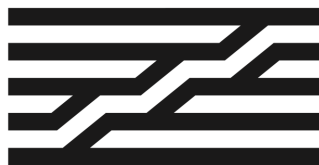


# Spatialisateur

## spat5 release notes

**ircam**  
Centre  
Pompidou



  
**MINISTÈRE  
DE LA CULTURE**  
*Liberté  
Égalité  
Fraternité*



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# 1 Overview

Version 5.x of **Spat~** reached another milestone in software development, providing a flexible program architecture and effective user interfaces.

The key features of **Spat~** version 5.x are :

- a large number of objects can be modulated and scaled (up to 250 inputs/outputs)
- intuitive control interfaces facilitate the configuration of loudspeaker setups and the manipulation of the sound sources
- a better coherence in the architecture and the management of messages
- easy and efficient OSC control; supports pattern matching
- interoperability with existing tools
  - o.dot <https://github.com/CNMAT/CNMAT-odot/releases>
  - IanniX <http://www.iannix.org>
  - Trajectory Library [https://github.com/nadirB/Trajectory\\_Score\\_Library](https://github.com/nadirB/Trajectory_Score_Library)
  - Antescofo <https://forum.ircam.fr/projects/detail/antescofo/>
  - TosCA <https://forum.ircam.fr/projects/detail/tosca/>
  - OSCar <https://forum.ircam.fr/projects/detail/oscar/>
  - etc.
- highly optimised GUIs. Revamped for better user experience and efficient GUI refresh rate
- thread-safe and efficient message dispatch
- fine control and customisation of objects
- various preset mechanisms
- stable and efficient MS Windows implementation
- supports Wave-field synthesis
- many new tools for: Ambisonics, Filter design, Time Code, Quaternions, FX, Geometrical operations, etc.
- huge HRTF database
- includes Panoramix (<https://forum.ircam.fr/projects/detail/panoramix/>) and ADMix tools (<https://forum.ircam.fr/projects/detail/admix/>)
- highly optimised DSP
- rich documentation

## 2 System Requirements

### 2.1 Platform

**Spat~** 5.x is compatible with:

- macOS **10.11** or higher, with Intel or Apple Silicon processor.
- MS Windows 10 or higher
- Max/MSP 8.x or higher

Minimum configuration	Recommended configuration
Cycling'74 Max/MSP 8.x	Cycling'74 Max/MSP 8.1.8
Mac Intel machine running macOS 10.11	Mac Intel machine running macOS 10.15

### 2.2 Spat~ and AVX Extensions

Ircam Spat5 requires "relatively new" (CPU) hardware. More specifically, it requires CPU with AVX 1.0 extensions.

Typically such hardware extension is available on all mac/PC computers released after 2010.

If your hardware is older than that, spat5 objects might not work, typically resulting in a software crash anytime you try to load an object in Max. In case of a doubt, you can check if your hardware supports AVX 1.0.

On Windows, download and install the Intel Processor Diagnostic Tool (<https://downloadcenter.intel.com/download/19792/Intel-Processor-Diagnostic-Tool>) to run a diagnostic for your hardware. In the "CPU Features" tab, check if your processor has "AVX Support" (see Figure 1).

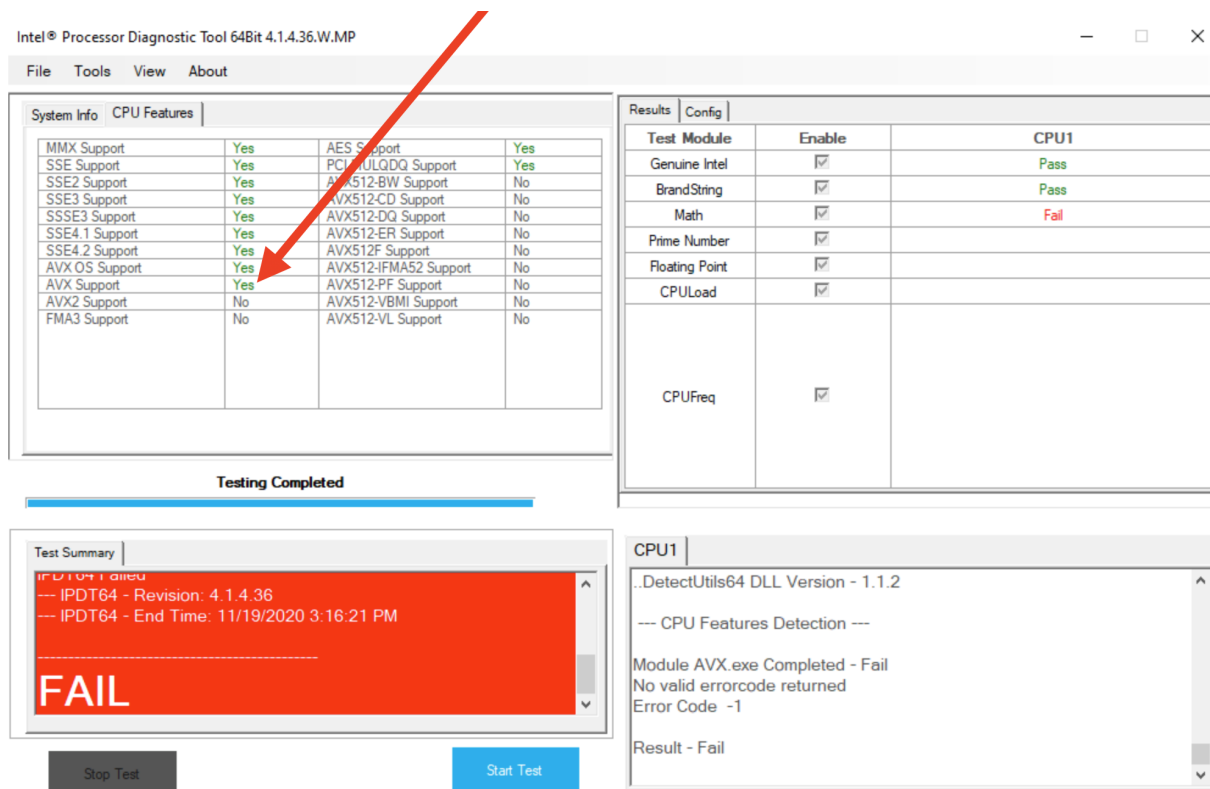


Figure 1: Checking AVX compatibility in the Intel Processor Diagnostic Tool for Windows

## 2.3 Spat~ 3, 4 and 5

**Spat~** 5.x will run without problems if you have **Spat~** 4.x or **Spat~** 3.x already installed on your computer. **Spat~** 5.x, **Spat~** 4.x and **Spat~** 3.x can live together in your Max/MSP<sup>®</sup> search path without conflicts.

## 2.4 Microsoft Windows Requirements

**Spat~** Windows version requires the "Visual C++ Redistributable Packages for Visual Studio 2019". You can (freely) download it from Microsoft website: <https://www.visualstudio.com/downloads/>. Select "Microsoft Visual C++ 2019 Redistributable" and "x64" and follow the instructions for installation. Restart Max after installation.

## 3 Installation

### 3.1 Standard installation, using Max/MSP Packages

If you are using Max/MSP® 6.1.4 or higher, you can install **Spat~** in the "Packages" folder.

For details, check <http://cycling74.com/2013/03/11/max-6-feature-packages/>

To do so:

- mount the **Spat~** disk image (i.e. double-click on the **Spat~** .dmg file) or unzip the **Spat~** .zip file.
- drag and drop the "spat5" folder into your Max Package folder. The Max Package folder is typically located in  
"~/Documents/Max 8/Packages" or  
"~/Documents/Max 7/Packages" or  
"/Applications/Max 6.1/packages", depending on which version of Max you are using.

Note the the ~ symbol represents your home folder, so typically :

"/Users/[username]/Documents/Max 8/Packages/spat5" for Max 8 on macOS

"C:\Users\[username]\Documents\Max 8\Packages\spat5" for Max 8 on Windows

In case you use both Max 7 and Max 8, you might want to copy the "spat5" folder in each of the Max Package folders.

- launch Max/MSP®, go to the "Extras" Menu and choose "spat5 overview" in the list
- this opens the "spat5 Overview" patcher which allows to navigate in the **Spat~** help patches and tutorials

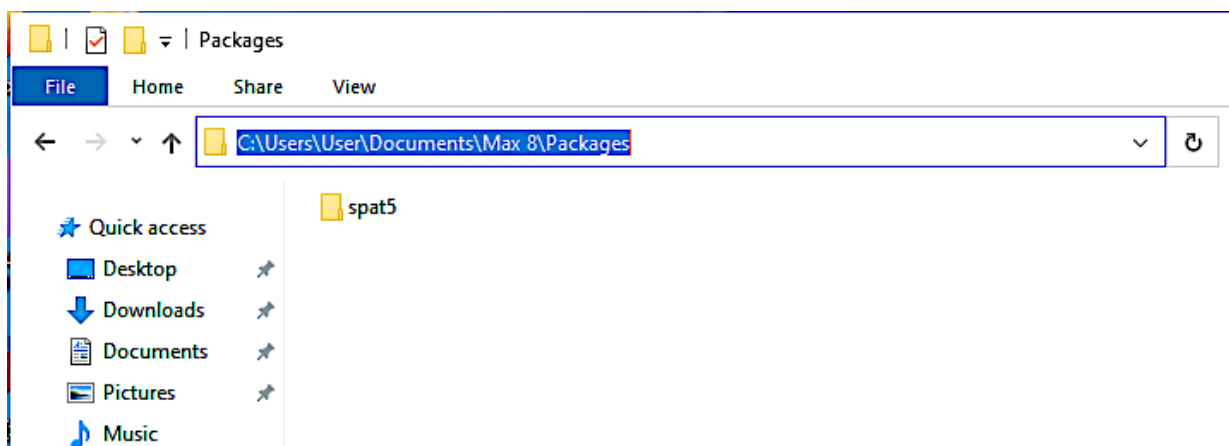


Figure 2: spat 5 installed in Max 8 Packages folder on Windows

### 3.2 Manual installation

If you prefer a manual installation:

- mount the **Spat~** disk image (i.e. double-click on the **Spat~** .dmg file).
- copy the whole "spat5" folder of the disk image where you want
- launch Max/MSP®, go to "Options", "File Preferences..." and add your "spat5" folder to the search path. Make sure the "Subfolders" box is ticked.

### 3.3 Troubleshooting for Windows

A frequent issue is to have an “Error 126 loading external”. This error message appears in the Max Console when creating a spat5 object (or when opening a patcher that contains spat 5 externals). In that case, the spat5 external objects appear in red color in the patcher window and they are unusable. Typically, this issue arises when the spat5 files have not been properly copied into your “Max Packages” folder. spat5 requires a number of DLL libraries; these DLL files must be in the

"C:\Users\[username]\Documents\Max 8\Packages\spat5\support"  
folder so that Max can load them (and subsequently load the spat5 externals).

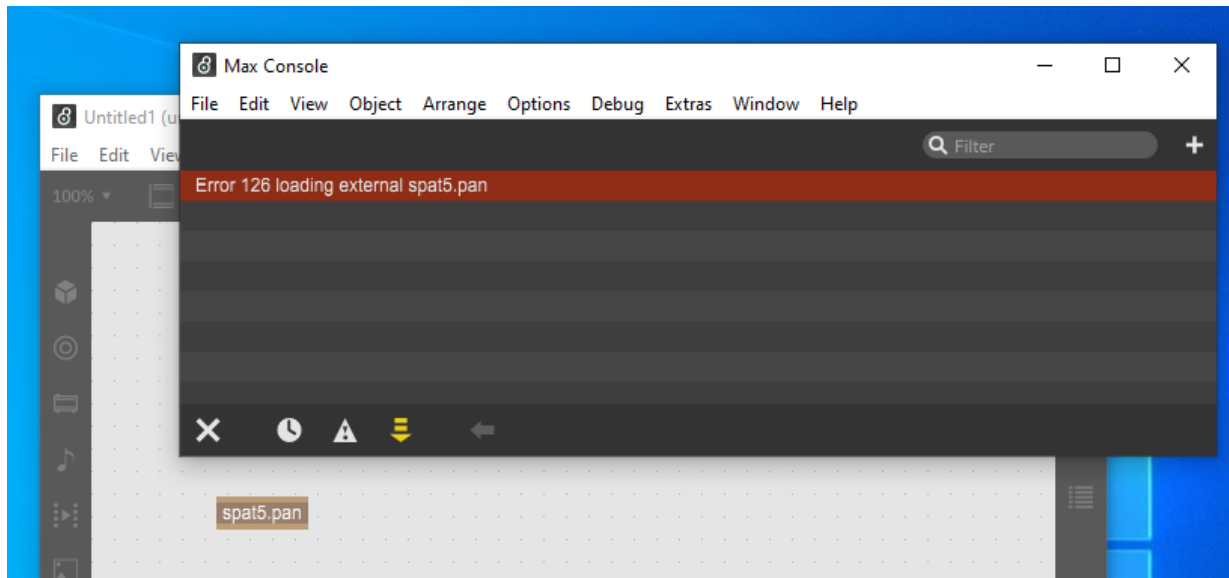


Figure 3: Frequent issue for Windows users

### 3.4 Quarantine on macOS 10.15+

If you are using macOS 10.15 Catalina (or higher), it is possible that the downloaded "spat5" files have been "quarantined" by the OS. As the result, the spat5 external objects wouldn't load in Max.

To avoid this issue, you need to remove the quarantine. To do so, you need to open the Terminal application, and execute the following command :

```
xattr -d -r com.apple.quarantine [path/to/extern/directory]
```

Examples :

```
xattr -d -r com.apple.quarantine "~/Documents/Max 8/Packages/spat5"
```

```
xattr -d -r com.apple.quarantine "~/Documents/Max 7/Packages/spat5"
```

Further information is available here :

<https://cycling74.com/articles/using-unsigned-max-externals-on-mac-os-10-15-catalina>

Once you have removed the quarantine, you can start Max, and spat5 external objects should work properly.

## 4 **Spat~** Package content

The **Spat~** folder contains the following subfolders:

- docs/ : documentation, release notes and reference documentation used in help patches
- examples/ : a brief tutorial to highlight the functionalities of **Spat~** for first-time users (and others)
- externals/ : external objects (for macOS or Windows)
- extras/ : the **Spat~** overview patchers
- help/ : help patchers
- javascript/ : some javascript extensions
- media/ : filters database (hrtf used for binaural and transaural applications), presets and other resource files
- patchers/ : patchers for macOS and Windows. Most of them are designed to be used as bpatchers
- support/ : additional DLL dependencies required for Windows



## 5 Bug reporting guidelines

Please report any problems you experience with clear and complete information, including steps to reproduce, software and system information, and where possible, an isolated example patch and crash log. Crash logs are located in the following folder :

"~/Library/Logs/DiagnosticReports" for macOS

"C:\Users\[username]\AppData\Roaming\Cycling '74\Logs" for Windows

With all bug/crash reports please provide your support information dictionary (Max menu->About Max->Copy support information to clipboard), a clear example patch with steps to reproduce, and crash logs where relevant.

Below is a template you can use for reporting bugs. With clear and complete information, it is more likely we will be able to reproduce and fix a problem quickly.

- Summary: Provide a descriptive summary of the issue.
- Steps to Reproduce: In numbered format, detail the exact steps taken to produce the bug.
- Expected Results: Describe what you expected to happen when you executed the steps above.
- Actual Results: Please explain what actually occurred when steps above are executed.
- Regression: Describe circumstances where the problem occurs or does not occur, such as software versions and/or hardware configurations.
- Notes: Provide additional information, such as references to related problems, workarounds and relevant attachments.

## 6 Changelog

=====

Release Version : 5.2.6  
Release Date : 11/2021

- \* spat5.sfplay~ : added "/dump/axml" message
- \* updated to Juce v 6.1.2
- \* updated IPP and MKL to v 2021.4.0
- \* panoramix : new options on AB bus to configure the mic pair
- \* spat5.viewer, spat5.oper : bang message delivers the speaker directions
- \* spat5.pan~, spat5.spat~ : default panning type is now vbap, instead of angular
- \* spat5.pan~, spat5.spat~ : added abap2d and abip2d (angle-based panning)
- \* spat5.wfs, spat5.wfs~ : major refactoring (again!)
- \* spat5.wfs.grid, spat5.wfs.config : deprecated, no longer needed
- \* spat5.wfs, spat5.wfs~ : slight improvements in the gain scaling law
- \* spat5.ebur128~ : cpu optimization; internal refactoring; delivers some new criteria
- \* spat5.ebur128~ : now works with arbitrary speaker layouts
- \* added abstraction spat5.mc.r128~
- \* spat5.hoa.beam~ : removed 64 beams limit

=====

Release Version : 5.2.5  
Release Date : 08/2021

- \* compatible with arm64 (Apple Silicon) (requires Max 8.2+)
- \* spat5.grids : fix missing "upper-\*" grids
- \* all objects : fix possible hang with coordinate conversion/modulo
- \* spat5.fir~ : added "/implementation" message
- \* spat5.hoa.compensation~ : fixed various bugs and improved calculation time  
(this also impacts "decoder compensation" in HOA decoders and HOA Bus on Panoramix)
- \* spat5.pan~ : minor improvements to phantom speakers
- \* spat5.speaker.layout : added "iem-cube"
- \* spat5.colormap : added 50 new maps
- \* spat5.panner.metrics : added new metrics
- \* spat5.hoa.scope~ : added "/resolution" message
- \* spat5.panoramix~ : fix potential lock issue (vu-meter thread)
- \* spat5.rms~, spat5.snapshot~, spat5.ebur128~, spat5.meter~, spat5.compressor~, spat5.noisegate~ : fix possible threading issue

=====

Release Version : 5.2.4  
Release Date : 07/2021

- \* now requires Max 8, and macOS >= 10.11
- \* spat5.hoa.focus : added "/background/color" message
- \* spat5.hoa.focus : added "/zoom/lock" message
- \* spat5.hoa.focus : zoom is now expressed in percent
- \* spat5.osc.unique : added "mode" attribute
- \* spat5.oper\_ : fix minor issues with "/drop" and "/drop/mode" messages
- \* spat5.oper\_ : improved initialization
- \* spat5.wfs, spat5.wfs~ : properly search files in search path
- \* spat5.viewer : improved orientation manipulations
- \* spat5.viewer : added "/direction" message to specify direction axis
- \* spat5.wfs~ : added "/prefilter" message
- \* spat5.eq : fix initialization issues with @initwith or @embed attributes
- \* added spat5.fir~
- \* spat5.panoramix~ : added pre-filter on WFS bus
- \* spat5.panoramix : fix bugs with groups when recalling presets
- \* spat5.conv~ : major cpu optimizations
- \* spat5.conv~ : defer load of IR in background thread to avoid audio clicks
- \* spat5.hostinfos : added "/system/sleep", "/system/logout"
- \* improved documentation and ref-pages for several objects
- \* spat5.viewer : added "/area/[index]/trigger" message
- \* added "spat5.tuto-viewer-7.maxpat" demonstrating area triggers
- \* all GUI objects : added dump notification for "/preset/loading" (immediately before loading preset)
- \* added spat5.rake~ on Windows
- \* spat5.wfs.config : major refactoring

- \* spat5.grids : added Poisson disc sampling (2D and 3D)
- \* added spat5.evert.fdn~ on Windows
- \* spat5.hoa.directivity, spat5.hoa.beam~ : supercardioid pattern can now be computed for arbitrary order
- \* spat5.hoa.directivity, spat5.hoa.beam~ : added dolph-chebyshev pattern
- \* spat5.grids : added "/format" message

=====

Release Version : 5.2.3  
Release Date : 05/2021

- \* all objects : major optimization in snapshot interpolation
- \* spat5.grids : fix tiny issues with healpix, lebedev and fliege grids
- \* updated lib matio
- \* audiofileconcat : added option to sort files (alphabetical or natural sort)
- \* spat5.delgen : fix possible bugs with /minsum message
- \* spat5.panoramix~ : fix bug with "/convention" not properly rendered on HoaStream and B-format tracks
- \* spat5.panoramix : fix display bug for hoa order on HoaStream tracks
- \* spat5.oper : fix possible bugs with the "distance" slider (when distance is smaller than radius)
- \* all objects : optimized aed to xyz conversion
- \* spat5.mirror, spat5.transform : fix /mirror/x and /mirror/y that were inverted
- \* spat5.panoramix : fix possible crash when deleting 'Multi' tracks (and reloading session)
- \* spat5.panoramix~ : fix bug with Direct-to-Master track, when the input signal is discontinued
- \* spat5.evert : added quaternion orientation messages for sources and listener
- \* all GUI objects : added "/window/export/image [file]" message
- \* spat5.panner.metrics : added "/speakers/label/visible" message
- \* spat5.evert~ : improved "/info" message
- \* spat5.spat~ : fix critical bug with early reflections for stereo sources
- \* spat5.spat~ : fix critical bug with panrev for stereo sources
- \* spat5.panoramix~ : fix bug with reverb on transaural bus
- \* spat5.spat~ : fix major bug with binaural iacc
- \* spat5.panoramix : fix copy/paste settings for linux
- \* spat5.panoramix : fix minor display issue with track d2b
- \* spat5.panoramix~ : fix possible bugs with bus thru
- \* spat5.panoramix~ : direct to master track contributes to LFE only if output routing is made
- \* spat5.filterdesign : added new filter topologies (more accurate at high frequencies)
- \* spat5.panoramix : added hoa focus component on eigenmike and zylia tracks
- \* spat5.pan~ : added missing parameters in the status window, when using diffuse panning
- \* spat5.evert~ : added messages to mute direct sound
- \* spat5.evert : added "/hoa/order" message to set HOA order for simulation of source directivity
- \* spat5.panoramix~ : save cpu when early reflections are muted
- \* spat5.panoramix : fix (benign) bug when creating a wfs bus
- \* spat5.speaker.layout : added new layouts
- \* spat5.wfs~, spat5.panoramix~ : fix various bugs with xdelay mode
- \* spat5.wfs~, spat5.panoramix~ : minor cpu improvements
- \* spat5.panoramix~ : added parallel mode (multi-threading) for tracks
- \* added spat5.weightingfilter
- \* added spat5.boids
- \* spat5.colormap : added "/random" and "/distinct" messages

=====

Release Version : 5.2.2  
Release Date : 03/2021

- \* spat5.panoramix : fix bugs with bus divergence
- \* spat5.sofa.loader, spat5.sofa.infos, etc. : updated according to AES69-2020 SOFA 2.0 standard
- \* spat5.panoramix : added missing notification for "/lfe/cutoff/bypass"
- \* spat5.compressor, spat5.panoramix : new link mode (multi-mono / link all / link to 1st)
- \* spat5.panoramix : improved groups processing
- \* spat5.panoramix : fix bug with "trim" not in groups
- \* spat5.panoramix : added automatic groups for all tracks sent to a given bus
- \* spat5.hoa.beam~ : fix various bugs with gain normalization
- \* added spat5.quat.frommatrix
- \* added spat5.hoa.directivity
- \* spat5.panoramix : group "all" is renamed "all tracks" for consistency
- \* spat5.hoa.focus, spat5.hoa.beam : minor optimizations
- \* spat5.oper : fix bug with aperture, at low frequencies, for some yaw values (bug since 2007!)

- \* spat5.evert~ : added @bands attribute; added anti-phase filter in FDN;
- \* spat5.panoramix~ : fix possible crash with wfs (with 3D speaker layouts)
- \* spat5.binaural~ : fix possible crashes in Ableton Live
- \* spat5.panoramix : added "no decoding" option for HOA bus
- \* spat5.panoramix~ : various optimizations (DSP and control)
- \* spat5.panoramix : tiny optimization in distance attenuation calculation
- \* spat5.wfs~ : added (expert users) options for online calculation of gains/delays
- \* spat5.graphiceq : minimized ripples in the band edges
- \* spat5.panoramix : fix missing messages for d2m/[index]/delay/bypass and d2b/[index]/delay/bypass
- \* spat5.spat~ : fix loading of HRTF for stereo input sources
- \* added spat5.graphiceq2, spat5.graphiceq3
- \* spat5.panoramix : avoid unnecessary notifications for /group messages
- \* spat5.wfs.config : fix bug with linear array
- \* updated Spat5-Benchmark.pdf
- \* all objects : fix possible issues with NaN values
- \* spat5.panoramix~ : fix bug with stereo AB bus
- \* spat5.panoramix : fix bug with group edition
- \* spat5.panoramix : fix bug with reverb send offset for Multi tracks
- \* spat5.panoramix~ : fix possible crash with HoaStream tracks
- \* updated spat5.panoramix2tosca for new panoramix syntax
- \* spat5.panoramix : fix bug with "/bformat/[index]/sorting" message
- \* spat5.panoramix : added reverb mute button on HoaStream, AFormat, and Bformat tracks
- \* spat5.panoramix : fix gain scaling
- \* spat5.panoramix : added delay bypass button on several tracks
- \* all objects : added message "/post/version details"
- \* all DSP objects : fix critical bug with filter's crossfade
- \* SOFA : updated netcdf libraries
- \* JUCE : updated to 6.0.7
- \* spat5.delay~ : added "/freeze" message
- \* spat5.oper\_ : added missing "/source/[index]/pitch" message
- \* spat5.oper, spat5.spat~ : added "/panrev" messages for late reverb

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Release Version : 5.2.1  
Release Date : 12/2020

- \* spat5.panoramix~ : minor CPU optimization (RMS metering)
- \* spat5.panoramix : optimize GUI painting for macOS >= 10.14
- \* spat5.spat~ : minor CPU optimization (cluster processing)
- \* updated Spat5-Benchmark.pdf
- \* spat5.osc.prepend, spat5.osc.append : fix crash when pattern contains '#' character
- \* spat5.panoramix~ : added transaural bus
- \* spat5.shuffle~, spat5.reverb~ : fix bugs with Householder matrix
- \* spat5.hoa.plot : added messages "/display/yaw", "/display/pitch", "/display/ypr", etc.
- \* spat5.hoa.slaconv~ : added "/info" message
- \* spat5.hoa.slaconv~ : improved help patcher
- \* spat5.hoa.slaconv~ : added warning messages if filter order mismatch
- \* all objects : warning message for OSC messages ending with '/' character
- \* spat5.panoramix : fix various issues with floating windows
- \* spat5.pan~ : divergence can operate even when spread is 0
- \* spat5.panoramix : added message "/bus/[index]/speakers/editor/window/open"
- \* spat5.panoramix : added message "/bus/[index]/speakers/editor/window/title"
- \* all GUI objects : minor look-and-feel changed for toggle buttons
- \* spat5.wfs, spat5.wfs~ : can now compute coefficients on the fly
- \* spat5.wfs, spat5.wfs~ : added gain scaling factor
- \* spat5.panoramix : added gain scaling factor for WFS bus
- \* spat5.room~ : extended to multiple sources (minor compatibility break)
- \* spat5.viewer, spat5.oper : fix issues when the source distance was set to 0
- \* all GUI objects : added dump notification for "/preset/loaded" and "/preset/saved"
- \* spat5.panoramix : fix minor issue with "/options/vumeters/visible" message
- \* macOS 10.9 is now the minimum deployment platform
- \* spat5.panoramix : added messages "/options/dock/viewer/window/title", "/options/dock/equalizer/window/title"
- \* spat5.panoramix : added "/direct/gain/offset", "/early/gain/offset" and "/reverb/gain/offset"
- \* spat5.ltc.trigger~ : changed behavior of 2nd outlet (delivers more useful messages)(minor compatibility break)
- \* updated qhull library
- \* updated IPP and MKL libraries
- \* spat5.calibrate.gain~ : added "/stop" message

- \* spat5.pan~, spat5.spat~, spat5.panoramix~, etc : more warning/error detections for loudspeaker setup
- \* spat5.spat~ : fix some spurious error messages (hoa)
- \* spat5.panoramix : added "/lfe/cutoff/bypass" message
- \* spat5.grids : added new spherical grids
- \* added spat5.granulator~
- \* spat5.hostinfos : added base64, base32 and base16 encoding/decoding
- \* spat5.viewer : added message "/source/[index]/proportion/add [float]" to increase/decrease proportion

Release Version : 5.2.0

Release Date : 11/2020

- \* spat5.delay~ : added "thiran2" and "thiran3" interpolation modes
- \* spat5.filterdesign : improved documentation
- \* spat5.grids : added many aliases
- \* spat5.routing : improved "/row/\*/color" messages
- \* spat5.turntable : fix bug where the socket connection would always failed
- \* added spat5.screencapture
- \* spat5.calibrate.delay~ : fix possible crash
- \* spat5.conv~ : major CPU improvement on Windows
- \* spat5.folder.infos : fix "/findfolders" message not working
- \* spat5.file.infos : fix spurious error messages with directories
- \* OSC : improved support for UTF8 strings
- \* spat5.smk~ : added "/options/saverawtxt", "/options/saveaxml", "/options/savelog" messages
- \* spat5.smk~ : overwritten files are now deleted (rather than moved to trashbin) for efficiency
- \* spat5.calibrate.gain~ : fix possible crash
- \* spat5.pan~, spat5.panoramix~, spat5.spat~ : fix possible crash when using invalid loudspeaker setups for LBAP
- \* spat5.hoa.binaural~ : fix bug with "/norm" message
- \* spat5.hoa.binaural~ : added new "/mode" message. changed default mode to "t-design"
- \* spat5.panoramix~ : fix critical bug where speaker gains/delays were not applied to reverb bus
- \* spat5.panoramix : added divergence on vbap/vbip busses
- \* added spat5.hoa.slaconv~
- \* spat5.panoramix~, spat5.pan~, etc. : fix potential issues with zenith/nadir phantom speakers
- \* spat5.panoramix : added delay on LFE bus
- \* spat5.hoa.decoder~ : fix possible crashes with CSAD
- \* spat5.hoa.decoder~ : fix possible crashes with phantom speakers
- \* spat5.hoa.decoder~ : added safety guards to avoid decoder blow-up
- \* spat5.hoa.decoder~ : fix bugs with regularized-mode-matching
- \* spat5.sfplay~ : fix scheduling bug with [int] and "/start" message
- \* spat5.panoramix : fix "/neighbors/exponent" not working
- \* reduced size of the distribution package for Windows
- \* spat5.ltc.encode~ : added "/forward" and "/backward" messages
- \* all objects : fix possible crashes in Ableton Live
- \* spat5.panoramix~ : cpu optimization for HOA busses
- \* spat5.panoramix~ : minor cpu optimization for compressors (when channels are linked)
- \* spat5.oper\_ : added "/reverb/[index]/roomsize" message
- \* spat5.oper : improved documentation
- \* spat5.trajectories : fix issue with "/rate" message
- \* spat5.panoramix : speed up preset loading time
- \* spat5.panoramix : added "/options/parallel/bus" message for multi-threading (use at your own risks).

Release Version : 5.1.9

Release Date : 09/2020

- \* spat5.speaker.layout : updated Geneva CME layout
- \* spat5.speaker.layout : added "immersive audio lab haw hamburg"
- \* spat5.speaker.layout : minor update to zkm kubus layout
- \* spat5.sfplay~ : added "/dump/metadata" message
- \* spat5.sfplay~ : added "/seek/marker/bylabel" message
- \* spat5.sfplay~ : added "/seek/marker/byid" message
- \* spat5.sfplay~ : now reads CUE chunk of WAV files for markers
- \* Panoramix-Ircam.maxpat : added predefined speaker layouts
- \* spat5.panoramix : improved various warning messages
- \* spat5.simone : fix minor issues in help patcher
- \* spat5.viewer, spat5.simone, etc : fix GUI issues on Windows
- \* spat5.viewer : fix possible crash with /area messages

- \* added missing offline /media/tools for Windows
- \* spat5.panoramix : added option to dock/undock the EQ/compressor window
- \* spat5.hoa.em32~ : added "/export/filters" and "/export/matrix" messages
- \* added "spat5.hoa.decoder~" command line tool in /media/tools
- \* minor improvements to all command line tools

Release Version : 5.1.8  
Release Date : 08/2020

- \* spat5.panoramix : fix minor display bug in HOA bus
- \* spat5.panoramix : added "Hoa Stream" tracks (as input)
- \* spat5.panoramix : added focus FX on A-format and B-format tracks
- \* panning : added "/spread/mode [azim/elev/x/y/z]" for single direction spreading
- \* spat5.ir.infos : added "/buffer" message
- \* spat5.ir.analysis : added "/buffer" message
- \* spat5.hoa.decoder~ : added "/export/coll" message
- \* spat5.hoa.decoder~ : added "/export/iemplugins" message
- \* updated Spat5-Benchmark.pdf

Release Version : 5.1.7  
Release Date : 06/2020

- \* spat5.sfplay~ : can now read BWF metadata (delivered through the dump outlet)
- \* spat5.hoa.em32~ : added "/fftsize" message
- \* updated to juce 5.4.7
- \* minimum macOS version is now 10.8
- \* added spat5.wav.insertaxml
- \* added spat5.wav.extractaxml
- \* added spat5.wav.generateaxml
- \* spat5.pan~ : added "/format" message
- \* spat5.decoder~ : added "/format" message
- \* spat5.hoa.decoder~ : added new warning messages
- \* spat5.hoa.decoder~ : added orthonormality error estimation, in the "/info" message
- \* added spat5.sf.trim
- \* spat5.hostinfos : added "/timezone" message
- \* spat5.sfrecored~ : added "/insertaxml" message
- \* spat5.colormap, spat5.hoa.scope~ : added new colormaps
- \* spat5.transform : now preserves list of speaker coordinates given by "/speakers" messages
- \* removed spat5.hoa.metrics and spat5.vbap.metrics. They are replaced and superseded by spat5.panner.metrics
- \* spat5.hoa.decoder~ : added constant spread ambisonic decoder (CSAD)
- \* spat5.grids : added new grids chebyshev-tdesign and gauss-tdesign
- \* added spat5.hoa.intensity~
- \* spat5.speaker.layout : now also supports all the types known in spat5.grids
- \* spat5.speaker.layout : added "/format" message
- \* spat5.calibrate.delay~ : added "/stop" message. Minor improvements.
- \* added spat5.fact2crit
- \* added spat5.complementarybank~
- \* VBAP : added "/phantom/auto" message : try to automatically add a phantom speaker in the appropriate direction
- \* added spat5.hoa.downscale~
- \* spat5.rms~ : added "/rounding" message
- \* spat5.hoa.beam~ : fix possible issues with normalization; added new beampatterns
- \* spat5.conv~ : added "/channel/[index]/fir" message
- \* spat5.hoa.decoder~ : when the speaker setup is 2D, the decoder now automatically downscales the HOA stream to 2D.
- \* all panning/decoding objects : more and more sanity checks on loudspeaker setup
- \* spat5.abs2rel : aperture messages are now bypassed
- \* spat5.hoa.decoder~ : added regularized-MMAD decoding (RMMAD)
- \* spat5.pan~ : added "csp" panning type
- \* spat5.hoa.decoder~ : now compatible with stereo speaker setups
- \* spat5.panoramix : changed minimum distance to 0.1m

Release Version : 5.1.6  
Release Date : 03/2020

- \* spat5.osc.udpreceive : added @quiet attribute
- \* spat5.viewer, spat5.oper : added "/speakers/visible [list]" and "/sources/visible [list]" messages
- \* spat5.ircamverb~ : added "/early/interpolation/mode", "/early/interpolation/time",  
"/cluster/interpolation/mode", "/cluster/interpolation/time", "/reverb/interpolation/mode", "/reverb/interpolation/time"
- \* spat5.osc.record~ : fix bug with time stamps
- \* spat5.reverb.timeview : added "/early/gains" and "/cluster/gains" messages
- \* spat5.roomsize : fix output messages when "/roomoffset" is changed
- \* spat5.delgen : added missing FullPacket method
- \* spat5.converb~ : added "/clear" message
- \* spat5.osc.play~ : fix issue where messages were improperly delivered in the audio thread
- \* spat5.spat~ : fix bug with stereo sources when early, cluster and reverb are muted
- \* spat5.spat~, spat5.pan~ : fix possible clicks with AB panning
- \* spat5.osc.view, spat5.osc.display : added "visible" attribute
- \* spat5.panoramix~ : fix bug with LBAP bus
- \* spat5.panoramix~ : fix various bugs with 'Multi' tracks
- \* spat5.osc.play~ : added new outlet; added "/report" and "/coalesce" message
- \* updated Spat5-Benchmark.pdf
- \* spat5.conv~ : added non-realtime processing mode ("/operating/mode" message)
- \* spat5.evert~ : added FDN
- \* spat5.viewer : added "/ruler/unit" message
- \* spat5.osc.var : added "dump" message
- \* added spat5.tuto-viewer-6
- \* added spat5.hoa.encoder command line tool
- \* spat5.meter~ : mouse drag on fader is now relative not absolute
- \* added spat5.jitter : deviate and randomize coordinate messages
- \* added spat5.jittering abstraction
- \* spat5.scale : added "/scaling/xy" and "/scaling/xyz" messages
- \* spat5.translate : added "/offset/xy" and "/offset/xyz" messages
- \* spat5.transform : added "/scaling/xy" and "/scaling/xyz" messages
- \* spat5.transform : added "/offset/xy" and "/offset/xyz" messages
- \* added spat5.colormap
- \* added spat5.trajectories
- \* spat5.viewer : added "/source/[index]/image [string]" message
- \* spat5.viewer : added "/speaker/[index]/image [string]" message
- \* spat5.roomsize, spat5.oper : fix issues with "/roomoffset"
- \* spat5.evert~ : added "/fdn/roomoffset" message
- \* spat5.panoramix : now possible to rename busses
- \* spat5.osc.interpolate : added "filterout" attribute
- \* all objects : added many "/snapshot" messages; added snapshot interpolation, import, export
- \* all objects : added many "/status/copytoclipboard" messages
- \* added spat5.snapshot.management.maxpat
- \* added spat5.common.messages.maxpat
- \* added spat5.mc.hoa.live.gain7~.maxpat
- \* all spat5.\*.embedded : added the missing "/pattr/store" message
- \* added spat5.octavebank~
- \* spat5.routing : improved help patcher, and error messages

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Release Version : 5.1.5  
Release Date : 11/2019

- \* spat5.osc.route, spat5.osc.routepass, spat5.osc.prepend, spat5.osc.append :  
improved abstraction support with #1 - #9
- \* spat5.panoramix : added "/track/[index]/equalizer/reset" message
- \* spat5.sfplay~ : added misc options
- \* spat5.filterdesign : minor improvement
- \* spat5.pan : minor optimization (output only the messages for the necessary source(s))
- \* added "spat5.known.colors.maxpat" abstraction
- \* added "spat5.compressor.settings.maxpat" abstraction
- \* spat5.compressor~ : fix bug when outlets are not connected
- \* added spat5.ltc.toms and spat5.ltc.fromms
- \* spat5.ltc.trigger~ : minor improvements
- \* spat5.panoramix~ : now properly searches hrtf files in Max search paths
- \* spat5.panoramix : added outlet for /window messages
- \* spat5.pan~ : fix spurious error messages with /sources and /speakers messages
- \* added spat5.ltc.easydecode~
- \* spat5.ltc.encode~ : added "/speed" message



- \* spat5.osc.var : "load" message now searches in Max search path
- \* spat5.osc.var : "load" message in right inlet wont trigger output
- \* spat5.osc.record~ : added "/noduplicate" message
- \* all objects : added selective "/dump" message. See "spat5.tuto-dump-1.maxpat" for details

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Release Version : 5.1.4  
Release Date : 10/2019

- \* spat5.ctc~ : notifications when loading hrtf files
- \* spat5.spat~ : fix missing attributes in status window when panning type is nearfieldbinaural
- \* spat5.abs2rel : now handles sources' yaw
- \* spat5.panoramix : fix bug when recalling blur value in HOA bus
- \* Panoramix : update for Mojave and Catalina security permissions
- \* spat5.ltc.encode~ : added "/pause", "/resume", "/switch" messages

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Release Version : 5.1.3  
Release Date : 09/2019

- \* spat5.align~ : improved and clarified some error messages
- \* spat5.panoramix : fix error messages with "/master/channel/[index]/equalizer/filters/params"
- \* spat5.ircamverb~ : fix bug with early reflections panning
- \* spat5.hoa.scope~ : now outputs location of maxima, minima
- \* spat5.panoramix : EQ filter order is now properly exposed to grouping
- \* spat5.panoramix : fix logic error with mute/solo when tracks are grouped
- \* spat5.panoramix : fix potential bugs with group management
- \* spat5.panoramix : fix crash with high-order low-pass filter in EQ
- \* spat5.transpan~ : fix panpot layer not updated when source moves
- \* all objects : minor OSC optimization
- \* spat5.wfs : fix spurious warning message for sample rate mismatch
- \* spat5.viewer : added "/source/[index]/hidewhenmute" message
- \* spat5.oper, spat5.oper\_, spat5.spat~ : fix bugs with panrev parameter
- \* all objects : fix possible crashes in Ableton Live
- \* spat5.panoramix : added "/options/dock [boolean]" message
- \* spat5.panoramix : added "/options/dock/floating [boolean]" message
- \* spat5.graphiceq~ : added "/crossfade/duration [number]" message
- \* spat5.graphiceq, spat5.graphiceq~ : added "/gain/db [number]" message
- \* spat5.hoa.decoder~ : improved SVD stability
- \* spat5.pan~ : added "/layering" option for building LBAP layers
- \* all objects : added option to specify end-of-line character when using "/preset/export"
- \* spat5.align~ : added "/soundvelocity" message
- \* spat5.osc.iter : added [int] argument to specify the number of messages in each chunk
- \* added spat5.osc.size
- \* spat5.panoramix : improved pop-up window for multi-screen usage
- \* spat5.decoder~, spat5.hoa.decoder~, panoramix : added phantom speaker option for HOA decoders
- \* added spat5.osc.chunk
- \* spat5.pan~, spat5.panoramix : added new options for LBAP : "/layering/type", "/layering/panning/type"
- \* all objects : fix possible crash when parameter mode is enabled
- \* added spat5.quat.interpolate
- \* spat5.pan~, spat5.panoramix, spat5.spat~ : added "/neighbors/maxdistance" option for KNN panning
- \* added spat5.osc.interpolate

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Release Version : 5.1.2  
Release Date : 06/2019

- \* spat5.panoramix : "/window" messages are properly saved with preset
- \* spat5.osc.udpreceive : fix possible bugs (truncated OSC bundles)
- \* spat5.panoramix2tosca : extended to stereo tracks
- \* spat5.oper, spat5.oper\_ : fix reverb gain when changing destination room
- \* spat5.simone : added "/style" message
- \* spat5.panoramix : added per channel EQ on Master track
- \* most GUI objects : "/color" messages now support strings, e.g. "/color blue"
- \* spat5.osc.fromdict : fix memory leak + optimization
- \* spat5.equalizer : optimized drawing
- \* spat5.ltc.trigger~ : various improvements (minor compatibility break)



- \* spat5.equalizer : added @channels attribute (minor compatibility break)
- \* spat5.hostinfos : added "/push/notification" message
- \* spat5.osc.ignore, spat5.osc.route : fix possible bug with bundles containing wildcards
- \* spat5.panoramix : added "/output/mode" on Master track
- \* all objects : CPU optimization when processing OSC messages
- \* added spat5.hoa.shelving
- \* spat5.pan~, spat5.ircamverb~ : avoid spurious error messages with aperture/orientation messages
- \* spat5.grids : added new grids for upper hemisphere
- \* spat5.ircamverb, spat5.ircamverb~, spat5.oper, spat5.spat~, spat5.roomsize : added "/reverb/roomoffset" message
- \* spat5.viewer : added YZ viewpoint

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Release Version : 5.1.1  
Release Date : 04/2019

- \* spat5.panoramix : fix bug with distance slider on "Multi" tracks
- \* spat5.viewer : fix various bugs with /multi elements
- \* spat5.cluster~, spat5.reverb~, spat5.spat~, etc. : fix potential crash when using a non-power of two number of internal channels
- \* spat5.hostinfos : added "/system/reboot" message
- \* spat5.hoa.scope~ : added "/colorbar/visible" message
- \* spat5.hoa.zm1~ : fix possible crashes
- \* spat5.panoramix~ : fix spurious error messages with vbap bus
- \* spat5.osc.display : added @title attribute
- \* added spat5.mcsfplayer~.maxpat
- \* spat5.panoramix : fix possible crash when loudspeakers are coincident
- \* spat5.hoa.zm1~ : adding new encoding methods ("/mode" message)
- \* spat5.panoramix : fix tiny bug with speaker labeling ("/bus/[index]/speaker/[index]/name")
- \* spat5.hoa.scope~ : added to windows release
- \* spat5.panoramix~ : fix various issues with Eigenmike tracks
- \* added spat5.hoa.triangle
- \* added spat5.hoa.plot
- \* spat5.panoramix : added message "/bus/[index]/listener/yp" for binaural bus
- \* spat5.hoa.scope~ : disable computation when window is not visible (economy mode)
- \* spat5.hoa.focus : fix minor bug with elevation messages
- \* spat5.file.infos : added md5 checksum
- \* spat5.hoa.focus : added reset button
- \* added spat5.hoa.fx~ and spat5.tuto-hoa-3
- \* spat5.smk~ : added session log file
- \* many DSP objects : improved inlets/outlets description when @mc = 1
- \* spat5.viewer : fix possible crash with sources' history

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Release Version : 5.1.0  
Release Date : 03/2019

- \* added spat5.hoa.dominance~ : dominance effect (1st order only)
- \* spat5.hoa.focus : added keyboard shortcut for circular constraint
- \* spat5.matrix~ : added "/clear" message
- \* spat5.sfplay~ : on "/open" message, tries to automatically detect file extension if missing
- \* spat5.sfplay~ : added @mc attribute
- \* spat5.grids : added new grids
- \* added spat5.simone.generator
- \* spat5.simone : added "/cell/[index]/angle/add" message
- \* added spat5.quat.fromvectors
- \* added spat5.sf.resample, spat5.sf.merge
- \* all GUI objects : fix possible issues with full screen mode
- \* spat5.doppler~ : added "/soundvelocity" message
- \* added spat5.rake~
- \* all DSP objects : fix @mc attribute when operating in a standalone
- \* spat5.panoramix : optimized GUI repaint
- \* spat5.oper, spat5.viewer : fix possible crash with invalid osc patterns
- \* spat5.cross3~ : fix possible crash with high order filters
- \* spat5.panoramix : added pitch and roll rotation to A-format, B-format, and Eigenmike tracks
- \* all GUI objects : added "/window/opaque" and "/window/titlebar" messages
- \* added spat5.hoa.warp~ : warping in the HOA domain
- \* spat5.panoramix : changed the default metering mode to "peak" instead of "rms" (for efficiency)

- \* spat5.panoramix : monitoring track is now muted by default (for efficiency)
- \* spat5.spat~ : minor cpu improvement
- \* added spat5.hoa.zm1~
- \* upgraded to juce 5.4.3
- \* spat5.panoramix : added menu to delete unused tracks/bus
- \* spat5.panoramix : when a file (sofa, sdif, etc.) cannot be found, try to fold back to another directory
- \* spat5.panoramix : added zylia track
- \* spat5.speaker.layout : added new layouts
- \* spat5.equalizer, spat5.filterdesign : improved filter stability (especially for higher orders)
- \* spat5.panoramix : added mute button for reverb send on eigenmike tracks
- \* spat5.sfplay~ : fix bug when @mc 1 (no output signal if second outlet not connected)
- \* spat5.panoramix : fix spurious error with "/backgroundimage" messages
- \* spat5.meter~, spat5.spectroscope~ : added @mc attribute
- \* spat5.osc.midimap : fix bug when reloading a xml file with duplicated entries
- \* spat5.hoa.scope~ : added @mc attribute
- \* spat5.panoramix : added "/options/clearsolo" message
- \* added spat5.cascade.resample

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Release Version : 5.0.9  
Release Date : 01/2019

- \* spat5.panoramix : improved allrad decoding
- \* spat5.panoramix~ : minor optimization
- \* spat5.decoder~, spat5.hoa.decoder~, spat5.panoramix~ : optimized dual-band HOA decoding
- \* spat5.pan~ : added dual-band vector-base panning (dualbandvbp). See help patcher
- \* spat5.wfs.config : added warning for non consistent speaker layout
- \* spat5.pan~ : improved error and warning messages
- \* spat5.spat~ : fix spurious error messages when switching from 2D to 3D HOA
- \* spat5.panoramix : fix minor memory leak
- \* all objects : fix possible crash (thread-safe issue)
- \* spat5.panoramix : improved "/session/delete/byaddress" message
- \* spat5.pan~, spat5.panoramix~, spat5.spat~, spat5.pan : added LBAP, layer-based amplitude panning
- \* spat5.panoramix : major optimization of preset loading time (and track/bus addition or deletion)
- \* spat5.panoramix : added new global settings
- \* spat5.panoramix : vumeter refresh rate is now stored with preset
- \* spat5.viewer : changed "/backgroundimage/xoffset" to "/backgroundimage/offset/x", for consistency (minor compatibility break)
- \* spat5.panoramix~ : significant CPU optimization (signal routing)
- \* spat5.panoramix, spat5.hoa.decoder~, etc : added allrad+ ambisonic decoder
- \* spat5.panoramix, spat5.hoa.decoder~, etc : added mvlad ambisonic decoder
- \* spat5.hoa.decoder~ improved warning and error messages
- \* spat5.hoa.encoder~, spat5.panoramix~, spat5.spat~ : cpu optimization for HOA encoding
- \* spat5.sfplay~ : now outputs the list of AIFF markers upon loading a file
- \* spat5.oper : fix initialization bug with omni/room filter
- \* spat5.knn : fix various bugs and crashes
- \* spat5.panoramix : Monitoring, Master, and Options strips can now be renamed
- \* spat5.viewer : added "/source/[index]/mute" message
- \* spat5.reverb~, spat5.panoramix : fix default delays when @channels > 8
- \* spat5.viewer, spat5.oper : added "/source/[index]/radius/visible" message
- \* spat5.viewer, spat5.oper : added "/source/[index]/orientation/mode" message
- \* spat5.quat.toeuler, spat5.quat.fromeuler : added @initwith attribute
- \* upgraded to juce 5.4.1
- \* fixed @embed attribute for spat5.\*.embedded objects
- \* spat5.frequencyresponse, spat5.hlsshelf, etc. : added "/xtick/color", "/ytick/color" messages
- \* spat5.frequencyresponse : added "/xtick/position" message (cf help patcher)
- \* spat5.frequencyresponse : added "/marker" messages (cf help patcher)
- \* spat5.osc.unslashify : fix bug with FullPacket
- \* spat5.oper : added "/spread" message and knob
- \* spat5.oper : added mute/bypass for axis/omni filters
- \* @initwith, @embed, @mc attributes now appear in the inspector (but cannot be edited)
- \* all GUI objects : added "/window/hidesondeactivate" for application-wide floating windows
- \* spat5.viewer : added "/source/1/history" messages (cf help patcher)
- \* added spat5.hoa.beam, spat5.hoa.beam~, spat5.hoa.beam.embedded (experimental)
- \* all GUI objects : the "/window" messages are now stored with the object state
- \* all GUI objects : the @embed attribute can now be dynamically changed
- \* all \*.embedded objects : added "/status" and "/help" messages
- \* all \*.embedded objects : fixed possible memory leak

- \* AVX extensions are now required for spat5 on macOS
- \* spat5.osc.append, spat5.osc.prepend : cpu optimization + improved thread-safety
- \* spat5.hoa.em32~ : fix possible crash when changing "/mode"
- \* added spat5.sf.split : audio file splitter
- \* all DSP objects : fix possible crash in Ableton Live
- \* spat5.osc.udpreceive : added "disconnect" and "reconnect" messages
- \* all DSP objects : improved inlets/outlets description when @mc = 1

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Release Version : 5.0.8  
Release Date : 10/2018

- \* spat5.grids : added "/project/tocube" message (cf help patch)
- \* spat5.viewer : "/backgroundimage" now searches in Max paths
- \* spat5.grids : added new types of grids
- \* spat5.panoramix : fix possible crash with WFS bus
- \* most objects : better parsing of OSC coordinate messages
- \* spat5.panoramix~ : improved error messages with invalid WFS files
- \* spat5.air~ : fix OSC messages improperly processed
- \* spat5.doppler~ : fix OSC messages improperly processed
- \* spat5.oper : fix issue with OpenGL rendering engine
- \* added spat5.random.poly.maxpat
- \* spat5.osc.replace : added @tautological attribute + improved help patcher
- \* spat5.pan~, spat5.spat~, spat5.panoramix~ : fix bug with KNN panning (gain normalization)
- \* spat5.panoramix : added stereo tracks
- \* spat5.wfs.config : min distance is now 1m
- \* spat5.osc.unslashify : fix possible type issue with OSC pattern starting with int
- \* spat5.oper, spat5.viewer : fix spurious error message with /backgroundimage
- \* spat5.oper : /roomsize is now an alias for /room/size
- \* spat5.panoramix : added @embed attribute
- \* spat5.folder.infos : added "/sort" message
- \* improved overview patcher
- \* fixed @mc not working on Windows
- \* spat5.panoramix : fix several bugs (e.g. bformat tracks)
- \* spat5.viewer, spat5.oper, etc : added "/source/[index]/tofront", "/source/[index]/toback" messages to change the z-order of the element, and ease the mouse selection
- \* spat5.panoramix~ : fix possible bug(s) with Eigenmike track
- \* spat5.panoramix : faster preset loading time
- \* spat5.panoramix : added "/track/[index]/tofront", "/track/[index]/toback" messages
- \* spat5.panoramix : track color can now be changed on the fly
- \* spat5.clip~ : fix OSC parsing
- \* spat5.gammatone : fix spurious error messages
- \* spat5.spat~ : minor improvement to the /parallel mode
- \* spat5.spat~ : added "/phantom/nadir", "/phantom/zenith" messages

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Release Version : 5.0.7  
Release Date : 09/2018

- \* spat5.osc.udpsend, spat5.osc.udpreceive : fix bug when the objects were eating all cpu
- \* spat5.panoramix : fix "Angular2D" shown twice in the bus creation menu
- \* spat5.viewer : added viewpoint selection to the settings panel
- \* added spat5.gopro.decode : decode UDP packets from GoPro VR Player (Kolor)
- \* spat5.osc.speedlim : now works with osc bundles
- \* spat5.calibrate.gain~ : added /db suffix to output messages (minor compatibility break)
- \* spat5.spat~ : doppler is now off by default (in agreement with spat5.oper) (minor compatibility break)
- \* spat5.matrix : now ready to be used
- \* added spat5.matrix~
- \* all GUI: /window/scale now expressed in % (minor compatibility break)
- \* spat5.scale : can now operate on bundles
- \* spat5.converb~ : fix spurious error messages (/dsp/mute, /dsp/bypass)
- \* all objects : improved @initwith parsing and processing
- \* all objects : fix attributes auto-completion
- \* spat5.panoramix~ : minor cpu improvements
- \* spat5.panoramix : input and bus routing can be edited on the fly
- \* panoramix : improved osc parsing for routing messages
- \* spat5.adm.room~ : fix duplicate messages in OSC status bundle

- \* spat5.meter~ : added fader; added option to disable rms filters
- \* spat5.smk~ : fix issues when interrupting a measurement
- \* added spat5.ir.infos
- \* added spat5.ir.analysis
- \* added spat5.hybrid~ (experimental)
- \* added spat5.eq
- \* spat5.filterdesign : fix bugs with chebyshev-2, and improved overall filter stability
- \* spat5.oper : fix possible memory leak
- \* spat5.oper : added "/style" message to display acoustical criteria / perceptual factors
- \* spat5.viewer (and others) : added /azimdist message to set azimuth and distance
- \* spat5.viewer (and others) : improved error messages
- \* documentation : fixing several spelling mistakes
- \* spat5.osc.view (and others) : avoid possible crash with corrupted FullPacket
- \* spat5.conv~ : added @inputs attribute (i.e. extension to multiple IRs)
- \* spat5.osc.slashify : fix potential crash
- \* spat5.panoramix~ : fix bug when reloading preset with WFS bus (source positions not recalled)
- \* spat5.panoramix : added rms/peak option for vu-meters
- \* spat5.panoramix : vu-meters options can now be modified on the fly
- \* added spat5.whichthread : for debug purpose
- \* spat5.panoramix : vbap2D bus can now work in mono
- \* spat5.panoramix : added bus send 'E' and 'F' (but not visible in the GUI)
- \* spat5.oper : fix bug with "/format" message
- \* spat5.panoramix : fix bug with "move" track interface
- \* spat5.panoramix : fix subtle and rare threading issue (possible crash)
- \* spat5.panoramix~ : fix possible crash when loudspeakers are coincident
- \* spat5.panoramix : added "/session" messages to create/delete track or bus
- \* spat5.file.infos : added "/reveal" message
- \* spat5.panoramix : added "Reveal" button to show the current preset file in Finder
- \* added : spat5.compressor.embedded, spat5.eq.embedded, spat5.equalizer.embedded, spat5.filterdesign.embedded, spat5.graphiceq.embedded, spat5.hlshef.embedded, spat5.hoa.display.embedded, spat5.hoa.focus.embedded, spat5.hoa.metrics.embedded, spat5.ircamverb.embedded, spat5.matrix.embedded, spat5.oper.embedded, spat5.routing.embedded, spat5.sofa.loader.embedded, spat5.speaker.config.embedded, spat5.vbap.metrics.embedded, spat5.viewer.embedded, spat5.zplane.embedded

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Release Version : 5.0.6  
Release Date : 06/2018

- \* added Spat5-ReferencePages.pdf
- \* spat5.align~ : clarified reference page
- \* spat5.osc.replace : added @initwith attribute
- \* improved many help patchers and reference pages
- \* all objects : minor optimization when parsing OSC messages
- \* added spat5.osc.pak
- \* added spat5.osc.pack
- \* added spat5.osc.unique
- \* added spat5.osc.queue
- \* spat5.pan~ : increased maximum ramp time
- \* spat5.transpan~ : fix duplicate messages in status bundle; renamed a few OSC messages for clarity
- \* spat5.sfplay~ : now supports sony wave64 (w64) file format
- \* spat5.reverb~, spat5.early~, spat5.cluster~ : added "/channel/[index]/delay" messages
- \* spat5.sfreord~ : added "/record/samples" message
- \* spat5.ircamverb~ : fix benign error messages
- \* spat5.leslie~ : fix bug (spatialization not working)
- \* several objects : increased the max number of speakers (from 128 to 250)
- \* all DSP objects : increased maximum number of inlets/outlets (Max8 only)
- \* vbap / vbip : added option to insert phantom speaker at the zenith and/or nadir
- \* vbap / vbip : added new triangulation mode (more robust) (see spat5.pan~ help patcher)
- this affects : spat5.pan, spat5.pan~, spat5.spat~, spat5.panoramix~, etc.
- \* spat5.hoa.scope~ : fix colorbar
- \* added spat5.vbap.metrics
- \* spat5.panoramix : added option to insert phantom speaker at the zenith and/or nadir (vbap and vbip busses)
- \* spat5.panoramix : /bus/[index]/delay/bypass and /bus/[index]/spread/bypass properly stored in presets
- \* snapshots : fix keyboard focus issues
- \* spat5.hoa.metrics : added "/speakers/label/color" message
- \* spat5.panoramix : added tooltip bubbles in routing matrix
- \* spat5.panoramix : fix minor display issues when resizing window

\* spat5.panoramix : fix bug with /monitoring and /d2m routing window refresh

=====

Release Version : 5.0.5  
Release Date : 06/2018

\* spat5.transform : can now deliver bundles, for efficiency  
\* added spat5.barycenter  
\* spat5.panoramix : added "/monitoring/listener/yp" message  
\* spat5.panoramix : added "/bus/[index]/orientation" message (for HOA bus)  
\* spat5.panoramix : added "/bus/[index]/yp" message (for HOA bus)  
\* spat5.panoramix, spat5.hoa.focus : minor cpu optimizations  
\* all objects : minor optimization when parsing OSC messages

=====

Release Version : 5.0.4  
Release Date : 05/2018

\* added spat5.isnan~  
\* added spat5.cascade.inverse  
\* spat5.hoa.scope~ : added new colormap schemes  
\* spat5.grids : added list output  
\* added spat5.fton, spat5.ntof  
\* spat5.osc.view, spat5.osc.display : added font size attribute  
\* spat5.oper : fix issues with /source/\*solo message  
\* spat5.oper : tab names follow source names  
\* spat5.smk~ : added waterfall plot matlab scripts  
\* spat5.osc.replace : can now operate on bundles  
\* spat5.viewer : added /grid/thickness message  
\* spat5.viewer : /proportion and /zoom now express as percentage. warning: might break compatibility  
\* spat5.viewer : renamed /display/offsetx to /display/offset/x  
\* spat5.viewer : added /legend/unit message  
\* spat5.viewer : added settings panel (/settings/editable [boolean], /settings/visible [boolean])  
\* spat5.panoramix : added /early/gains and /early/delays messages for Mono and Multi tracks  
\* spat5.panoramix : avoid possible crash when @inlets and @outlets are not consistent  
\* all GUI objects : added workaround for pattr support. see spat5.tuto-osc-2  
\* spat5.panoramix : fix bug with /bus/B/mute message

=====

Release Version : 5.0.3  
Release Date : 05/2018

\* spat5.viewer : added "/layout auto" -> automatically update according to the loudspeaker positions  
\* spat5.oper : fix bug with /axis or /omni messages (missing notifications)  
\* spat5.oper\_ : fix spurious error messages  
\* spat5.oper\_ : added @internals attribute  
\* added spat5.printbytes : low-level debugging of FullPacket  
\* spat5.smk~ : minor improvement in exported matlab scripts; added option for repeated measurement  
\* spat5.file.infos : fix /launch message on Windows  
\* minor improvements to the help patchers

=====

Release Version : 5.0.2  
Release Date : 05/2018

\* all objects : improved error messages  
\* spat5.pan~ : added documentation about binaural geometrical models  
\* added spat5.hoa.binaural~ : transcodes HOA stream to binaural (experimental)  
\* all objects : fix issues with utf8 characters  
\* ADM renderer : added output routing matrix  
\* spat5.speaker.config : minor improvements  
\* ADM renderer : fix mute/solo for multi programs ADM files  
\* panoramix : added b-format track  
\* vbap, vbip, allrad : improved triplet visibility tests  
\* spat5.panoramix~ : fix HOA focus and HOA blur bypass not working  
\* spat5.hoa.aformat~ : added high-cut filter; minor improvements  
\* spat5.osc.slashify : minor change for list of symbols

- \* added new ambisonics tutorials
- \* spat5.panoramix : now supports OSC messages /layout, /grid, /display, etc. to tweak the viewer window
- \* spat5.pan, spat5.pan~ : added divergence option (experimental): automatic spread for source close to the origin
- \* added tutorial for compatibility with AmbiX, ICST, HoaLibrary
- \* spat5.panoramix : fix bug with /set/track messages
- \* spat5.panoramix : added some touch messages (experimental)
- \* spat5.hoa.focus, spat5.panoramix : double-click now resets the selected beam to default
- \* spat5.hoa.em32~, spat5.panoramix~ : fix issue with method 4 encoding
- \* spat5.osc.print : added optional timetag
- \* spat5.viewer : added several options for areas' display (border color, fill color, thickness, etc.)
- \* added spat5.constraint : apply constraints to coordinate messages
- \* spat5.panoramix : fix issues with bypass of delays
- \* spat5.panoramix, spat5.sofa.loader : fix refresh of HRTF list not working
- \* panoramix : added a-format track
- \* spat5.osc.record~ : fix strange bug with incoming time signal
- \* spat5.osc.record~ : fix crash when inserting OSC bundles
- \* spat5.osc.record~, spat5.osc.play~ : added message "/memory/clear time1 time2", and "/memory/offset"
- \* spat5.frequencyresponse : added load message; improved resolution
- \* spat5.panoramix : fix tiny issue with output vumeter visibility
- \* spat5.panoramix : increased maximum reverb time
- \* spat5.filterdesign, spat5.equalizer, spat5.panoramix : improved filter stability
- \* added spat5.hoa.metrics : compute and display metrics for HOA decoders
- \* spat5.osc.trim : added option to trim end of pattern
- \* added spat5.hoa.scope~ : RMS metering for HOA 2D/3D sound-field (cpu intensive...)
- \* spat5.spat~ : improved error messages
- \* spat5.oper : fix several critical bugs
- \* spat5.wfs.config : increased maximum distance
- \* spat5.panoramix, spat5.panoramix~ : lot of internal refactoring
- \* spat5.adm.play~, spat5.adm.renderer~ : fix several issues with jumpPosition and interpolationLength
- \* added spat5.distance : compute distances and angles between sources and speakers
- \* spat5.filterdesign : fix possible crash
- \* spat5.panoramix~ : fix bug with routing of Monitoring strip
- \* spat5.smk~ : added /stop message
- \* spat5.decorrelate~ : fix bug when changing /allpass/number
- \* spat5.decorrelate~ : power normalization instead of amplitude normalization of filters
- \* spat5.hoa.metrics : fix minor bug with energy vector
- \* updated User Manual PDF
- \* spat5.panoramix : display speaker positions per bus
- \* spat5.viewer : added hoa fields
- \* spat5.spat~ : added several missing parameters for pan (/spread, /divergence, /neighbors, etc.)
- \* spat5.hoa.rotate~ : fix bug with quaternions
- \* added spat5.hrtf.infos
- \* spat5.smk~ : many improvements and new abstraction patchers
- \* spat5.panoramix : store additional viewer attributes in presets

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Release Version : 5.0.1  
Release Date : 03/2018

- \* spat5.sfreord~ : fix possible scheduling issue with /record message
- \* spat5.sfplay~ : fix possible scheduling issue with /start and /stop messages
- \* all objects with /open message: fix possible utf8 encoding issue with file path
- \* all objects with /open message: fix possible issues with file path like "Macintosh HD:/Users/etc"
- \* added spat5.version
- \* added documentation for B-format and UHJ processing
- \* added new abstraction patchers for TransPan
- \* spat5.wfs.config : now export areas containing virtual grid
- \* ADM : fix issue with Cartesian flag
- \* spat5.panoramix~, spat5.hoa.compensation~ : fix possible overload/NaN with allrad decoder
- \* spat5.spat~ : added "/parallel [boolean]" message
- \* spat5.adm.play~ : supports ADM files with multiple audioProgrammes. Updated patchers.
- \* spat5.panoramix~ : fix bug with /channel/\*/gain/db messages for Multi tracks
- \* spat5.panoramix~ : fix crash with Multi tracks
- \* spat5.binaural~, spat5.pan~, spat5.panoramix~ : fix major bug with binaural processing

=====

Release Version : 5.0.0

Release Date : 03/2018

- \* panoramix : fix possible crash with Multi tracks
- \* spat5.osc.udpsend : don't use type int64 for backward compatibility with Max udpreceive
- \* spat5.decorrelate~ : fix seed issue
- \* spat5.decorrelate~ : added /export option; added /truncate option
- \* spat5.hoa.decoder~ : added /export option
- \* spat5.wfs : added /delay/scaling option
- \* spat5.calibrate.gain~ : added option for pink noise
- \* spat5.osc.udpreceive : fix possible crash when many instances are used at once
- \* all @numsomething attributes renamed @something (for simplicity and clarity).  
e.g. @numchannels -> @channels
- You'll need to update your patchers accordingly!
- \* improved error messages
- \* spat5.oper : fix many missing messages
- \* spat5.oper : added early shape
- \* spat5.smk~ pretty much finalized; new display of results
- \* spat5.viewer : added 'emphasis' option (emphasize sources when close to the mouse)
- \* spat5.oper : fix issues with air and infinite messages
- \* all: improved help patchers and reference pages
- \* spat5.hlsshelf : added mute button
- \* spat5.plot : added bar mode
- \* added spat5.edc
- \* added spat5.hoa.aformat~
- \* spat5.osc.view : added shortcut (cmd+c) for copy to clipboard
- \* spat5.ircamverb : added independent mute button for each section
- \* spat5.osc.fromdict : fix possible crash
- \* spat5.converter : now works with OSC bundles
- \* spat5.transform : pass through all unprocessed messages
- \* spat5.spat~, spat5.oper : fix doppler effect
- \* spat5.cpu : fix possible crash
- \* changed a couple of OSC messages here and there;  
hopefully that should not break compatibility with previous versions.
- \* spat5.wfs~ : fix error messages in help patcher
- \* spat5.osc.view : fix possible crash
- \* spat5.osc.display : fix possible crash
- \* spat5.panoramix~ : fixed possible crash with VBAP 3D bus when the loudspeaker setup happens to be planar.
- \* spat5.panoramix~ : added delay parameter on each bus
- \* spat5.panoramix~ : added listener rotation on binaural bus
- \* spat5.panoramix~ : improved HRTF management
- \* spat5.panoramix : added annotations to the OSC preset
- \* spat5.panoramix, spat5.panoramix~ : fix major bug with track number >= 10
- \* spat5.panoramix, spat5.panoramix~ : added HOA2D bus, VBIP3D and VBIP2D bus
- \* renamed all objects spat5 to avoid clash with previous versions
- \* added spat.osc.unslashify : break the osc pattern



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This manual originally was written by Jean-Marc Jot (under the editorial responsibility of Marc Battier).

Design of digital signal processing algorithms, overall architecture, and original implementation: Jean-Marc Jot.

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Additional contributions: Véronique Larcher (binaural), Markus Noisternig (higher-order Ambisonic).

Design & Development of spat5: Acoustics & Cognition Research Group, UMR 9912 STMS Ircam–CNRS–Sorbonne Université.

Thanks: Gérard Assayag, Alexis Baskind, Georges Bloch, Xavier Chabot, Etienne Corteel, Eric Daubresse, Gerhard Eckel, Serge Lemouton, Martine Marin, Laurent Pottier, Leslie Stuck, and Zack Settel for instructive discussions and advice.

First English Edition of the documentation, March 1995.

Updated October 2006 by Terence Caulkins.

Updated October 2017 by Rama Gottfried.

Updated November 2, 2021.

This document is a reference manual for version 5.x of **Spat~**, which runs on Max/MSP® version 6.1 or higher.



## 8 Contacts

The use of this software and its documentation is restricted to members of the Ircam software users group.

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zlib.h – interface of the 'zlib' general purpose compression library  
version 1.2.11, January 15th, 2017

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## matio

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## 10 IRCAM Forum Software License Agreement

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## III – Maintenance and Service

### Article 12 – Definition of Provisions of Services

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Beginning on the date of your membership, you will receive, for twelve months, software programs and documentation developed by IRCAM. These software programs are protected by a personal code (necessary for downloading and installing the software programs). This code is personal and may not be given to a third party.

Unless you renew your membership, when your one-year membership period expires, you no longer have access to the IRCAM Forum services or software programs. You do maintain, however, the right to use the elements received during your membership.

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#### 12.3 Additional Services – Discounts

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The applications created by an IRCAM Forum member and made available to other Forum members can be used free of charge by IRCAM or by other IRCAM Forum members in the domains of research, teaching and educational activities, and musical production. Any use of the applications created by an IRCAM Forum member in any other domain, or any commercial distribution or redistribution of these applications requires authorization.

## Article 14 – Members’ Obligations

### 14.1 Relations With IRCAM

You can propose developments to the IRCAM Forum team that will communicate these ideas to the development groups at IRCAM. IRCAM can distribute your developments as are, without any support. IRCAM can also decide, with your accord, to further develop your developments and to assure the documentation and support.

IRCAM cannot guarantee the finalization of the developments proposed by users.

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Your membership to the IRCAM Forum is valid for twelve months beginning with your date of registration. If you choose not to renew your membership, or you cancel your membership, you lose all rights acquired during your membership although the conditions defined in articles 4, 5, 6, 7, 8, and 9 remain unchanged.

### **Article 18 – Membership Fees**

Membership fees and conditions may be revised at any time. Membership fees are identical in France and abroad.

## IV – IRCAM Forum Free Freeware License Agreement

### Article 19 – Conditions for Distribution and Use

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