KB2D Interactive Device
Laser Harp MIDI controller

The KB2D Interactive Device is a detection system working as a MIDI controller. It enables to send customizable MIDI messages just by touching / interacting with lasers, and can be used with any scanning laser projector system in order to create an interactive projection.

With the various detection modes available, it can be adapted to any show, from the easiest laser Harp system to the most complete Interactive laser show. It also features laser tracking modes for laser Theremin for instance.

Thanks to an exclusive and innovative patented detection system and powerful algorithms, it is actually the most compact, stable, competitive and versatile Laser interactive device on the market.

Footswitches or other external MIDI controllers can be used to improve the flexibility of the device during shows.

FEATURES

- COMPACT AND LIGHT DESIGN, EASY TO USE

- OPEN-SOURCE SOFTWARE INTERFACE

- CROSS-PLATFORM INTERFACE (WINDOWS, MAC, LINUX).

- CAN BE USED WITH EXTERNAL MIDI CONTROLLERS LIKE FOOTSWITCHES FOR INSTANCE

- POLYPHONIC DETECTION

- LASER HARP MODE WITH UP TO 16 NOTES WITH HEIGHT MODULATION

- CONTINUOUS MODE FOR LASER TRACKING AND MODULATIONS

- POWER AND COMMUNICATION THROUGH USB
    - UP TO 4 X MIDI IN AND OUT PORTS VIA USB
    - LOW POWER CONSUMPTION

- LASER SENSITIVE
    - NOT SENSITIVE TO DAYLIGHT
    - EXTREMELY RESISTANT TO PARASITIC LIGHTS
    - PERFECT FOR USE ON LIVE SHOWS

- HIGHLY VERSATILE AND FLEXIBLE SYSTEM
    - CAN BE USED WITH ANY LASER PROJECTOR
    - NO SYNCHRONIZATION OR COMMUNICATION WITH THE LASER
    - POSITION, HEIGHT AND WIDTH DETECTION FOR CUSTOM INTERACTIVE SCENES
    - THE SOFTWARE INTERFACE CAN BE CONNECTED TO ANY EXTERNAL MIDI DEVICE

- VERY HIGH DETECTION RANGE WITH PROGRAMMABLE AMPLIFICATION FOR LONG DISTANCE INTERACTIVE SHOWS

TYPICAL APPLICATIONS

- LASER HARP

- LASER TRACKING

- INTERACTIVE LASER SHOWS

- INTERACTIVE GAMES

TABLE OF CONTENT

I. PRESENTATION OF THE DEVICE

1. TECHNICAL SPECIFICATIONS

Parameter	Comment	Min	Typical	Max
Electrical Specifications				
V_{in}	Voltage, USB Powered	4.5V	5V	6V
I_{in}	Current consumption	-	60mA	-
Detection Specifications				
FPS	Frames Per Second on detection (Set by User)	50	-	130
BW	Bandwidth on beam detection (Works with scanning systems)	5 Hz		50 kHz
D_{det}	Detection distance of interactions (*)	0.3m (1) 0.8m (2)	-	~10m (1) ~25m (2)
Φ_X	Detection angle (can be customized on demand)	-35°	-	35°
	Angle accuracy		1 mrad	
λ	Wavelength detected - By default	320nm	-	1100nm
λ	Wavelength detected – Optional	510nm	520nm	535nm
λ	Wavelength detected – Optional	625nm	635nm	-
λ	Wavelength detected – Optional	370nm	445nm	470nm
	Maximum ambient light		1000 lux	
Mechanical / Housing Specifications				
L x W x H	Length x Width x Height (mm) (Without the Handle)		100 x 32 x 58	
m_{sys}	Weight		155g	
IP	Ingress Protection		IP44	

(*) When interacting with a Lambertian white target with ~80% reflectance

(1) With a 3W laser projector. Maximum is obtained using the x16 software amplification.

(2) With a 20W laser projector. Maximum is obtained using the x16 software amplification.

2. SETUP OF THE KB2D

The KB2D is a detection system that can be used with any scanning laser projector. The KB2D is not communicating with the projector, so there is no direct dependency between the KB2D and the projector.

To create a laser interactive scene, you only need:

➢ A laser projector to project the pattern you want to interact with.
➢ The KB2D interactive device with a USB (A – B) cable.
➢ A computer with Windows 10 or above with the KB2D Laser Harp Interface. The last KB2D setup can be downloaded at https://lightdiction.com/Ressources/ .
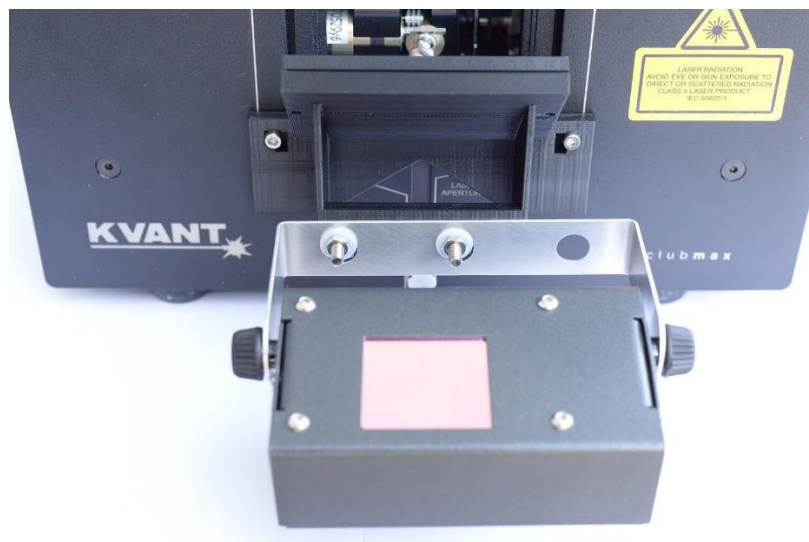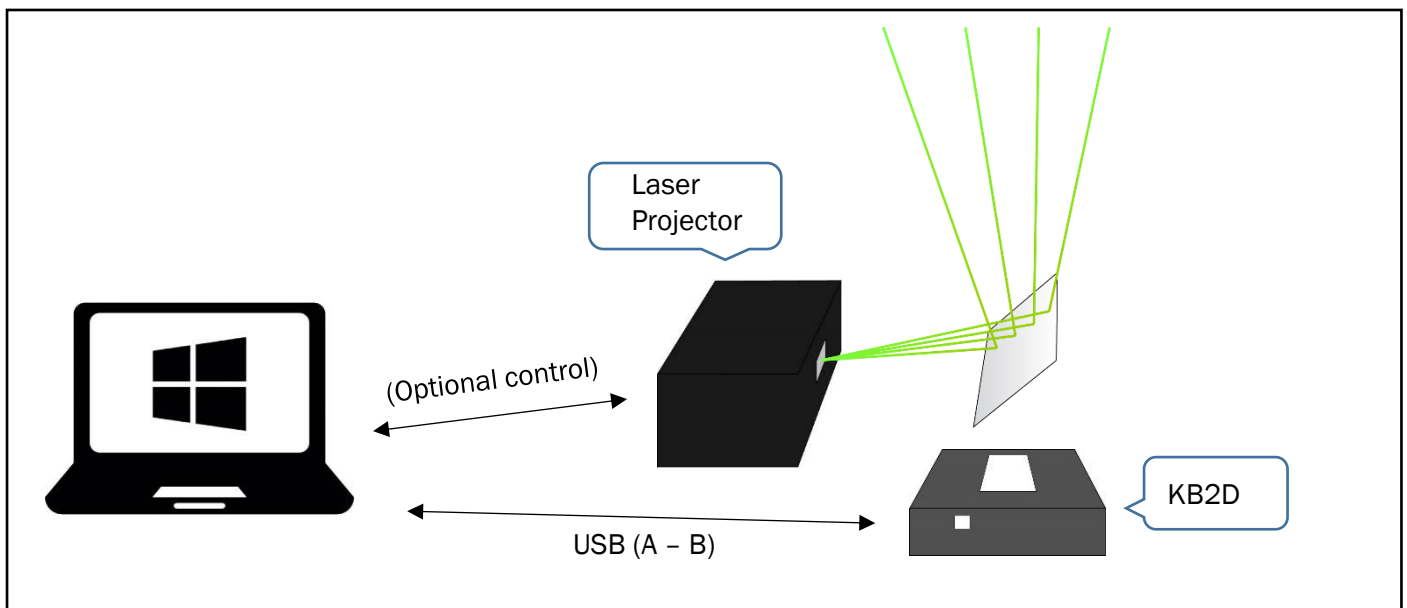

Fig. 1: Typical installation of the KB2D interactive device for a laser Harp application.

- In order to improve the accuracy, the KB2D should be aligned with the (virtual) cross of the beams.
- The length of the KB2D device must be parallel to the plane formed by the beams.

3. HOW DOES IT WORK?

The KB2D is detecting the position angle of each incident light interaction. With the help of a complex algorithm, it can then precisely separate each laser beam from parasitic light source, and send a MIDI signal associated with a specific interaction. Multiple interactions can be detected simultaneously (so it is possible to play a "polyphonic" laser Harp for instance).

Interactions can be detected in a 3D environment, but position measurement is in 2 dimensions with the KB2D. The X (angle) and Z (distance) variables correspond to the coordinates of the interaction. The "Width" variable also gives an information on the width of the interaction.
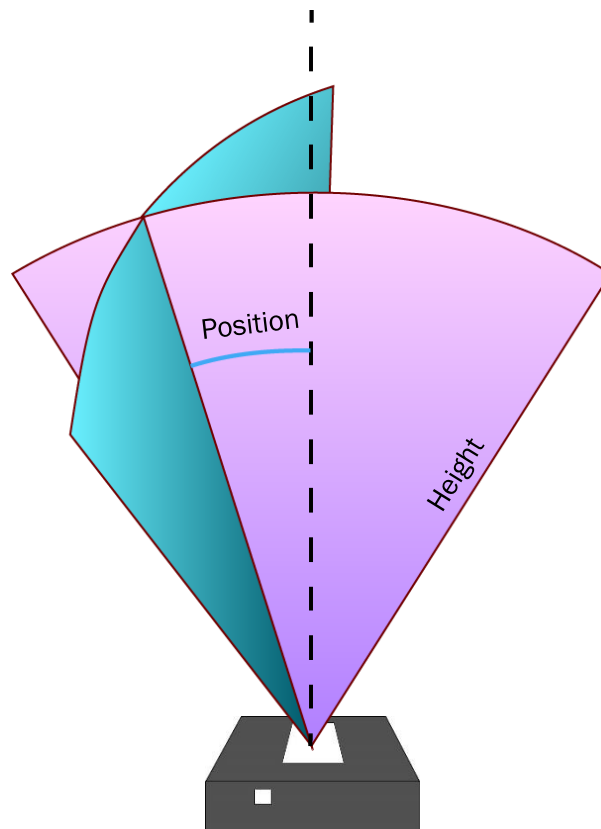

Fig. 2: The 2 dimensions on detection with KB2D.

Every interaction in the blue plane will have the same "Position" coordinate. The "height" coordinate is determined in function of the luminous power received by the KB2D, which is directly correlated with the distance between the interaction and the KB2D module. Thus, it can introduce a variation on Z height coordinate if the laser source has not a constant emission power.

The KB2D also detects the width of each interaction, and can send a MIDI signal varying in function of the width.

As the KB2D is measuring the angle and not just detecting light (or laser) interactions, it does not have to be synchronized with the scanning system of the laser source.

II. KB2D LASER HARP INTERFACE
1. DOWNLOAD AND INSTALL

The latest version can be found here:

https://lightdiction.com/Ressources/

The KB2D Laser Harp interface is an open-source software. The code can be found here:

https://github.com/Lightdiction/KB2D_Interface_V3

It is recommended to always use the latest version of the Firmware and of the KB2D Laser Harp Interface, to benefit from all the performances and options available. If the computer running the KB2D Laser Harp Interface is connected to the internet, all available firmware and software updates will be automatically proposed at the start of the software.

To install the software, simply start the setup file.

2. FIRST START

Connect your KB2D on your computer, it will automatically install the standard MIDI Driver. Once your KB2D is connected and the driver installed, you can start the KB2D Laser Harp Interface.

If your KB2D is connected and correctly recognized by the interface, it should show an information window at the start of the interface, showing some information like the Serial Number and firmware version of your KB2D controller.
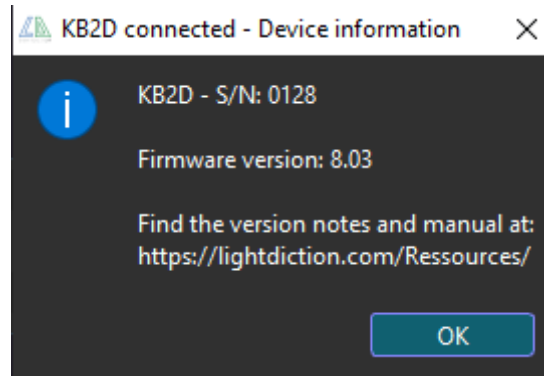

Fig. 3: Information window when we start the interface with the KB2D connected

If for some reason the KB2D is detected but the ports are not available, you will see this kind of warning window:
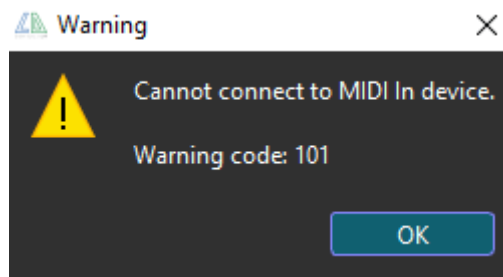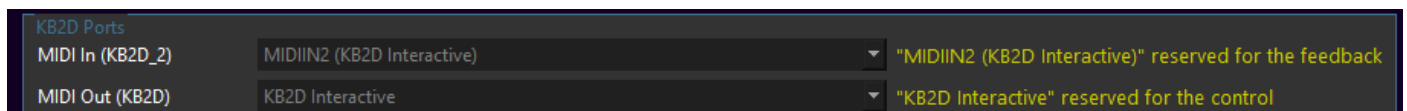

Fig. 4: Warning window if MIDI ports are detected but are not available

This generally happens when another software took the control of the KB2D. For instance, if your DAW is started, it may have taken the control automatically. Simply deactivate the reserved ports in your DAW, so the KB2D Laser Harp Interface can connect to these:

The reserved ports are the following:

- MIDI IN 2 – KB2D Interactive
- MIDI OUT – KB2D Interactive

Or you can also close other MIDI software then start the KB2D Laser Harp Interface in priority so it takes the control of the port.

Then, the interface opens and read all parameters in the KB2D. It should look like this:
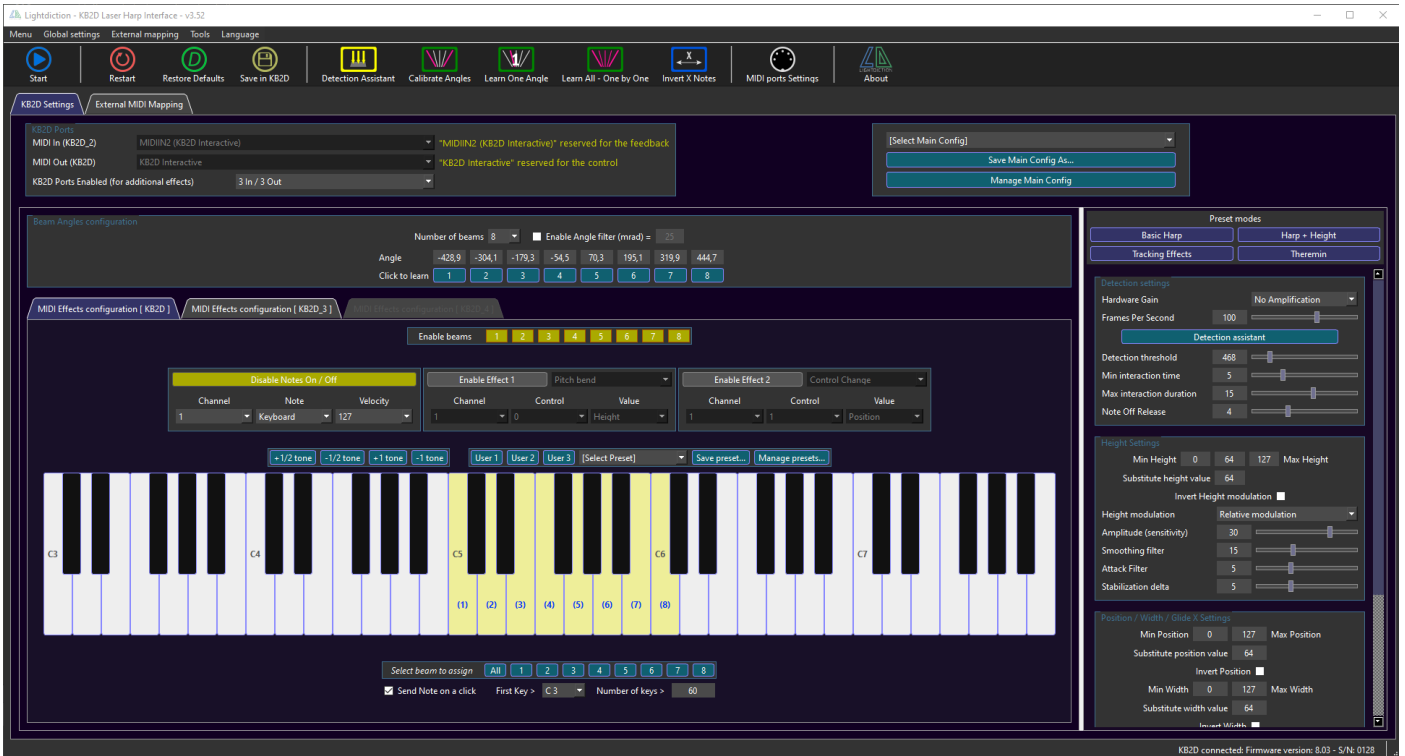
Fig. 5: KB2D Laser Harp Interface when the device is detected and successfully connected

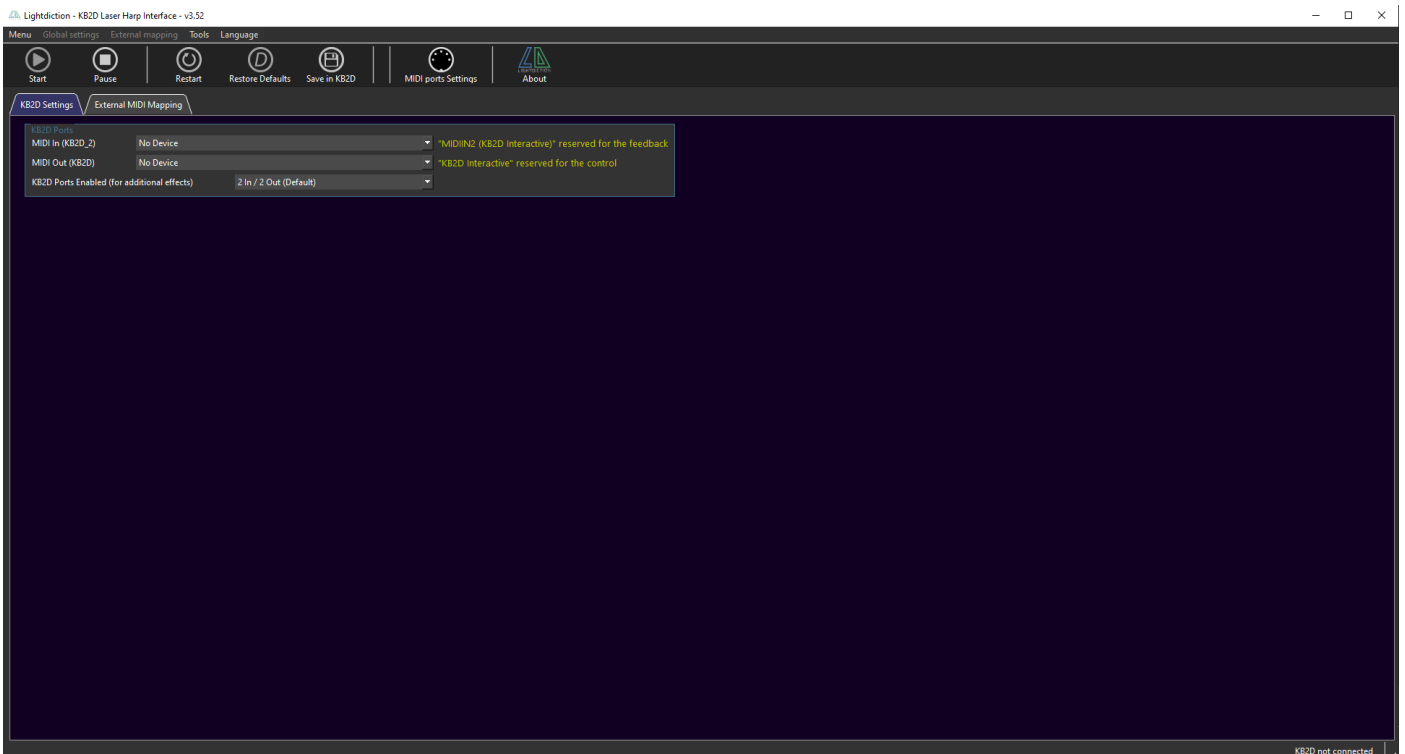If no device is found, the interface is almost empty like this:

Fig. 6: KB2D Laser Harp Interface when no device is found

3. DESCRIPTION OF THE INTERFACE

Button bar
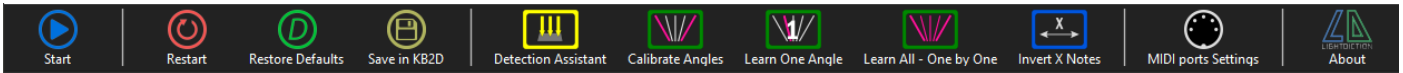
At the top of the interface, we have the button bar:

Fig. 7: Button bar

Button	Description
Start / Pause	Enable or disable the detection of the KB2D. When the KB2D is started, we see a light on the button next to the USB connector on the KB2D. We can also manually go to Start state by pressing this same button on the KB2D device.
Restart	Force the KB2D to restart. If parameters are not saved in the KB2D, changes will be lost.
Restore Defaults	Restore defaults parameters, except the number of MIDI ports.
Save in KB2D	Save all parameters in the FLASH memory of the KB2D. So, the KB2D will restore these parameters after a restart or a loss of power.
Detection Assistant	Opens the detection assistant window. This helps to set the detection threshold and Speed parameters automatically (Min interaction time, Max interaction duration).
Calibrate Angles	Opens an assistant to calibrate automatically all the beams by interacting with the first beam and the last beam. All intermediary beam angles will be deduced from this.
Learn One Angle	Calibrate one beam in particular. Click on this button, then select the number of the beam you want to learn to measure its position angle. This enables to have a better accuracy for intermediary beams, in comparison with "Calibrate angles".
Learn All – One by One	Equivalent to click on Learn One Angle for all beams. This is recommended to calibrate all the beams in laser harp mode, with a very good accuracy.
Invert X Notes	Invert all angles, so the notes and position variables
MIDI Ports Settings	Opens a window to access and customize all MIDI connections: KB2D Ports, External Mapping Ports, and MIDI Bridge to connect an Input port to an Output one.
About	Show some information about the version of the software.

MIDI Ports Settings

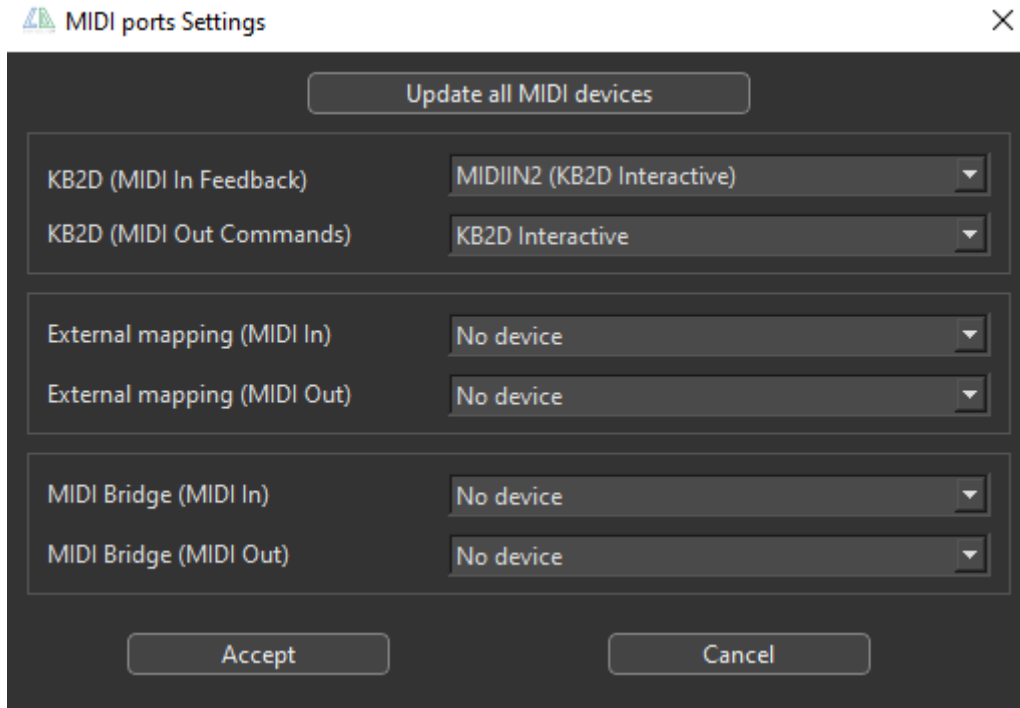This window can be accessed by clicking on "MIDI Ports Settings" button on the button bar.

Fig. 8: MIDI Ports Settings window

Command	Description
Update All MIDI devices	Updates the list of all MIDI Devices available.
KB2D (MIDI In Feedback)	Select the MIDI port corresponding to the KB2D for the feedback (generally this is the 2nd input port of the KB2D). Changing this may result in an incorrect communication with the KB2D.
KB2D (MIDI Out Commands)	Select the MIDI port corresponding to the KB2D for the commands sent to the device. By default, it Is the 1st output port of the KB2D. Changing this may result in an incorrect communication with the KB2D.
External mapping (MIDI In)	MIDI Input port used for the external mapping in the interface.
External mapping (MIDI Out)	MIDI Output port used as a MIDI through for the external mapping in the interface. All MIDI messages received by the input for the mapping are sent to this output.
MIDI Bridge (MIDI In / Out)	Select a MIDI Input that you want to connect directly to a MIDI Output. All messages received by the input are sent to the output. This is useful to connect 2 hardware together. For instance, we can use this bridge to connect the KB2D (Input 1) to an external hardware Synth.
Accept / Cancel	Accept or cancel changes and close the window.

KB2D Ports

The KB2D Ports section gives information about the connected hardware.
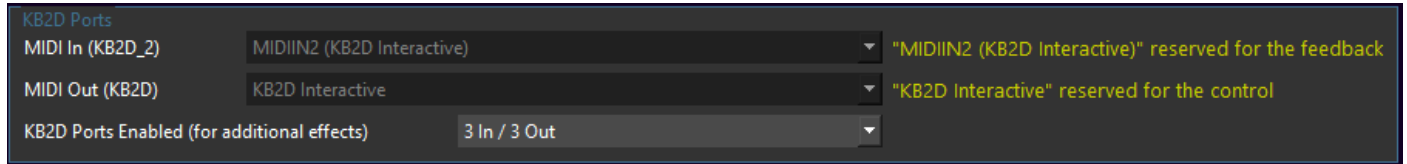

Fig. 9: KB2D Ports section

Once the KB2D ports have been opened, if the communication succeeded, the ports are locked to avoid disconnecting these by mistake. We normally do not need to select anything in these ports. The connection is done automatically if the correct ports are detected.

KB2D Ports Enabled lets you select the number of Ports you want to use for the KB2D. By default, the KB2D uses 2 In / 2 Out.

Indeed, 1 In and 1 Out is used for the feedback + command. One other Output of the KB2D is used to send the MIDI signals corresponding to the interaction and effects.

We can select 3 In / 3 Out or even 4 In / 4 Out to be able to create additional effects. This way we can have a configuration with 1 output of the KB2D connected to a DAW for instance, another one to a laser software to control the laser projector itself, and another output connected to the Bridge (connected to a hardware synth) for instance.

The MIDI messages sent by each port of the KB2D can be customized individually.

Here is a typical connection diagram of MIDI ports, with a 2 In / 2 Out configuration:
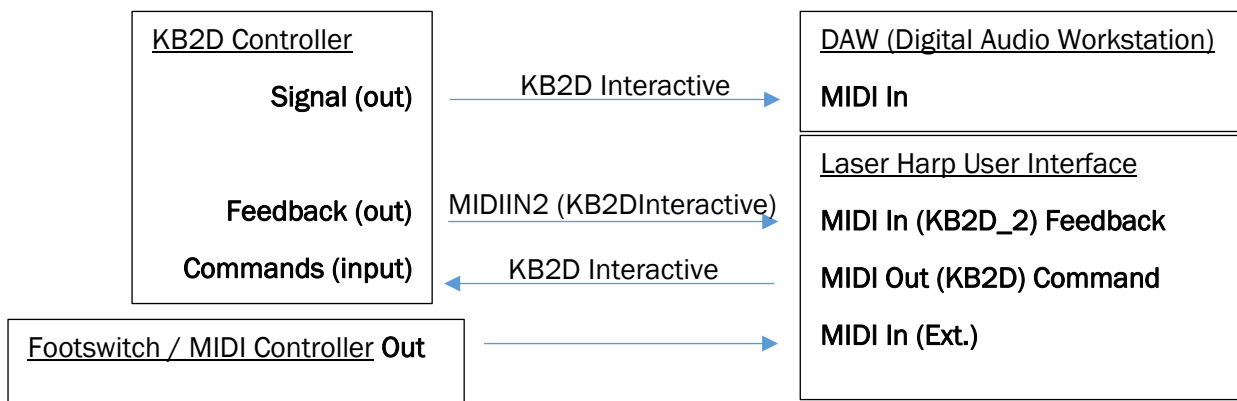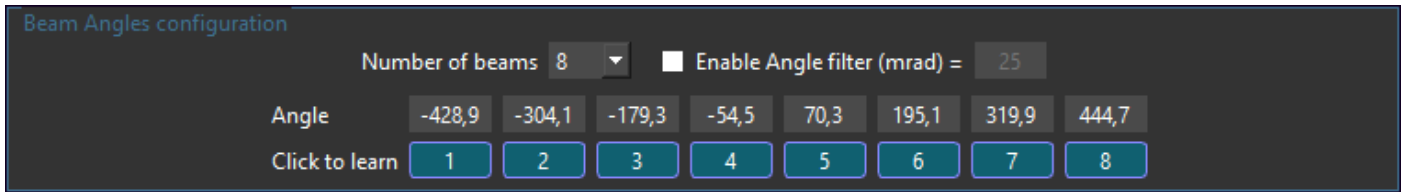
Beam Angles configuration

Fig. 10: Beam Angles configuration

The Beam Angles configuration section gives you information and commands about the number of beams used and their position.

Command	Description
Number of beams	Select the number of beams you want to interact with. The maximum number of beams is 16. This value is useful only for discrete beam detection. For continuous detection (with Position variable), this number of beams is not relevant.
Enable Angle filter (mrad)	When the angle filter is enabled, a detection is considered as valid only if it corresponds to the angular position of a beam +/- the value of this filter. When disabled, all detections are valid. The valid beam will be the closest one to the angle measured.
Angle	Gives some information about the position angle in mrad. This value should not be considered as an absolute mrad value, but more as an arbitrary unit close to a mrad. The maximum detected angle can go up to +/- 500 mrad. For the Position variable, the minimum and maximum of the Position correspond to the angle of the first beam and last beam.
Click to learn	Click to learn a beam (just like the "Learn One Angle" of the Button bar).

MIDI Effects Configuration

This is probably the most important section of the interface. This is where you do all the settings regarding the messages you want to send to each port of the KB2D.

There is one tab for MIDI Effects Configuration for each port of the KB2D you have activated (1 in 2/2 mode, 2 in 3/3 mode, 3 in 4/4 mode, since 1 port In and Out is reserved for the control and feedback).
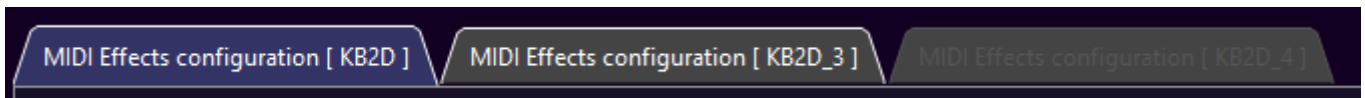

Fig. 11: MIDI Effects tabs in 3In/3Out mode. 2 Tabs are enabled.

Click on the tab you want to configure. All the tabs are the same and can be configured for each port.

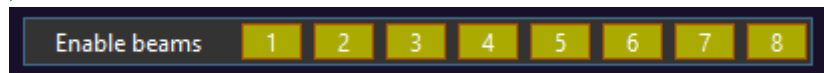*At the top of this section, we have the Enable beams buttons.*

Fig. 12: Enable beams buttons

By clicking on these buttons, we can activate a specific beam, or disable it. By default, all beams are activated (yellow background). This option can be useful when we use multiple ports. We can activate a beam on a MIDI port (for sounds for instance), but disable this same beam for visual effects, on another ports.

Just below, we have the effect selection section.
This is where you decide how you want the KB2D to interact with the beams.
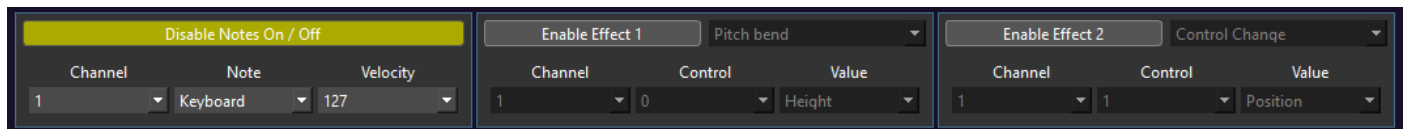
Fig. 13: Effect selection section

On the left, we can enable or disable Note On/Off effect. This is a particular effect, as when there is an interaction, it will send a Note On. When the interaction stops, it sends the corresponding note off.

On the middle and on the right, we can add MIDI effects on interaction. These effects can be one of a standard type of MIDI message: Poly Aftertouch, Control Change, Program Change, Channel Aftertouch, Pitch Bend.

We can activate the Note On / Off and 2 MIDI effects on each channel, at the same time, if we want so.

This means the KB2D can create up to 9 types of MIDI interaction at the same time (3 MIDI interactions by port, on 3 ports).

As a MIDI message is composed of 3 values, we can decide what we want to put on these values.

The first value is the Channel.

Fig. 14: Channel selection

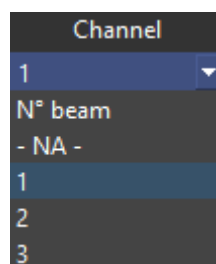We can select here the Channel where we want the effect to play. The channel goes from 1 to 16. We can select a fixed value, or we can select a Variable called "N° beam".

By selecting this variable, you indicate to the KB2D that you want the value to change in function of the beam you interact with. When you interact with the first beam, it will be channel 1. If you have 16 beams and you interact with beam number 16, It will send 16.

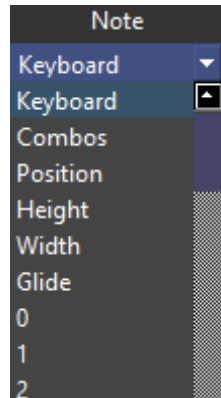*The second value is the Note or Control:*

Fig. 15: Note / control selection

This second value can vary from 0 to 127. Here again, we can choose a fixed value, or we can select a variable:

Variable	Description
Keyboard	Select this variable to be able to assign a value on each beam. To ease the selection of the value, a keyboard will be displayed, so you select the note you want on each beam. Then, the interface will automatically make the conversion between the note you chose, and its MIDI value.
Combos	Just like the Keyboard variable, "Combos" lets you decide the value you want to assign to each beam. The difference is about the way you select the value. With "Combos", you have to select directly the value you want, from 0 to 127 (by default).
Position	This variable will vary from continuously from 0 to 127 (by default) in function of the position (angle) where you interact with beam. 0 correspond to the angle of the first beam. 127 correspond to the position of the last beam. Let's say we project a continuous line; we can track the position of the interaction in function of the value of this variable. On a large interaction, or if you interact on multiple points at the same time (polyphonic), the position value will be the median of the extreme values.
Height	This variable will vary continuously from 0 to 127 in function of the height of the interaction. By default, in relative mode, the value will be 64 when you start interaction. Then it goes up or down in function of the variation of the height after the interaction. If you interact on multiple height at the same time (polyphonic), the value of the height will correspond to the average height.
Width	As an interaction is never punctual, this variable corresponds to the width of the interaction. 0 is a punctual interaction. 127 is an interaction that goes from the angle of the first beam to the angle of the last beam. When interacting on multiple position at the same time, the width corresponds to the maximum distance covered by all the interactions.

Glide	Glide is a test variable, currently not used.

The third value is the Velocity or Effect value.

The third value has the same options as the second value.

Application example:

For a Basic Harp application, with pitch variation with height, we can set the following parameters:

Fig. 16: Configuration example for a Harp application

We enable Notes On/Off for sure. We select Channel 1 for instance. As we want to choose the notes played on each beam, we will select the "Keyboard" variable for the note value. And we will set the velocity to a fixed value: 127 to have it at full volume.

For the pitch effect with height, we enable one of the effects, and we select "Pitch" in the drop-down menu. Then, we also select the Channel 1 (for instance), and we put the control to 0. Then we will let the value of this pitch vary in function of the height, so we select "Height" as the variable for the value.

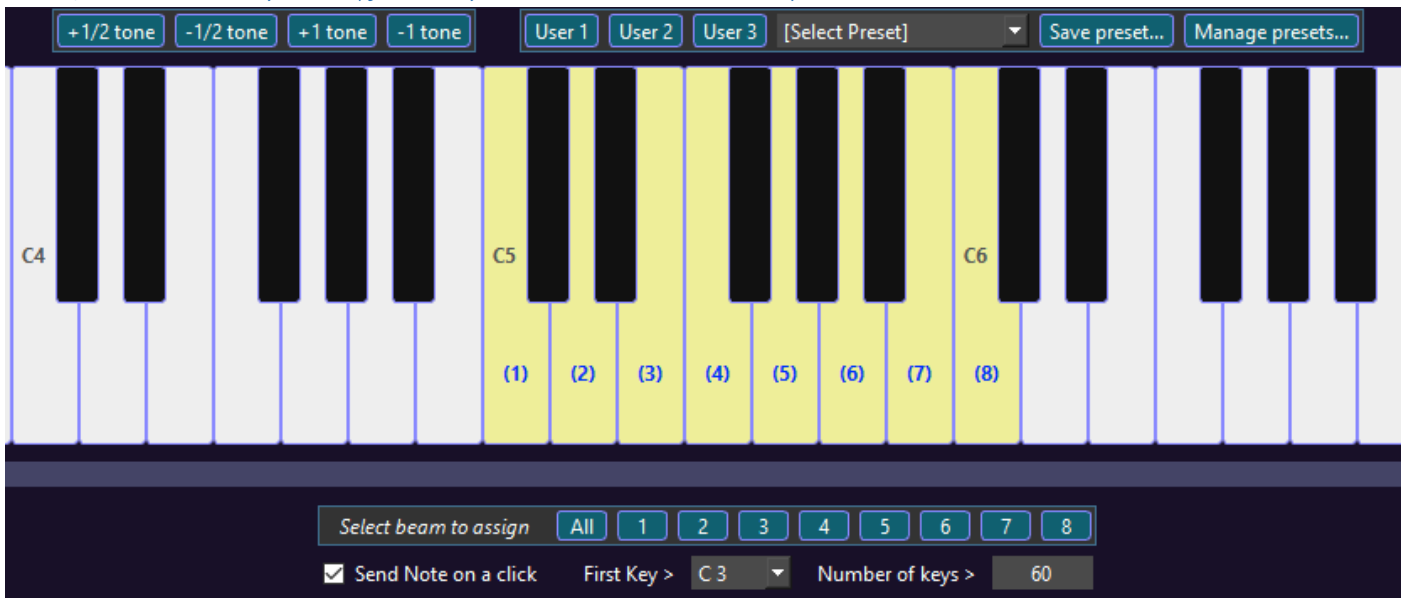*Below, we have the Keyboard (if the "keyboard" variable is selected)*

Fig. 17: Keyboard section

This section is shown only if the "Keyboard" variable is used.

A keyboard is displayed. The keys currently used are colored in yellow, and the corresponding beam number is indicated on the key.

We also have a few options and buttons:

Variable	Description
+1/2 tone -1/2 tone +1 tone -1 tone	These buttons are quite explicit. This shifts all current notes selected up or down.
User 1 / 2 / 3	These buttons load note values that have been saved previously. This user presets are saved locally on the computer, not in the KB2D.
Select Preset	You can select and load here any custom preset you saved previously.
Save Preset...	Click to save the current notes configuration to a preset of your choice. You can save to a User preset (1, 2 or 3), or to a custom preset that you can also name as you want.
Manage presets...	Open a window to let you manage your presets currently saved: switch presets, delete preset, rename preset, and so on.
Select beam to assign	Click here on the beam index you want, then click to a key on the keyboard to assign the key to the index. You can also click on "All" to assign all beams one by one, starting with the first or the one currently selected.
[Click on a key]	By clicking on a key of the keyboard, this will send the note. This is also a way to check if your KB2D is correctly connected to your DAW or synth. Also, clicking on the Key will let you choose the beam you want to assign to this note. This is an alternative method to assign a key to a beam.
Select Note on a click	If you uncheck this box, the note will not be sent when you click on a key of the keyboard. (But you can still assign a note to a beam index by clicking on the key).
First Key	Select the first key shown on the keyboard.
Number of keys	Select the number of keys you want to be shown on the keyboard.

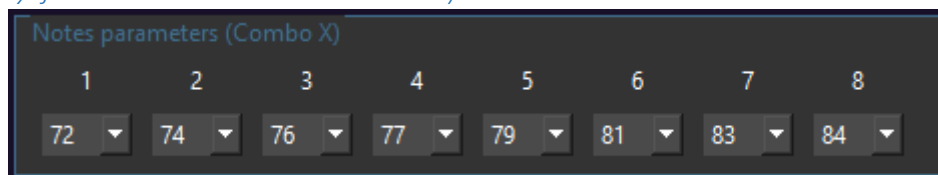*Combos section (only if the "Combos" variable is selected)*

Fig. 18: Combos section

This section is shown only if the "Combos" variable is used.

Drop down menus are shown for each beam. Each drop down has a value going from 0 to 127. You can select the value you want directly here on each combo.

Generic settings

The generic settings are in the panel at the right of the interface.

The size of this panel can be adjusting by clicking and moving on its left edge.

Preset modes

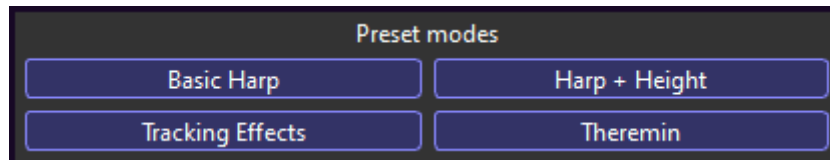At the top of this panel, we have the preset modes:

Fig. 19: Preset modes

This section lets you switch quickly between some preset modes. This also helps at the beginning to show you some examples, if you do not know how to set the KB2D.

Variable	Description
Basic Harp	This mode sets a basic harp mode, with only notes On and Off activated when you interact with the beams.
Harp + Height	This mode is the basic harp, but with the height also enabled.
Tracking effects	This just enables a position varying effect, so you can use it to track your interaction. It should be used with a line pattern on the laser.
Theremin	This enables a Theremin mode, with a fixed note being played, a pitch varying with the position and a CC effect varying with the width. It should be used with a line pattern on the laser.

Detection settings
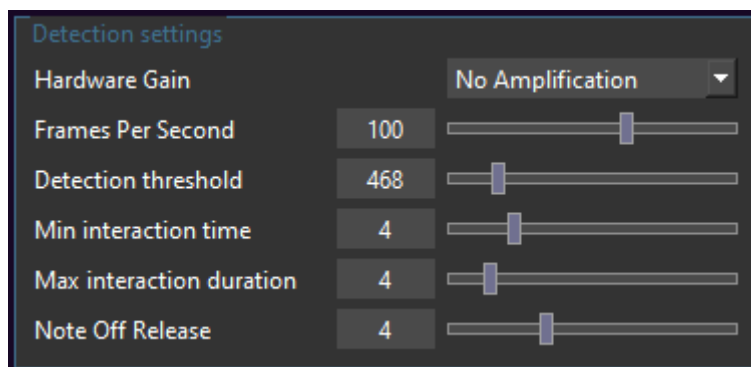
Just below we have the detection settings:

Fig. 20: Detection settings section

This section lets you adjust the following parameters regarding the detection. Some of these parameters (detection threshold, Min interaction time, Max interaction duration) are set automatically when you use the detection assistant, but you can still adjust these manually in order to optimize the detection.

Parameter	Description
Hardware Gain	This is an additional amplification on the KB2D electronic board, that can be selected with the software. By default, there is no additional amplification, but if the detection threshold is very low (less than 100), you can enable a x2, x4, x8 or x16 amplification. This can also be useful for long distance interactions in some configurations.
Frames Per Second	Set the detection frame rate. This should be close are slightly less than the frame rate of your laser pattern.
Detection threshold	This is the minimum value (arbitrary unit) of lighting power that the sensor needs to receive to consider an interaction as potentially valid. If this value is too low, the KB2D can detection other elements in the environment, like the background (ceiling if you project your laser vertically indoor). If this value is too high, the system will have difficulties to detect your hand or the object you want to interact with.
Min interaction time	To be considered as valid, an interaction has to last a minimum time specified by this parameter (arbitrary unit). This parameter can help to filter some parasitic lights (like short flash from cameras, for instance).
Max interaction time	This qualify the maximum time an interaction should last to be considered as valid (in 1 frame). In most environments, this parameter is not very useful, and you can set it at an intermediary value.
Note Off release	This is the number of frames before a note turns Off, when you start interacting with a beam (or when a beam is not detected). In particular, it is useful if the frame rate set in your interface is approximative. It will avoid parasitic Note Off messages when you interact with a beam. If the value is too high, it will introduce a latency on the note off. A value of 4 is generally good, and we don't really feel the latency.

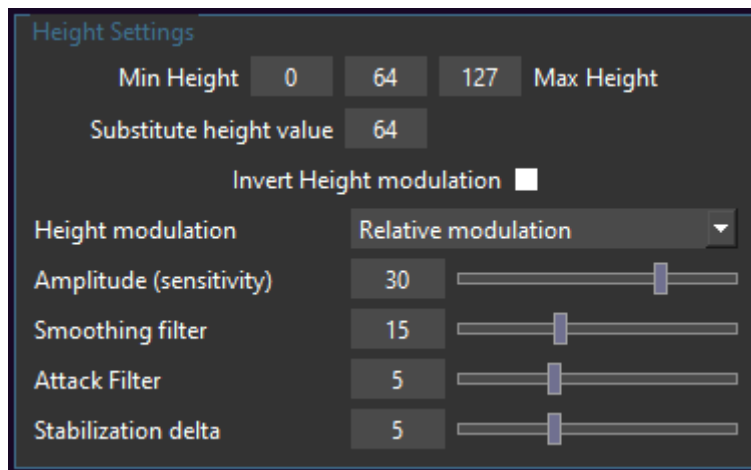## Height settings

Just below we have the height settings:

Fig. 21: Height settings section

This section lets you adjust the settings related to the "Height" variable.

Parameter	Description
Min Height / Intermediate / Max Height	Assign the minimum and maximum value the height can take. The intermediate value corresponds to the initial value the Height takes when you start interacting (in relative mode).
Substitute Height value	The substitute value is sent when we stop interacting with the beams, instead of keeping the last value. This is a kind of "Note Off" for effect.
Invert Height modulation	By default, the minimum value corresponds to an interaction far from the sensor, and the maximum value is close to the sensor. Check this box to invert the variation.
Height modulation	Type of modulation (relative or absolute). Relative modulation always starts with the intermediate value, and then varies in function of the height variation. Absolute modulation corresponds to the absolute power value received by the sensor. Currently, absolute variation is not fully functional and should not be used.
Amplitude (sensitivity)	The Amplitude is the amount of variation in function of the height. If this value is high, the height variable will vary faster.
Smoothing filter	This is used to avoid brutal variation of the height variable in function od the height. If the smoothing filter is high, the height variable will vary very slowly. It is recommended to not set it too low, or you could have brutal variation when removing your hand for instance.
Attack filter	This sets the minimum number of frames before the KB2D starts modulating. It avoids to have incorrect values at the start of the interaction, you should keep it quite high preferably.
Stabilization delta	This sets in area around the initial height where the variable will keep the intermediate value and will not modulate. This lets you play easily without having a modulation constantly when you are trying to play the exact note without modulation.

Position / Width / Glide X Settings

This section can be found just below the Height Settings section:
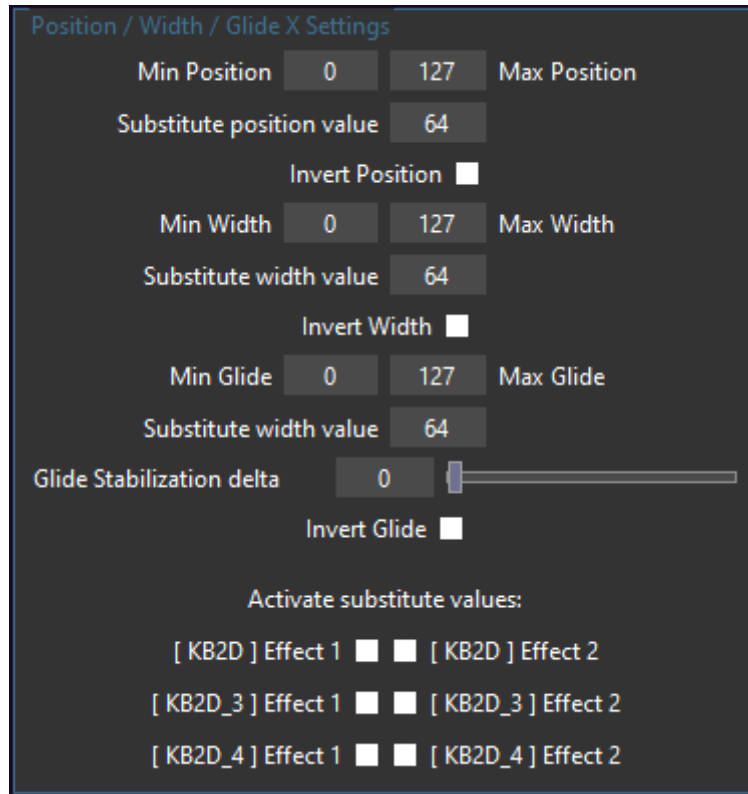

Fig. 22: Position / Width / Glide X Settings section

This section lets you adjust parameters relative to generic variables.

The glide variable is not functional yet.

Parameter	Description
Min/ Max	Assign the minimum and maximum value the variable can take.
Substitute value	The substitute value is sent when we stop interacting with the beams, instead of keeping the last value. This is a kind of "Note Off" for effect.
Invert	Check this box to invert the variation of the variable. When uncheck, the position varies from the first beam angle to last beam angle. The width varies from small interaction to large interaction.
Activate Substitute values	Substitute values can be activated independently on each MIDI effect of each KB2D port. By default, default values are disabled. (The activation of height substitute value is also depending on this activation).

Main Config

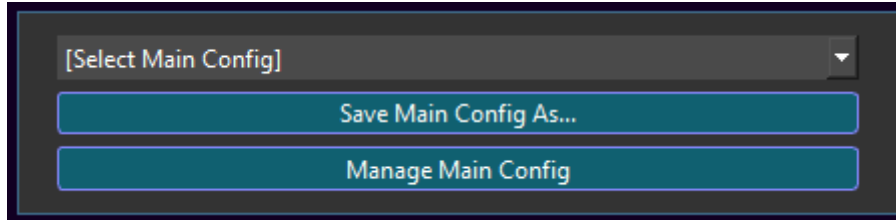The main config section can be found on the right od the KB2D ports settings.

Fig. 23: Main Config section

In this section, you can create presets of all your parameters, to switch quickly from one configuration to another.

Command	Description
Select Main Config	Click to select and load an existing configuration.
Save Main Config As...	This opens a save dialog window to select what you want to save and to enter the name of your new configuration (see below).
Manage Main Config	This opens a dialog window you switch configurations, delete configurations, rename configurations (see below).

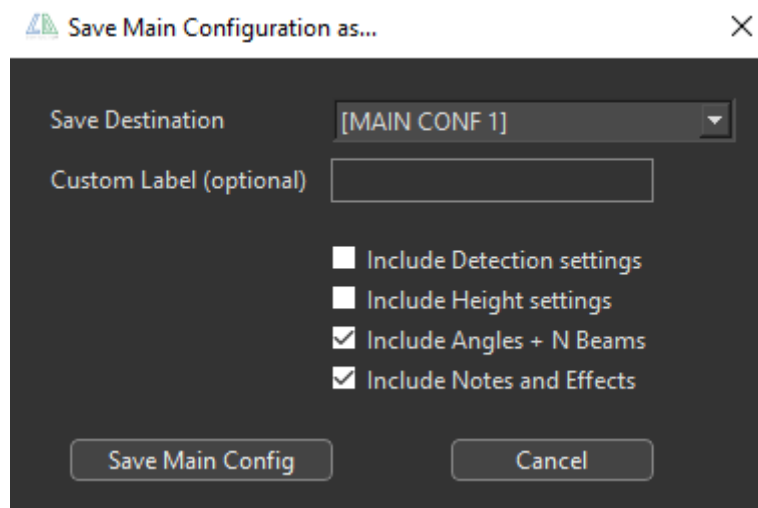The Save dialog looks like this:

Fig. 24: Save Main Configuration dialog

Command	Description
Save Destination	Select the index where you want to save your configuration. You can also select an existing position to rewrite it.
Custom Label	Enter a name for your configuration if you wish.
Include Detection settings	Include detection settings in your configuration.

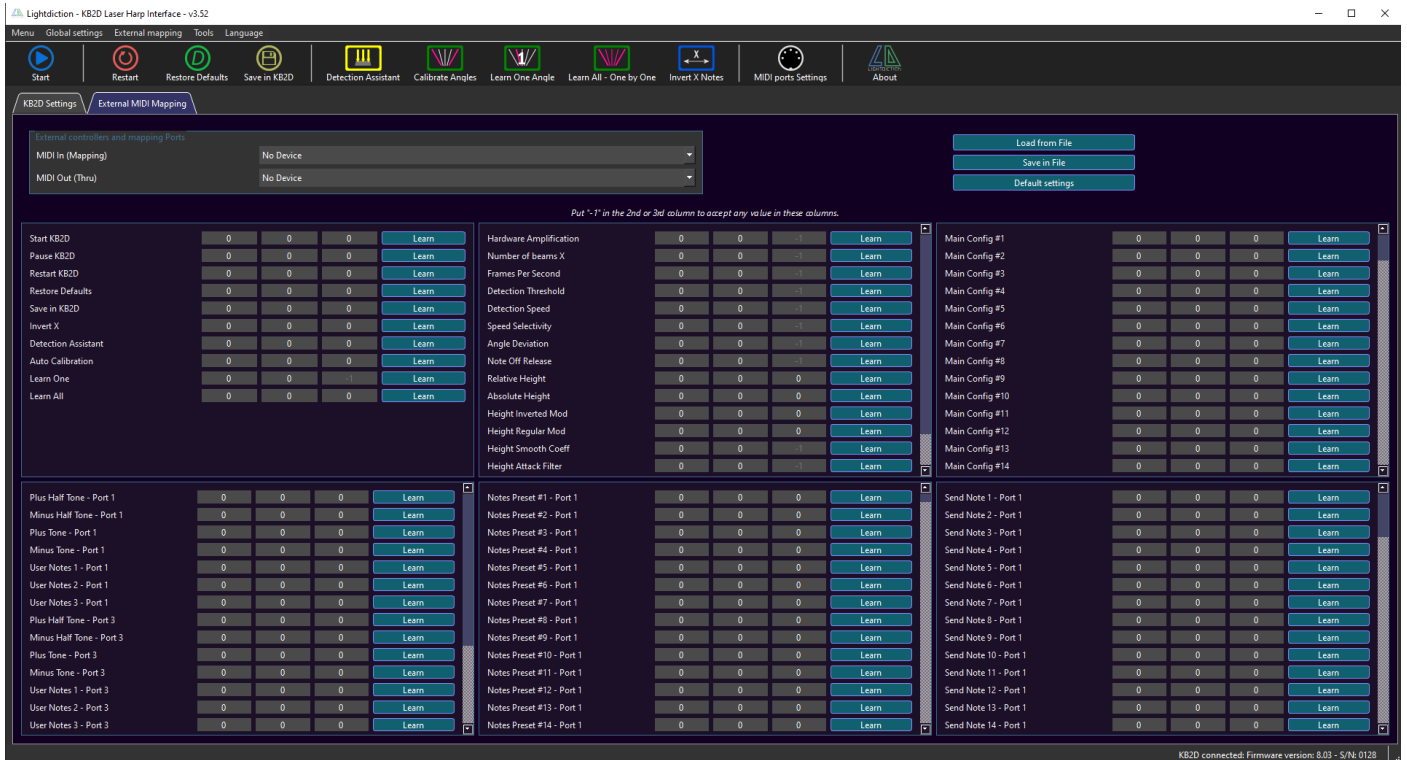|	
Include Height settings	Include Height settings in your configuration.
Include Angles + N Beams	Include the Beam Angles configuration section in your configuration.
Include Notes and Effects	Include the parameters in MIDI Effects configuration.

External MIDI Mapping

Fig. 25: Overview of the External MIDI Mapping tab

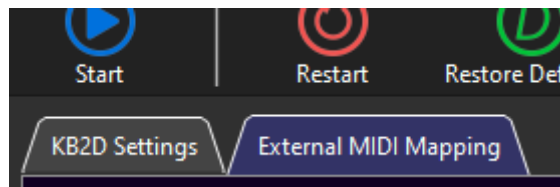The external MIDI mapping tab can be accessed just under the main Button bar.

Fig. 26: Access the External MIDI Mapping tab

The External MIDI Mapping section is used to connect an external MIDI controller to control almost any parameter of the Laser Harp interface in live. In particular, this is very useful to switch between presets for instance, or to start the detection in a live configuration.
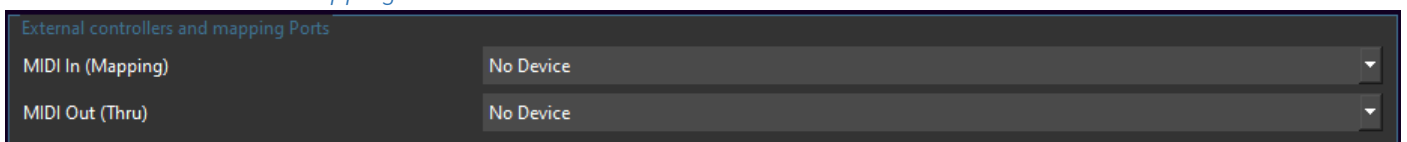
External Controllers and mapping Ports

Fig. 27: External Controllers and mapping Ports section

This is where you choose the MIDI controller you want to use to control the interface (MIDI In). You can also select a MIDI Out port as a MIDI Thru. All incoming MIDI messages will be automatically transmitted to the MIDI Out port.

External Mapping table

Put "-1" in the 2nd or 3rd column to accept any value in these columns.			
Hardware Amplification	0	0	-1	Learn
Number of beams X	0	0	-1	Learn
Frames Per Second	0	0	-1	Learn
Detection Threshold	0	0	-1	Learn
Detection Speed	0	0	-1	Learn
Speed Selectivity	0	0	-1	Learn
Angle Deviation	0	0	-1	Learn
Note Off Release	0	0	-1	Learn
Relative Height	90	24	-1	Learn
Absolute Height	0	0	0	Learn
Height Inverted Mod	0	0	0	Learn
Height Regular Mod	0	0	0	Learn
Height Smooth Coeff	0	0	-1	Learn
Height Attack Filter	0	0	-1	Learn

Fig. 28: Overview of the external mapping table

In this table, we can enter the MIDI message we want to set as in input for the mapping control of any command.

The value of the MIDI message can be entered manually in front of the command we want to assign, or we can click on "Learn" to learn automatically the value.

Click "**Learn**", then press the button or move the slider of the external MIDI controller you want to use.

You can put "-1" in a column to accept any value. Note that all commands that need a Value (like Number of Beams X) will take the value in the 3rd column of the MIDI message as the parameter.

For instance, if you want to activate a specific button or preset with a key of an external Synth, you can press the key after clicking on Learn. However, this Key will send a velocity value depending on the force used to press the Key. We want the button or preset to be triggered each time we press the key, and not only when the value is exactly the same. So, we can put -1 in the 3rd column (velocity column).

When a command is used for mapping, its color turns yellow.

All values entered in this section are in hexadecimal!

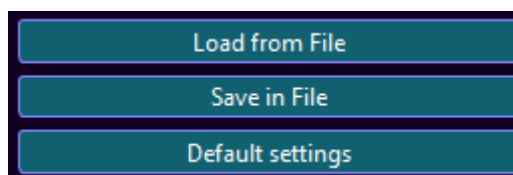*Load, Save File and Reset to Default*

Fig. 29: Load, save Files and reset to default for mapping

We can keep a file of the current preset used for the external mapping. We can also load an existing file, or reset to Default values.

Firmware Updater

The Firmware Updater is used to update the firmware inside the KB2D. When activated, the KB2D will restart in this mode. The interface will automatically detect the KB2D in this mode and change the user interface to match the firmware updater needs.
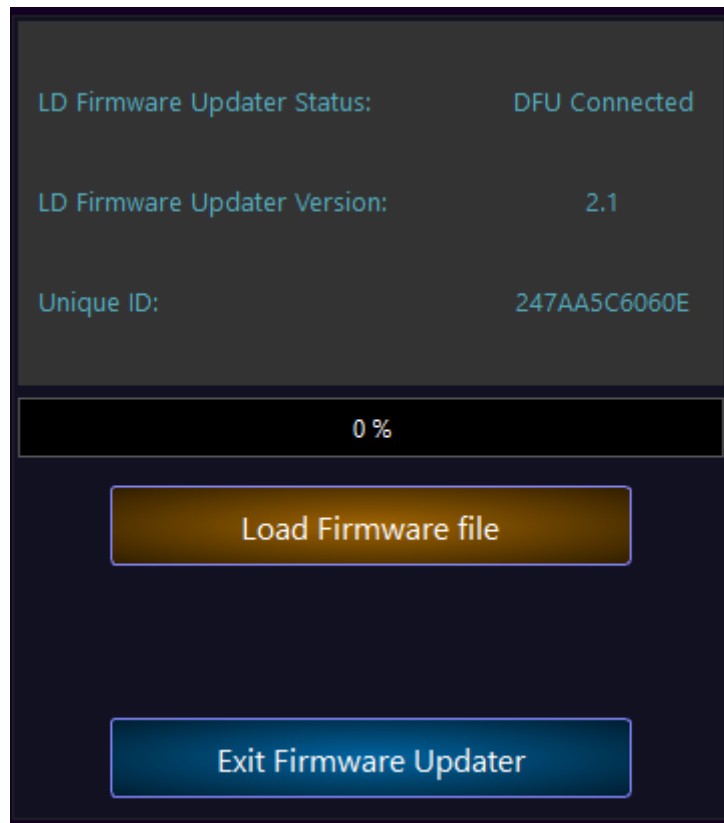

Fig. 30: Firmware Updater interface

Some information is shown here: the version of the firmware updater itself (this remains the same can only be updated by Lightdiction).

The Unique ID is unique and qualify the microcontroller inside the KB2D

A progression bar indicates the progression of the loading of the firmware.

To update your firmware, click on "**Load Firmware File**", then select a "kb2d" file corresponding to the new firmware you want to load and accept.

When the loading is finished, click "**Exit Firmware Updater**" to go back to the main Laser Harp Interface.

When switching to Firmware Updater mode, the KB2D is detected as a new MIDI device, thus it is strongly recommended to close all MIDI applications (like DAWs) before starting the Firmware Updater, to avoid errors.

This mode is started automatically by the interface if you are connected to internet and a new version is available, but you can also start it manually.

Go to the menu > **Tools > Start Firmware Updater**.
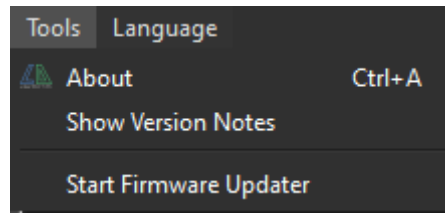
Fig. 31: Menu to start the Firmware Updater manually

If for some reason, the loading fails, and you are unable to start the KB2D anymore, you can force the KB2D to restart in Firmware Updater mode, so you load the firmware again. To do so, unplug your KB2D. Then press the start button on your KB2D device, next to the USB connector, and plug the KB2D while pressing the button. You can now load a new firmware file by starting the KB2D Laser Harp Interface.

III.   HOW TO QUICKLY SET A LASER HARP SYSTEM

A Laser Harp system can be set in a few minutes using the KB2D Interactive Device.

1. INSTALL THE KB2D USER INTERFACE

Last version of KB2D User Interface can be downloaded here: https://lightdiction.com/Ressources

The name of the program is KB2D_v3.53_setup.exe (version may vary, you should take the last version).

Install the program on a computer with Windows 7 or more (Win10 is recommended) and start it. If the program does not start because some files are missing, install "vc_redist" package.

2. PLACE THE KB2D

Place your KB2D device accordingly to *Fig. 1*. If you have a KVANT or Unity Laser Projector, attach the mirror and the holder as shown on the following pictures:

Else, just place the KB2D in front of your laser projector to have a position similar to the one on the picture above. The window of the detection system should be centered (approximatively) relatively to your laser emission point.

3. CONNECT THE KB2D AND START THE INTERFACE

Connect the KB2D to your computer with the USB cable. It should automatically install the MIDI drivers after a few seconds. Then, start the KB2D User interface. It should show the following window, with the **firmware version** and **Serial Number** indicated:
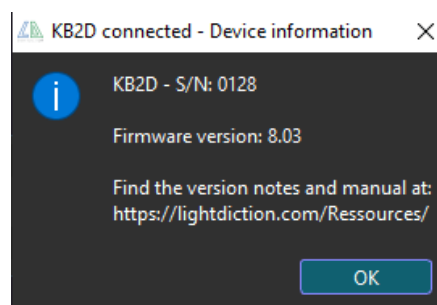

If you get an error and the interface cannot communicate to the KB2D, close all other programs that may use MIDI ports and restart the interface. In particular, start the KB2D interface preferably before your DAW.

4. START YOUR FAVORITE DAW

Start your favorite Digital Audio Workstation (or download and install one). Then, connect Midi In (KB2D Interactive) to your DAW, if it is not already connected by default, to play the notes sent by the KB2D.

5. SELECT THE NOTES YOU WANT

Select the MIDI Notes you want the KB2D to send by clicking on a key on the keyboard and assign it to a beam number. This will also force the KB2D to send the note you selected to its MIDI Out. If you cannot hear anything, check that "KB2D Interactive" MIDI In port is correctly connected in your DAW.
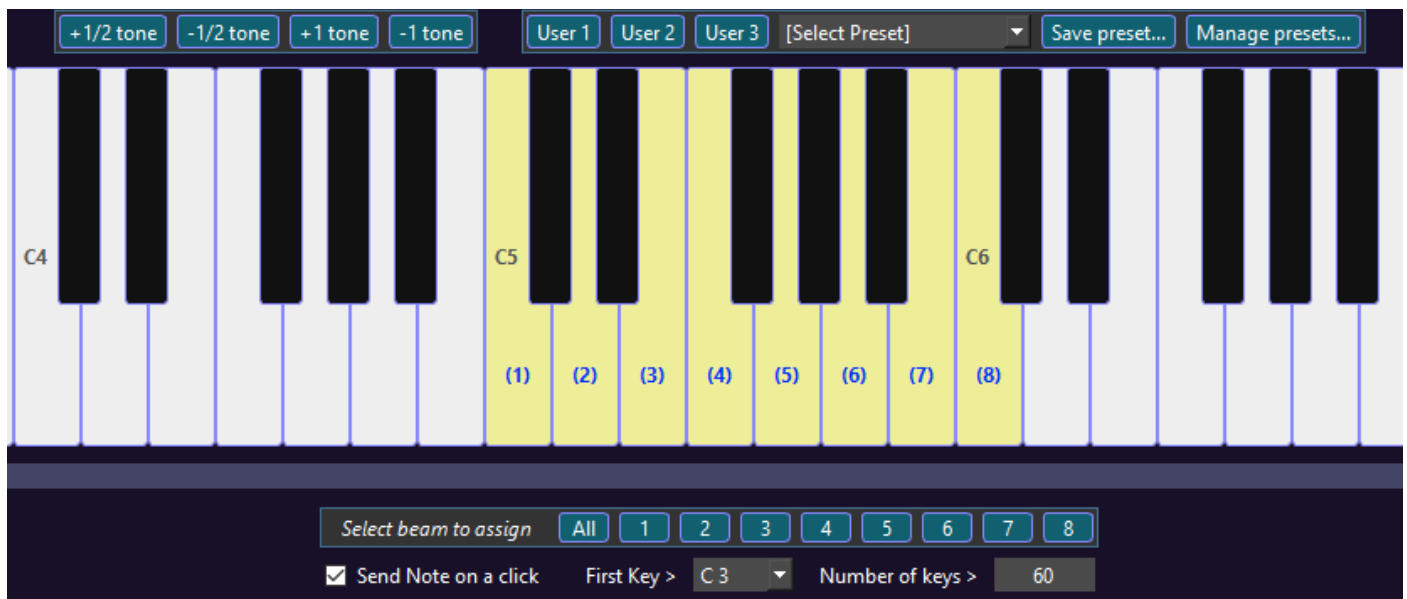
6. CALIBRATE DETECTION PARAMETERS

Create a fan pattern on your laser, then click on "Detection assistant" (in top bar) and follow the instructions.
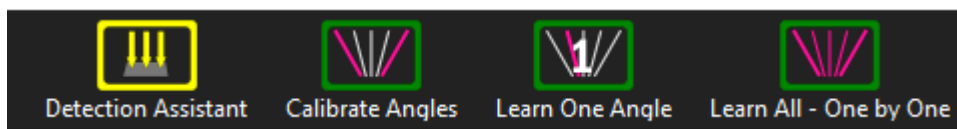
7. CALIBRATE ANGLES

Click on "Calibrate angles" (top bar), and follow the instructions. After this calibration, the KB2D is automatically in "Start" state: the LED on the button on the KB2D device is now On.

That's it! Your system is now calibrated. You can play each note by interacting with the corresponding beam. You can fine tune beam position by clicking on "Learn one", and fine tune detection settings by following the details in ANNEX 2. When all parameters correspond to your needs, you can save them by clicking on "Save in KB2D". Thus, the KB2D will retrieve these values if you disconnect and reconnect it.

If you encounter a problem during settings, report to V. COMMON ISSUES.

IV. PRECAUTIONS AND RECOMMANDATIONS ON USE

- Be careful not to aim at the KB2D with direct lasers. This can damage irreversibly the photo-detection system. The KB2D device is detecting light diffusion caused by objects (or hands) interrupting the lasers. Do not use mirrors or other objects with specular reflection for interacting.

- In order to reduce parallax error (variation of detection angle with height), the KB2D should be placed preferably close to the origin of the laser source (as shown on Fig. 1).

- In order to optimize detection parameters and reduce false alarms. The "background" projection surface should be dark or at a long distance compared to the desired distance for interactions.

- To interact with the beams it is preferred to use white gloves, or uniform surfaces. It is possible to play directly with the hand, but the detection threshold would probably need to be lowered, because of the low reflectivity of the hand.

- The KB2D device is able to detect variations on 2 dimensions: angle X (in the plane aligned with the length of KB2D box), and distance (height) Z. Place your device accordingly (see *Fig. 2*).

- Any interaction with the laser beams can be detected. Thus, a background too close can cause false detections. Also, white surfaces are more reflective than black surface. Using a white glove can thus help detecting the hand instead of the background.

V. COMMON ISSUES

Issue	Cause	Solution
Cannot connect to midi port In and / or Out	A software may already use the MIDI port (some software automatically connect to MIDI port).	Close other music software and such before starting KB2D interface.
The KB2D does not detect anything even with detection assistant	There is no detection. Have you clicked on "Start Detection"?	Depending on the filter used (**Green, red, or Blue**), check that the beam at least has the wavelength of interaction.
The distance of interaction is very low	The detection threshold is not correctly set.	Lower the "Detection threshold". Eventually use "Detection assistant" to help.
The latency is high when I interact with the beam	The software used to play the notes from MIDI (DAW) can introduce a latency.	There may be parameters to change, like buffer or samples.
The latency is high when I interact with the beam	The detection parameters on KB2D interface are not correct.	The device may have difficulties to detect the beams. Change the detection parameters or use the "Detection assistant".
The Notes are not stable / the KB2D does not detect correctly	Detection parameters are not correct or the environment is confusing the system	Use the detection assistant, change the deviation angle or other settings manually. Test the system without parasitic lights.
The Notes are not stable / the KB2D does not detect correctly (Not all notes)	Angles parameters are not correct for every all notes / The KB2D has been roughly calibrated.	Calibrate each beam independently with "**Learn One Angle**".
The KB2D is playing notes without interactions	The KB2D is detecting parasitic lights from the environment or because the background is too close.	Is the background is close, increase the Detection threshold, or use a dark surface on the background to reduce interactions. Try to be more selective on detection parameters, to limit parasitic interactions.
The KB2D does not play notes, even when "Detection assistant" succeeds	Notes parameters are not correct, or the KB2D is not linked to an external audio software.	Check Notes parameters and click on Key (send test note) to verify the KB2D is properly linked to the external Software.
Monophonic detection is good, but polyphonic detection is not stable	Polyphonic detection causes a slight variation of the measured angle on each beam	Try to increase slightly the "Angle filter" or disable the angle filter
KB2D is not recognized any more by the computer	The firmware is corrupted. Something wrong / a disconnection happened during firmware loading.	Press the start button directly on the KB2D while plugging USB cable, to force it to start in Firmware Updater mode. Then just upload the firmware again.
The KB2D always start in Firmware Updater mode / cannot go back to normal mode.	The firmware is corrupted. Something wrong / a disconnection happened during loading.	Just upload the firmware again.

VI.   PLEASE READ CAREFULLY:

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VII.   REVISION HISTORY

Date	Information	Version
30.08.2017	Basic KB2D information	1.0
26.11.2018	General information – interface updated	1.1
23.03.2019	Information – interface updated	1.2
13.04.2019	Content and information – interface updated	1.3
01.12.2019	Content and information – Interface updated	1.4
09.05.2020	Content and information – Interface updated	1.5
25.03.2022	Content and information – Interface updated	2.0