

MADLASER

GUIDE

MadLaser is the first MadMapper extension, allowing to control beams of light using cutting-edge tools!

Driving laser projectors is now easy, accessible and enjoyable with the user-friendly yet powerful MadMapper workflow...!



1. Introduction

- **MadMapper** is a video and light mapping key-software, it now handles laser mapping! The ease of use remain the same, and the new specific laser surfaces and laser outputs features are presented in this guide.



- This extension is a paid feature of **MadMapper 5**. More information on the [MadMapper website](#).

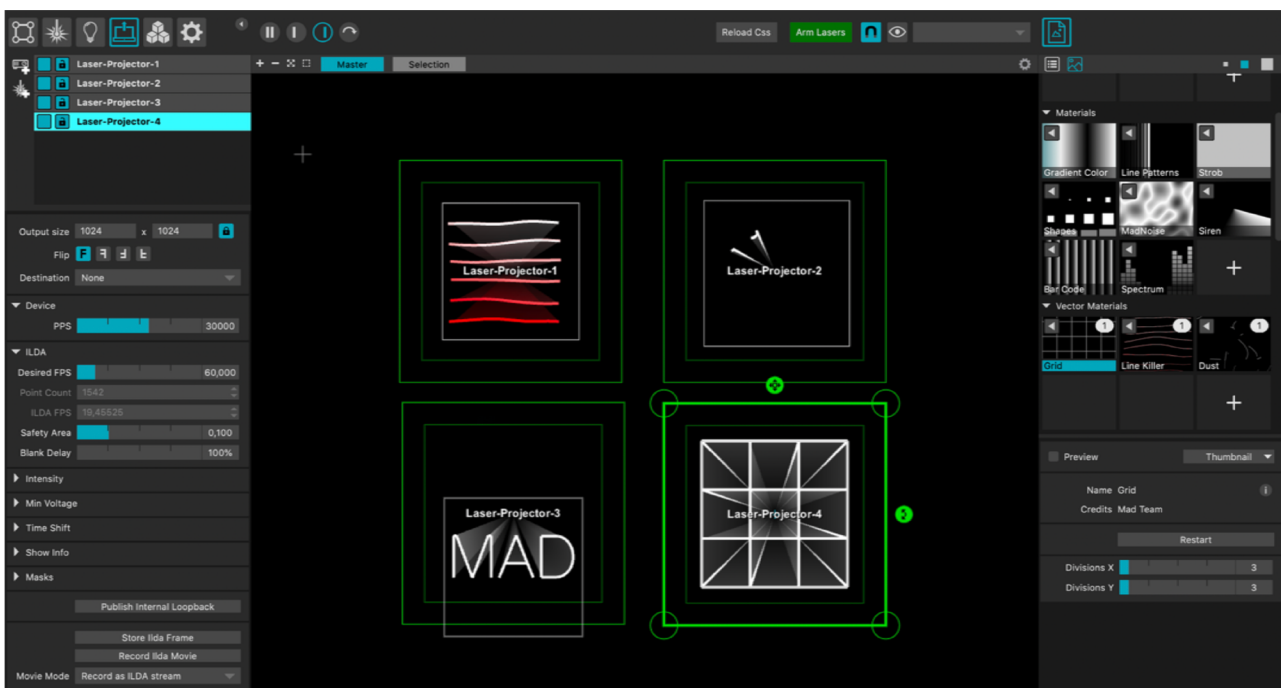
Safety Warning

Lasers are powerful and dangerous, hence they should be handled with care and safety for the audience in mind.

Please comply with your local regulations.
MadMapper / GarageCube / 1024 architecture cannot be hold responsible for misuse of laser equipment.

Don't shoot rays towards your audience, always use a safety switch on your hardware and specify a safety area.
Avoid burning your laser hardware by limiting the laser scan rate.

- The **MadLaser** extension which comes with :
 - Unlimited lasers
 - Multi protocol: ILDA through EtherDream or Helios USB, Shownet, FB4 through Pangolin Beyond
 - Realtime vectorization of video or material content
 - Laser lines just like regular lines
 - Realtime programmable laser shaders
 - Mesh warping of laser content
 - Multi laser content dispatch
 - Laser projector masks
 - ILDA file import/export
 - Laser text with included OneLineFonts
 - SVG file import to render precise vector graphics
 - Angle optimization, blanking, draw order, maximize FPS, time offsetting signals, etc.
 - Surfaces controllable through MIDI, OSC, DMX, Audio analysis, etc. and cuable
 - And much more.
- The **MadLaser** extension allows you to create as many laser projectors output as your computer can handle and place them at your liking in the preview. Then add **Laser Surfaces** to your Laser projectors. Just like the classic video mapping workflow.



Laser tips

Each laser output will receive laser paths (colored polylines) from all surfaces that are on it, and will generate ILDA points depending on output parameters and from the Laser Render Settings of each surface.

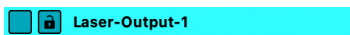
2. Laser Outputs



- ▶ Laser Outputs are located next to the light surfaces tab, at the top left of the interface.



- ▶ Click on the second icon on the left to create a **Laser Output**.



- ▶ As for video projector, laser outputs will be listed in the projector list and you can rename them, display or undisplay then, lock them or unlock them at any time.

Laser tips

A Laser Projector is positioned in the output.
Any laser surface will transmit their paths together with the render infos.
Laser Projector's job is to create an ILDA frame to send to the Laser DAC selected in Destination combo box.



- ▶ **Output Size:** the size of the output rectangle in the output preview.
It has no use for output data, but to position surfaces relatively in the output, it can be useful.



- ▶ **Flip:** options to flip the laser projection.



- ▶ **Destination:** you can select here any DAC laser detected. Supported DAC are Etherdream, ShowNet, Helios usb and FB4 Pangolin Beyond. For Ethernet based DAC, make sure you're on the correct network.



- ▶ **Device / PPS (Points Per Second):** laser DACs receive a list of points to render through ethernet or USB.
They will then modify the output voltage or X/Y/R/G/B channels to reproduce each point MadMapper sent.

(Device / PPS): Lasers are generally sold with a PPS mention, which should reflect the performances of the scanner. You're supposed to specify here what the manufacturer says because this number will be used to drive the point number calculation.

Laser tips

The **PPS** is sent together with the frame. The higher it is, the more you have definition in your electric signal (which doesn't mean that the result will be better).

PPS range is limited by default in order to avoid bad manipulation and hurting the galvo. For instance, setting the **PPS** to 100kpps will increase scan speed and make your galvo more hot.

Setting a value over 45kpps generally doesn't make sense, except if projecting very far & using a very small angle of the projector.

Desired FPS  60.000

- **Desired FPS:** choose the number of frames per second the laser should render. If you want to synchronize with a video projection, you can choose the same FPS than the projected movie to ensure perfect synchronization. If you're rendering text, you might want to optimize path quality while avoiding the blinking (we don't notice the scan over 45 FPS, under 35 we really see the blinking).

Laser tips

MadMapper will try to generate an **ILDA** frame with the appropriate number of points for the laser DAC to reproduce the frame at this rate but it is limited by the Laser Surface's **Max Speed** of the paths to draw, the blanking time to move from shape to shape etc.

As said before, scanning too fast hurts the hardware.

Point Count | 3160 

- **Point Count:** the actual number of points in the current generated frame.

ILDA FPS | 9.49367 

- **ILDA FPS:** the real scan FPS (until the DAC does its job well) = $\text{PPS} / \text{Point Count}$, ie $30\text{kpps} / 500 \text{ points} = 60 \text{ FPS}$.



- **Safety Area:** some laser scanners need to avoid the beam reaching the boundaries of the projecting area. Setting up a safety area will ensure you don't damage your equipment.

Laser tips

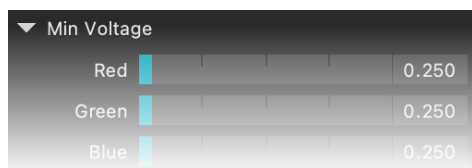
Don't set the **Safety Area** too low. Some laser handle full angle range properly, some will enter security when going to wide, some could be damaged (listening to your scanner is a good way to notice if something's wrong : the sound should be smooth and not clicky).



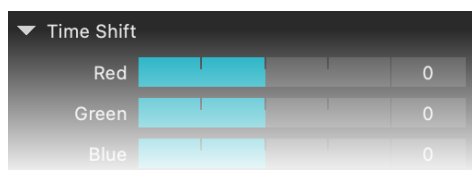
- **Blank Delay:** when there are multiple paths to render, MadMapper shuts down the beam, moves smoothly to turn the beam on before the next path. That's called «blanking». If the laser content looks weird, try to increase this setting. 100% corresponds a delay value we chose based on different laser devices. Some devices might need adjustments. **Laser export mode** allows lower values.



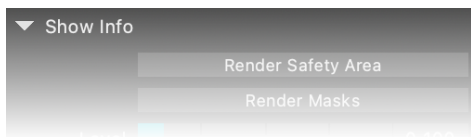
- **Color Levels**, allows software adjustment of red, green and blue intensity levels. Useful when using different projectors or if you want all your surface white adjusted to video projection or lights.



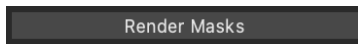
- Laser projectors are using laser diodes. The **Minimum Voltage** that will produce light may vary from diode to diode in the same projector. But if you use a greyscale gradient, you don't want red to appear when it's almost black, that's why it's generally recommended to shut down all diodes under a certain level.



- **Time Shift** : some laser projectors have a delay between XY response and color response, some even have a delay between the RGB diodes response. That's why MadMapper offers the possibility to offset each color channel in time (by ILDA points).



- **Render Safety Area** : if enabled in the **Show Info** category, the safety area rectangle will be drawn to the laser projector.



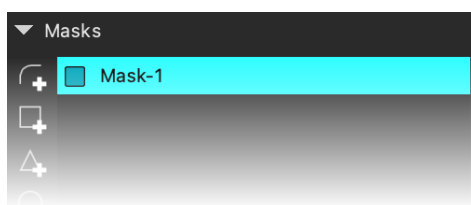
- **Render Masks**: if enabled, the selected mask(s) outline (or all masks if no selection) will be drawn to the laser projector.



- **Level**: light level of the safety area & masks rendering.



- **Color**: color used for rendering safety area & masks.



- **Masks**: you can create masks to protect some regions of the space you're projecting to, to protect people or a camera. MadMapper will prevent the laser beam from reaching those regions (if the mask opacity is at 100%).

You can also use the mask to decrease the lightness (setting mask opacity) of the beam in some regions. This is useful in countries where scanning to the public is allowed under a certain level. Masks area also applied to mouse cursor when rendering cursor is enabled.



- **Invert Mask**: masks can be inverted so they don't define an area to protection, but an area where it's safe to shoot.



- **Opacity**: by default mask opacity is at 100%. If you decrease it to 90%, scanning in the mask will be allowed but luminosity will be decreased by 90%.



- **Publish Internal Loopback**: you can create a laser composition on a projector that has no destination. Enable this option and you'll get a new media in MadMapper Media List / Live Inputs. This media holds the laser paths.

Laser tips

You can for instance **loopback** on a quad in another laser projector and mesh warping the quad.
Useful for mesh warping a laser composition with many surfaces, lines etc. So you don't have to remap all surfaces, you can just do mesh warping of your "composition projector" loopback in your "real projector" (assigned to a laser device).

Dispatch Count 1

- **Dispatch Count:** when internal loopback is published, you can set the **dispatch count**. This is used to dispatch paths from the "composition projector" to multiple medias and display each media on a different laser projector (with one **Laser Quad** on each).

Store Ilda Frame

- **Store Ilda Frame:** records a snapshot of current output points on the projector to an ILDA file in MadMapper workspace / ILDA folder.

Record Ilda Movie

- **Record Ilda Movie:** enabling it will start recording an ILDA movie with the ILDA points generated for this projector.
Disabling it will stop recording and save the ILDA movie file in MadMapper workspace / ILDA folder.

Movie Mode Record as ILDA stream

- **Movie Mode:** ILDA file format misses lots of features (such as playback PPS).
ILDA movies in MadMapper are read as fixed frame rate content but when putting the ILDA file on the SD card of a laser device it might work differently, more as a ILDA point stream, a frame with 500 points might last 1/60 seconds while a frame with 700 points will be longer.
So it has variable frame rate if using video movies language.

Laser tips

MadMapper supports recording as **ILDA** stream to ensure playback on laser hardware.

In general, if you want to record **ILDA** to play it back in MadMapper, choose "**Record at fixed frame rate**", if playing back on a laser device or DAC, choose "**Record as ILDA stream**".

3. Laser Surfaces

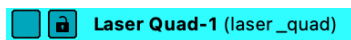


- Laser Surfaces are located next to the video surfaces tab, at the top left of the interface.

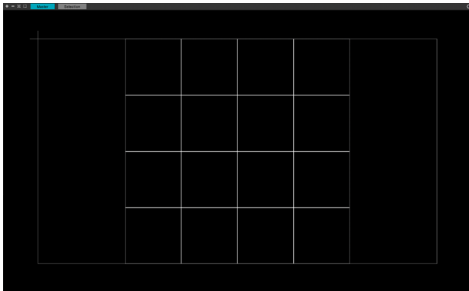
3.1. Laser Quads



- The first Laser surface option is the quad: click on the icon to create a **Laser Surface Quad**.



- As for video mapping, laser surfaces will be listed in the surface list and you can rename them, display or undisplay them, lock them or unlock them at any time.



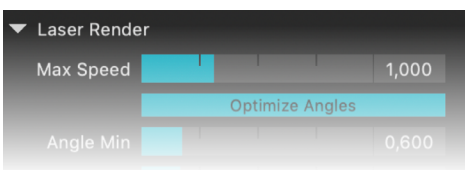
- The Laser Quad created is a rectangular surface that can be transformed in perspective, with mesh warping (like the video quad surface).

Must know:

The Laser Quad will propose different parameters depending on the visual assigned to it.

If the visual offers vectorized content (Laser Material, Ilda Movie file or Laser Projector loopback), you'll get Laser Render settings and some Path Filtering parameters.

If the visual is a movie, an image, a camera or another source that must be vectorized, you'll have a lot of vectorization settings that you'll have to adjust depending on the visual.



- Once your Laser Quad is selected, you'll have access to its surface inspector at the bottom left of the interface.

Laser render, the first parameters, are common to all laser surfaces.



- **Max Speed:** this defines the maximum speed at which MadMapper is supposed to scan paths to render. Imagine your surface contains a huge line and a small circle, MadMapper will try to dispatch the laser scan time (so the light intensity) over all paths. So it will spend more time on the huge line than on the small circle, so they look as bright.

(Max Speed) So if you choose for your Laser Projector to draw the laser paths at 60 FPS, MadMapper will try to spend the projector scan time uniformly accross all paths depending on their length.

But if there is too much to draw, the software won't achieve the "Desired FPS" to avoid hurting the hardware. Also by increasing scan speed, it looses in quality because of the physics of the Laser Projector scanner.

Laser tips

Decreasing "Max Speed" to very low value will reduce a lot the ILDA FPS, which can give nice effects.

Increasing it to maximum value shouldn't damage your hardware.

In "Laser Expert Mode" (an option in Preferences/Laser) you can reach higher "Max Speed". **But be careful, some laser scanners are fragile, scanning fast produces more heat..**

Optimize Angles

- **Optimize Angles:** once activated, MadMapper will add some ILDA points where it finds angle points. If it's not adding point on angles, due to the physics of the laser scanner, they will be smoothed and look curved.

Angle Min 34.377

- **Angle Min:** minimum angle to trigger angle optimization (in degrees, from 0 to 90).

Angle Delay 0,050

- **Angle Delay:** if an angle reaches the minimum value, MadMapper will add a number of ILDA points depending on the angularity and on this parameter.

End Repeat 6

- **End Repeat:** because of the physics of the Laser Projector, MadMapper never really knows the real position of the beam when we send positions. So to be sure the software ends the shapes, it repeats the last position a certain time to ensure the path is completely drawn.

In Fade 1,000

- **In Fade:** when starting scanning a path, the scanner is stopped, due to inertia, so the lightness on start point might be too high. This parameter allow you to avoid this "hot point" on path start.



- **Out Fade:** when ending a path, you might need to add some “End Repeat” points to get a clean rendering. But that might make another “hot spot”. Increasing the out fade will fade down the luminosity in the “End Repeat” points.



- **Point Intensity:** this parameter controls how bright isolated points will be rendered (how many time we’ll spend on each of those points). An isolated point is a path with a length of zero. When dispatching points over the different paths MadMapper have to render (depending on desired FPS, max speed etc.), the software will decide how many points to use on each path depending on their length. But since isolated points have no length, we let you choose how much power to give them.

That’s very handy to be able to render a strong beam on a specific position (many points without moving) and a long path with less power.

Laser tips

All those Laser Render parameters will be used by the Laser Output in MadMapper to generate the ILDA frame to send to the Laser Projector DAC.

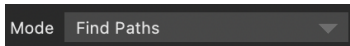


- The next parameters category is **Process**. There are two vectorization techniques: searching for “**contours**” (or edges) in the image, or searching for “**paths**” (colored paths on a black background).

Select first the algorithm using the Process in the Mode list (parameters depends on the selected mode).

Laser tips

MadMapper has optimized algorithms for vectorization in real-time. It offers a lot of possibilities, and the main goal is to allow creating a laser show with After Effects (or another pro video editing software) with a timeline and multiple extensions. We’ll soon write a document on how to generate the content.



- **Find Paths:** it consists of searching pathes on the image. All pixels darker than parameter “threshold” are ignored. All pixels over threshold are the parts you’d like to render with your laser.

Generally you’ll use a picture with bright pixels (you can use color) on a black background. So threshold could be set to zero, but if you use a compressed movie file, compression would increase background luminosity over zero close to your paths.



- **Threshold:** minimum lighting to consider pixels as being part of the background or part of a path to be rendered.



- **Use Color:** if not active, detected paths will be white (can be adjusted by surface modulation color). If activated, paths will use pixels color.



- **Thickness:** if you create a picture from a image editor, it’s easy to make an uncompressed image (ie PNG) with paths drawn without antialiasing, so it’s just one pixel thick.

But if you’re using a video production software, you might not have this option, so MadMapper will reduce the detected pathes to their skeleton.

You have to specify yourself the thickness of thicker path in your content with the “Thickness” parameter. If you have a block of lightened pixels bigger than “thickness”, it won’t be completely reduced, and you’ll end up with contours. Ie a line 5 pixels wide with thickness set to 2 would end up 3 pixels large, the output in this case would be the two sides of the (not completely) reduced line.



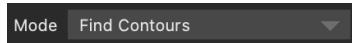
- **Denoizing:** denoizes the resulting paths.



- **Max Res:** maximum dimension of input media. If set to 1024, and if the media width or height is over 1024, media will be downscaled preserving aspect ratio (ie max res 1024, media 4096x1024 => reduced to 1024x256). This allows gaining performances if using a too high resolution movie on a computer that cannot handle it. Of course if you make an image or movie yourself, use the appropriate resolution for your project / computer.

Laser tips

Path detection content best practice: make your lines as thin as possible, without antialiasing if possible, use a black background, don't compress too much, compression artefacts might affect the path detection.



- **Find Countours:** contours detection is the other vectorization process.
The Contours detection uses the Canny edge detector algorithm running on the graphics card.



- **Threshold:** defines how strong the edge must be to be accepted. It must be adjusted depending on the content.



- **Blur Size:** defines the Gaussian blur kernel size.
This denoizes the image and make small parts not detected.



- **Canny Size:** defines the Canny kernel size. Low value will be small variations in the image detected. High value will focus on bigger variations.

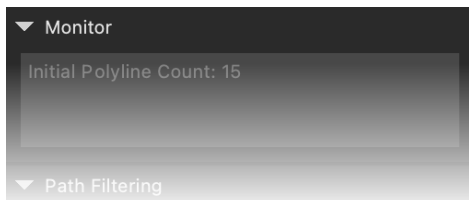


- **Max Res:** same as for “Find Pathes”, it allows downscaling the visual in case computer performances are too low.



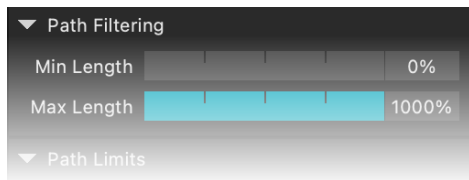
- The next parameters category is **Display**.
It specifies what to show in the preview, used for understanding vectorization process and view how to the media creating / encoding can be improved.

By default MadMapper shows the paths found (mode **Output Polylines**). You can also choose to see the **Source Image**, the **Processed Image** (after reduction / skeletonization) or the **Processed Image + Polylines** (with detected pathes on top).



- **Monitor** shows errors and information about the vectorization process.

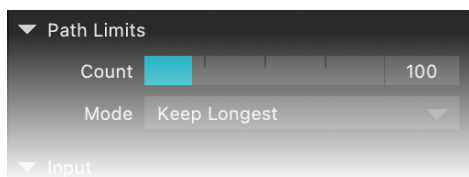
Including media errors, ie. if it detects more than 2.000 pathes, it will give up processing the image to avoid slowing down the engine.



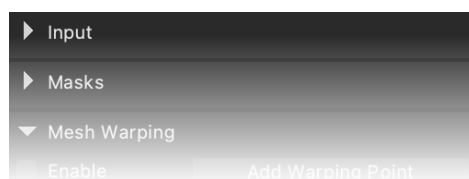
- **Path Filtering** allow you to exclude paths from rendering depending on the length.
Min Length & **Max Length** are set as a pourcentage of input media maximum dimension.
For instance if using an image in 4096x1080 pixels, a value of 10% would mean 10% of 4096 = 410 pixels long.
Any path shorter than «**Min Length**» or longer than «**Max Length**» will be removed and not sent to the laser output.

Laser tips

That make no sense to use this when the input media is a **Vector Material**, but when you're vectorizing a movie, it helps removing cleaning the paths. And when rendering the same content with multiple projectors you can select by size some content to render on a projector or on another. It offers quite a lot of possibilities.



- **Path Limits** is another way to exclude paths. It's mostly useful with vectorized content (image or movie): you might have a few frames of a movie where there is more noise and you don't want to generate a 3 seconds long frame for the laser projector.
You can say, "hey, if there are more than 50 paths there, keep only the 50 longest ones" (or shortest ones for adventurous people).



- **Input, Masks** and **Mesh Warping** are classic MadMapper tools for which you can refer to our Introduction to the MadMapper User Interface, My First Video Mapping, Masking and Mesh Warping guides.

Laser tips

On **Laser Quad**, FX will be applied before vectorization. You can use any Surface 2D FX (like for video surfaces). Color Controls can be useful to help vectorization. Channels Shuffle can be useful to vectorize using a single channel (red, green, blue, alpha) of a movie (ie if you also do video projection you can use the other channels of the same movie for video output, while it's easier to use a movie with two images side by side, you gain a lot of performances by reduced movie size by two).

3.2. Laser Lines



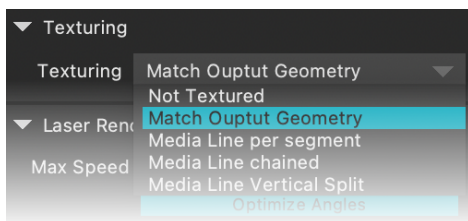
- Click on the second icon to create a **Laser Line**.



- As for **Laser Quads**, Laser Lines will be listed in the surface list and you can rename them, display or undisplay then, lock them or unlock them at any time.

Laser tips

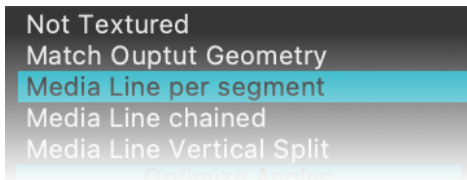
Similarly to the video lines surfaces, you can create **Laser Lines** in different ways: **drawing by hand on the output** (menu Output/Show Laser Cursor will make mouse cursor drawn on the laser projector to draw directly on your environment), **import an SVG file**, **use predefined shapes**, **convert a Laser Text or Laser Quad surface to Laser Lines** (allows adjusting each path point & bezier handles). Paths can then be animated with a visual or FX.



- **Texturing:** specific to Laser Lines, it defines how the visual will be applied to the paths.

Options are:

Match Output Geometry: the input rectangle will be mapped to the line surface bounding rectangle in the output, so a point of the path at the center of the output rectangle will have the color the visual has at the center of the input rectangle.



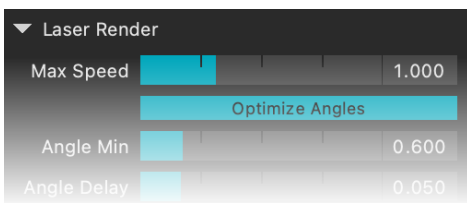
- **Match Line per segment:** the selected visual part will be applied individually to each path (the left part of the media on each path start & right part on path end).

Match Line chained: the selected visual part (input) will be dispatched over all the paths in the surface respecting each path / line length.

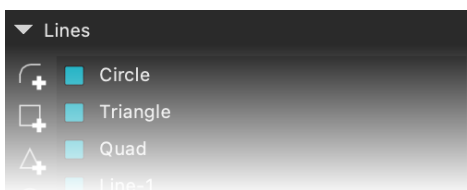
Match Line Vertical Split: same as media line per segment except that the visual will be splitted in a user defined number of horizontal sections (“Split Count”).

Laser tips

Match Line Vertical Split allows advanced animations when using appropriate visual content (for instance some Materials in MadMapper let you choose a number of vertical splits and offset animation in each, ie Line Patterns).



- **Laser Render** settings are the same as for **Laser Quad**, except that there’s no “**Point Intensity**” parameter since here you can set for each path (even isolated points) the minimum time the laser beam should spend there (“Min Points”).



- As for video lines surfaces, you can add / edit or remove line items from the line list view. There are four buttons on the left to create a new path, listed below.



- **Add Laser Path** (same as form menu Project / Add Laser Path - keyboard shortcut Alt+A) : draw a path manually (either point per point - with line segment inbetween - or by freehand draw - with left mouse button down, generating in the end a bezier curve).



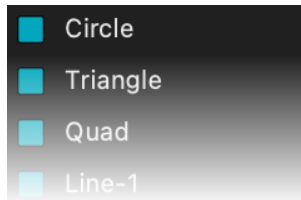
- **Add Laser Path with Quad Shape:** add a rectangle path.



- **Add Laser Path with Triangle Shape:** add a triangular path.



- **Add Laser Path with Circle Shape:** add a circular path.



- Line items can be reordered by drag & drop. They can be copied (Cmd/Ctrl + C), pasted (Cmd/Ctrl + V) and duplicated (Cmd/Ctrl + D).



- **Min Points** is a specific Laser Line setting which defines the minimum number of ILDA points to spend rendering a path. It can be useful to have some paths have more power, in both volumetric & in graphic laser applications.



- The **Revert Path** button will revert the selected path, so texturing will be reverse.

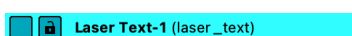
Laser tips

FX for **Laser Lines** surfaces are almost identical to video line FX, except that we don't have feathering and some other things. So they have different types. FX can modify the color and the geometry of the different paths.

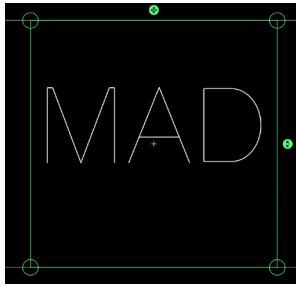
3.3. Laser Text



- Click on the third icon to create a **Laser Text**.



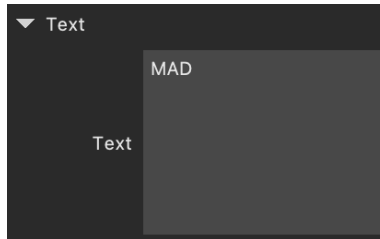
- As for **Laser Quads** and **Laser Lines**, **Laser Text** surfaces will be listed in the surface list and you can rename them, display or undisplay them, lock them or unlock them at any time.



- **Laser Text** surface is quite close to the **Line** surface, but paths will be generated directly from your text parameters.

Texturing & Laser Render are the same as for Lines Surfaces.

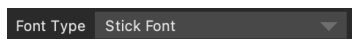
Laser Text uses the same FXs than for **Laser Lines**.



- **Text** is the specific category of parameters here. Type your text in the multi-line text area.



- **Aspect Ratio:** since you can transform your surface in perspective, MadMapper can't deduce its width/height in real life just with the surface rectangle. You need to specify the aspect ratio to avoid stretching the characters.

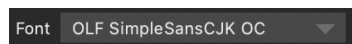


- **Font Type:** you can choose to use a Stick Font or a standard font installed on your system. MadMapper supports stick fonts as TTF files that you can add in your MadMapper workspace folder / Stick Fonts.

MadMapper is bundled with incredible font from <https://www.onlinefonts.com/> with thousands of glyphs to support many languages.

This is pure vector font with only the skeleton of the characters being rendered, which makes laser scanning much faster than when rendering the contours of the characters.

You can also use any font installed on your system by choosing Font Type "System Font".



- **Font:** choose your font.



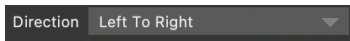
- **Italic:** switch to Italic characters.



- **Horizontal Align:** defines the horizontal alignment of the text (left/right/center).



- **Vertical Align:** defines the vertical alignment of the text (top/bottom/center).

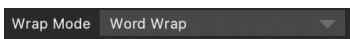


- **Direction:** mostly useful in arabic languages.



- **Adjust Font Size To Fit:** if activated, font size will be adjusted to match the surface bounding rectangle (by preserving aspect ratio), and Font Size & Wrap Mode will not be available.

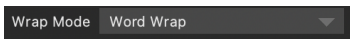
In some projects, you might want to display text in a specific manner, to display a text changing while keeping characters the same size (ie you can send strings to display with OSC to MadMapper).



- **Font Size:** sets the size of the characters.



- **Text Weight:** for system fonts only, defines the thickness of the font.



- **Wrap Mode:** when one line of the text to display is larger than the surface rectangle, you can choose the behavior:
 - No Wrap:** text will exceed surface width and continue outside.
 - Word Wrap:** adds line returns between words.
 - Wrap Anywhere:** adds line returns before the first character that would.

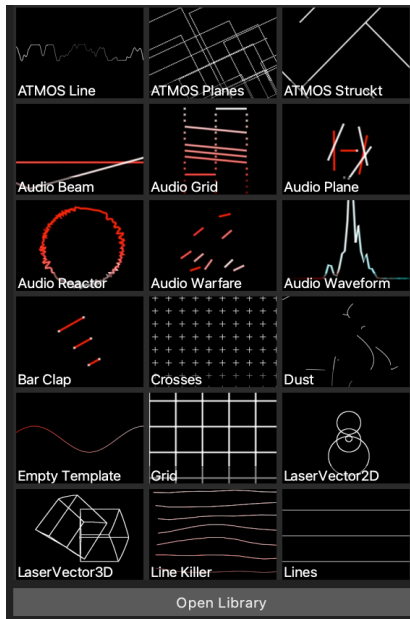
Last surface tip

While **Quad** and **Text** surfaces will generate paths from text or from an image, **Lines** surfaces let you edit the paths precisely. You might start working with a logo image on a Quad with contours detection and you want to adjust something, in this case, just right click your surface, choose “**Create Lines from Surface Content**” and it will create a laser lines surface with the pathes from your image vectorization.



- «**Add a group**», the same way as for video or light mapping. Allows to group surfaces just like in Photoshop.

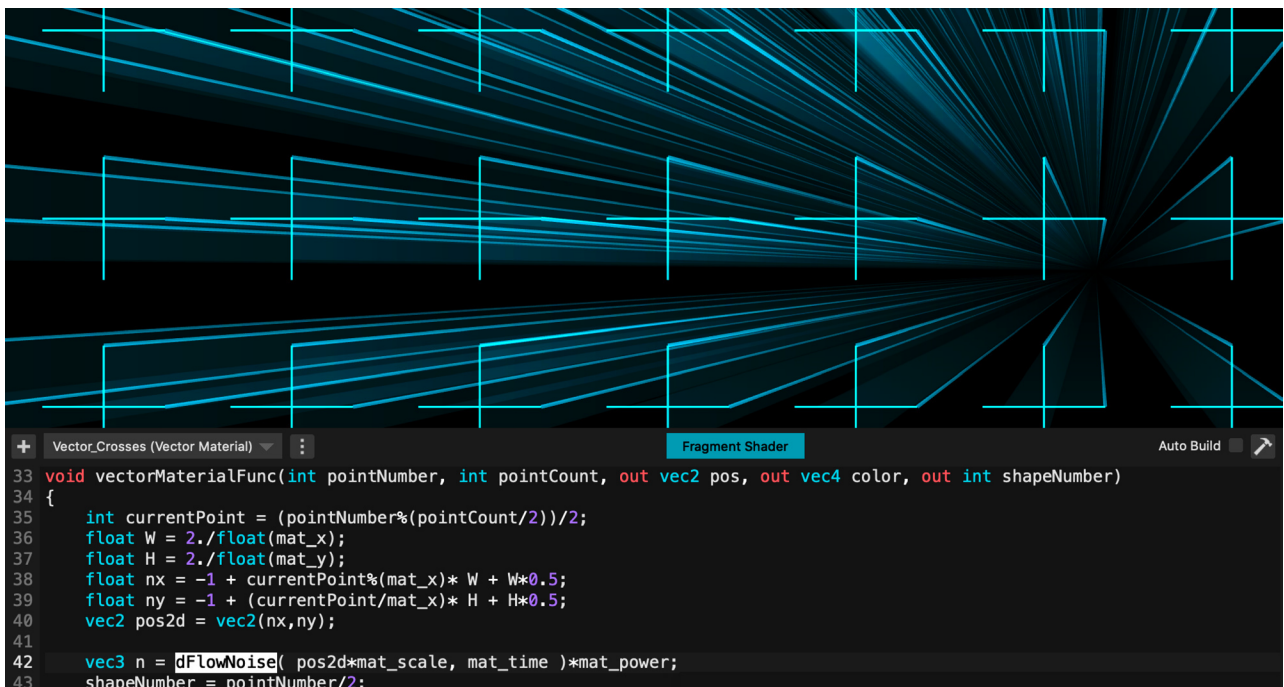
4. Laser Materials



- From the Media Library on the right a new breed of materials are dedicated to MadLaser: the **Laser Materials** which will output true vector graphics.

Templates are already available by default as well as in the online library.

- **Laser materials** still use GLSL language, all in realtime, live from the code editor : at anytime drag and a drop a laser material into the editor to edit the code.



- Also check out our **MadLaser** video tutorials on the [MadMapper Youtube page](#) !