of the source to be reset starting at 0.

7.2. OSC messages in *ControlGRIS*

There are the OSC messages that *ControlGRIS* can send and receive. The first number corresponds to the plugin ID. The second number corresponds to the source number. These are the default values:

- /controlgris/l/traj/l/x value
- /controlgris/l/traj/l/y value
- /controlgris/l/traj/l/z value
- /controlgris/l/traj/l/xyz/l value
- /controlgris/l/traj/l/xyz/2 value
- /controlgris/l/traj/l/xyz/3 value
- /controlgris/l/traj/l/xy value
- /controlgris/l/traj/l/xyz value
- /controlgris/l/azispan value
- /controlgris/l/elespan value
- /controlgris/l/sourcelink value => l à 8
- /controlgris/l/sourcelinkalt value => l à 5
- /controlgris/l/presets value => l à 50

7.3. Open Stage Control

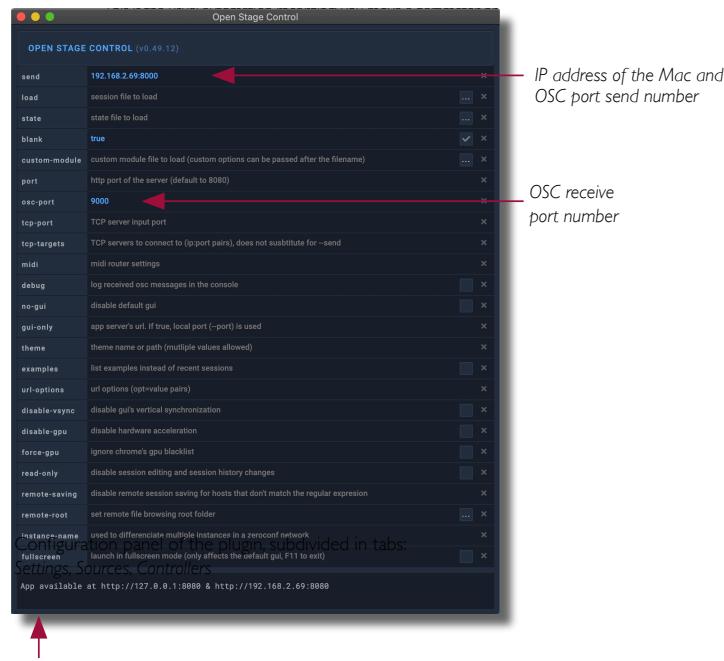
There is an Open Stage Control patch for *ControlGRIS*.

The software is available here:

<https://openstagecontrol.amm.net>

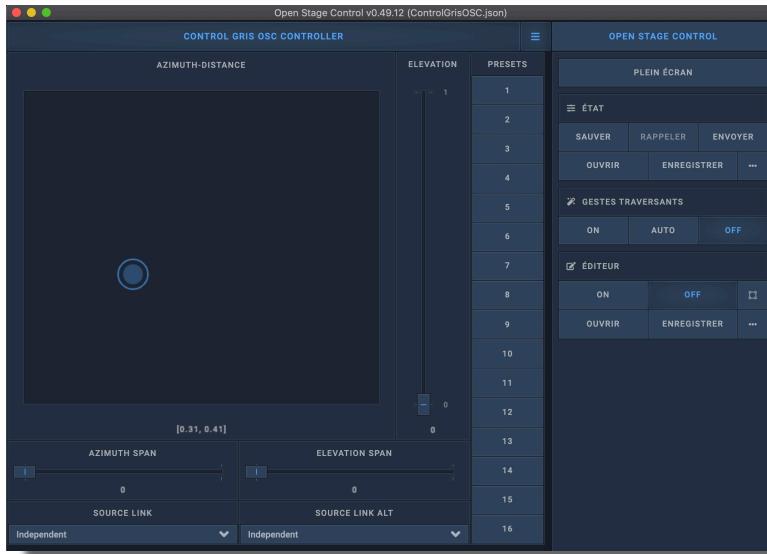
Open Stage Control, designed by Jean-Emmanuel Doucet, is composed of two elements:

- Open Stage Control server:



Address of communication between Open Stage Control server and Chrome/Chromium web site

- Chrome/Chromium web site:



NOTE: The Mac and the iPad should be put on the same Wi-Fi network, either local or public. Local implies less latency in general.

Steps to use Open Stage Control

- Open the server;
- Set the Send and the Receive ports according to the ones set in *ControlGRIS*;
The Send port should be preceded by the IP address of the Mac
- Press Start: At the bottom of the window, you'll then see the address that you have to enter in the Chrome-Chromium web site. After the server has been set to On, the editor window will open. It looks exactly like the web page opened in Chrome. You can use it to edit the patch in your Mac. But the editor is also available on the iPad. It's up to you to choose. There is no need to leave the editor opened in the Mac;
- Open Chrome/Chromium in the iPad and put the IP address.
Be careful, this address is followed by 8080 (and not 8000, like for the OSC port). This address is used for the communication between the server and the iPad;
- Open the patch *ControlGrisOSC.json* with Ouvrir/Open button;
- Open *ControlGRIS* and put it in Realtime mode.
Azimuth-Distance and Elevation are only controllable in real-time mode;
- Make sure that OSC ports and addresses are correct;
- Put the OSC ports to On (orange squares).

Steps to finish a session with Open Stage Control

- Quit Chrome on your iPad
- Quit the server
- Deactivate the OSC port in *ControlGRIS*.

NOTE: Unless you plan to use several *ControlGRIS* at a time with an external OSC device, it's always preferable not to leave any instance of the plugin with OSC ports to On.

7.4. Lemur

There is a Lemur¹⁴ patch for *ControlGRIS*. It has been designed by Christophe Lengelé.

Lemur was developed by LIINE¹⁵:

<https://liine.net/en/products/lemur/>

In summary, the Lemur can send up to 8 different ports. Therefore, a maximum of eight *ControlGRIS* can be controlled simultaneously.

7.4.1 Connections and Settings

• Connection with ControlGRIS

The Lemur connects to the iPad through a Wi-Fi network, either local or public. The main advantage to use a public network is that if you are using the same network (at home for instance), the IP address of your Mac will remain the same, hence a simpler setup to do each time you connect. You should know though that public Wi-Fi introduce more latency than a local one. If latency is a concern, use a local network instead.

• Settings

Regarding Lemur, go to the configuration panel (accessible at the top right), choose "More Settings", then add 8 addresses with the computer's IP address in OSC Targets (by example 169.254.117.110).

The ports must be numbered from 9000 to 9007, from OSC0 to OSC7.

• Receive and Send on port

In *ControlGRIS*, you must activate Receive on port in the Controllers tab (the IP address of the Mac is automatically recognized here), and indicate the corresponding port number from 9000 to 9007 (depending on the function you plan to use in the Lemur). Send on port must be set to 8000 for the Lemur, because it receives exclusively on this port and it cannot be modified. The Lemur's IP address must be indicated (the Lemur IP is automatically detected in the More Settings tab). The OSC output plugin ID is also to be set according to the function used in Lemur.

¹⁴ Lemur is not free. It has to be bought on the Apple store.

¹⁵ A note to say that this patch is offered without any guarantee. The Lemur team seems not to be active for more than two years now. And there was no update of the Lemur application for iPad since January 2018.

7.4.2. The five tabs

The 1st tab: 0. Config



This is the global configuration panel. This is where you choose:

- Between Spat DOME or Spat CUBE;
- Init Assigns 1 to reset default values;
- To put Play and Physics to Off or Physics to On;
- To adapt the range of XY for the next four tabs, to have a smaller and more centred trajectory. Range should be set to 1 if you intend to use the bidirectionality;
- To adjust an Offset of XY to put the centre of the trajectories anywhere but in the centre (only for MultiBalls of the 2nd and 3rd tab).

• The 2nd tab: 1. 1MultiBall



It is the basic configuration to control one instance of *ControlGRIS*. It controls the port number 9000 and OSC plugin ID has to be set to 1. It's bidirectional. You can control most of the parameters of *ControlGRIS*.

- Attraction_XY: if you leave your finger on the ball and Physics on XY, you'll see a link that appears between both. Attraction sets the distance between them. Small numbers set a longer link and vice versa;
- Friction_XY: it's a dampening factor. The higher the number, the shorter the trajectory.
- Speed_XY: adjustment of the... speed! Plus (+) numbers are Clockwise, minus (-) numbers are Counter Clockwise.
- Tension_Elev: It's the speed of the back & forth movement of elevation.
- Friction_Elev: it's a dampening factor. The higher the number, the shorter the duration of the movement.

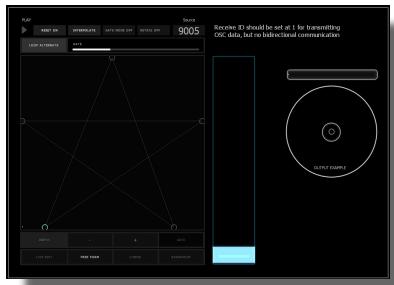
• The 3rd tab, 2. 4MultiBalls



It is possible to send data to four instances of ControlGRIS at the same time. It controls the port numbers of 9001, 9002, 9003, 9004 and OSC plugin ID has to be set to 2, 3, 4 & 5 (as indicated in the tab). It's bidirectional.

- There are global XY physical settings: Attraction, Friction and Speed. Elevation is static.

• The 4th tab, 3. Trajectory



This is where you can edit a trajectory with the different parameters available. It controls the port number 9005 and OSC plugin ID has to be set to 1. It's not bidirectional¹⁶. There are many parameters here. Here are some tips.

Points

- Double-click on a line to add and edit point.

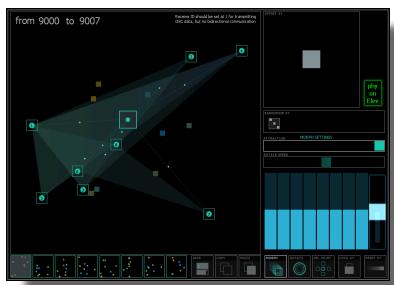
Speed

Adjust the speed parameter to increase or decrease the speed of the trajectory.

Tabs

- Use the different tabs — Live Edit, Free Form, Linear, Randomize — to make global changes.

• The 5th tab, 4. Morph8



It offers an alternative global control for 8 instances of the plugin. It controls the port numbers from 9000 to 9007 and OSC plugin ID has to be set to 1. It's not bidirectional¹⁷. There are many parameters here. Here are some tips.

- Save Preset:

Hold down SAVE button and click any preset slot (left side squares).

- Load Preset:

Click on any preset slot to load the stored settings.

- Copy & Paste Preset:

1. Select the preset you want to copy.

2. Select the preset where you want to paste the copied preset.

3. Click PASTE button.

- Add/Edit Morph Points

While holding a preset - Click and drag over the big XY area to add or edit Morph Points.

- Presets Morph

1. Enable MORPH button.

2. Move the XY green square to morph the selected preset.

NOTE: In order to use this feature two or more Morph Points are required.

¹⁶ This page was adapted from the AB VEKTER patch: <https://liine.net/en/community/user-library/view/326/>

¹⁷ This page was adapted from the SQU4R-3 patch: <https://liine.net/en/products/lemur/premium/squ4r-3/>

If you want more information on this patch, you can find the documentation by downloading the original patch.

- Delete Morph Point
1. Hold down DEL POINT button and click over the preset to remove its Morph Point.
- Preset Randomize:
1. Click the RANDOMIZE button to generate random positions for the eight squares, the horizontal value set up the amount of randomization from the current XY control positions.
2. Repeat “Save Preset” step if you like the produced results.
Performing randomize function is not destructive, this is in case you click accidentally the button, you can restore your previous settings by clicking the current selected preset.

NOTE: The Lemur physics engine cannot operate at the same time as the bidirectionality. Therefore, you have to choose between bidirectionality and physical engine, by checking or unchecking send on IP Port in ControlGRIS.

7.5. Uninstall SpatGRIS2

If you need to uninstall SpatGRIS2, or if you find strange behavior of the software, you'll have to do so manually.

- Put the application itself in the trash;
- Use the Uninstall Jack OSX command in the Jack folder;
- Put these files to the trash:

~/Library/Preferences/com.UdeM.GRIS.SpatGRIS2.plist
~/Library/Caches/com.UdeM.GRIS.SpatGRIS2
~/Application Support/GRIS/SpatGRIS2.xml

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