**yk.abstractions**

A collection of bpatcher and low-level abstractions for Max environment

# Version

* 1.07 (Dec 23, 2016), developed by Yota Kobayashi (yota@programsounds.net)

# System Requirement

* Max 6.1.10 and higher
* 64-bit compatibility:
  + Note that ver. 1.05 is the last version that was developed for Max 6.x in 32-bit mode. Ver. 1.05 is available upon request.
  + The newer version should work with Max in 32-bit mode nonetheless, however, they are designed and tested only with Max 6.1.x in 64 bit mode.
* Max 7 is not supported.
* NEW
  + In ver 1.08, support only Max 8.0 and higher

# Installation

* Unzip yk.abstractions\_1.xx.zip and move the contents as follows:
  + yk.abstractions to anywhere in a Max search path
  + yk.clippings to Max 6.1/patches/clippings
* Any files from the pervious versions of yk.abstractions must be removed from Max search paths.

# Dependencies

* The following modules use third-party external objects. They are zipped and included in yk.abstractions/lib/third-party. The modules assume that the versions of the externals being used are higher than those that are included. Therefore, even if the user already has the externals in Max search path, outdated externals do not guarantee the right performance of the modules.
  + yk.antescofoBP
    - antescofo~.mxo
      * Version:
        + 0.8 and higher
      * Source:
        + IRCAM Forum (http://forumnet.ircam.fr/product/antescofo)
  + yk.additiveBP, yk.FOFBP, and yk.pitchTrackerBP:
    - sigmund~.mxo
      * Version:
        + 1.1.2 (64-bit version based on the original version 0.07) and higher
      * Source:
        + Volker Böhm (https://github.com/v7b1/sigmund\_64bit-version/releases)
  + yk.FOFBP
    - fof~.mxo
      * Version:
        + 2014 build and later
      * Source:
        + IRCAM Forum, Max Sound Box (http://forumnet.ircam.fr/product/max-sound-box/)
  + yk.resonatorBP
    - resonators~.mxo
      * Version:
        + 2014 build and later (pending for 64-bit version)
      * Source:
        + CNMAT (http://cnmat.berkeley.edu/downloads)
  + yk.spatializerBP:
    - ICST Ambisonics Max externals
      * Version:
        + 2.3.1 and higher
      * Source:
        + Institute for Computer Music and Sound Technology (http://www.zhdk.ch/index.php?id=71595)
    - vbap.mxo
      * Version:
        + 64-bit version based on the original version 1.03
      * Source:
        + Nathan Wolek (https://github.com/jamoma/JamomaDependencies)
  + yk.spectralDelayBP and yk.spectralFilterBP:
    - chromax.mxo
      * Version:
        + Dec 2014 build and later
      * Source:
        + IRCAM Forum, Max Sound Box (http://forumnet.ircam.fr/product/max-sound-box/)

# yk.clippings

* yk.clippings allows for accessing bpatcher modules and other abstractions instantly from the editing context menu.
* yk.crossbarSwitch:
  + Note that yk.crossbarSwitch64 and 128 are created as subpatchers and available only from yk.clippings/IO/crossbarSwitch. This is because yk.crossbarSwitch uses a preset object to save its setting separately from the parent pattr preset chain.

# Notes on Modules

* “Scheduler in Overdrive” in Max Audio Status must be on for the proper operation of the modules.
* Some FX modules have 1ch, 2ch, and 8ch versions, which share the same receive message prefix. This is because the modules have the identical parameters. The distinction in use should be made by assigning different ID number (bpatcher's 1st argument).
* Spectral FX modules:
  + A symbolic connection in the series of spectral FX module chain is available in order to avoid unnecessary analysis/resynthesis by fftin~ and fftout~, denoted by the mode “ext”.
  + FFT sizes 1024, 2048, and 4096 are available. The overlap factors are 4, 8, and 8 respectively. The FFT sizes of those that are set to the same ID number are synchronized.
  + Exceptionally, FFT size 16384 (overlap factor 16) and 1024 (overlap factor 2) are available in yk.spectralMorphBP and yk.spectralFM respectively. The signals in these modes are available only from the internal output.
  + yk.spectralMixer is the utility module which allows for parallel processing and feedback of signal which are all undertaken within a single set of fftin~ and fftout~. Besides, yk.spectralRouter allows for flexible frequency domain signal routing between the connected spectral modules. Thus user is able to construct a larger set of spectral FX modules, a spectral suite, flexibly without sacrificing the CPU usage, audio quality deterioration, and latency caused by the sequential analysis and resynthesis. (See the test patches of yk.spectralMixer and yk.spectralRouter for examples).
* More detailed information on the individual modules are available in the info subpatcher (access by info UI) of each module. The following pages show the list of module names and their respective receive message prefixes.

# Module Prefixes and Descriptions

## Data

|  |  |  |
| --- | --- | --- |
| module name | prefix | description |
| gaussianMixture | gm | parametric probability density function represented as a weighted sum of Gaussian component densities |
| logisticChaos | lchaos | chaos generator by logistic distance equation |
| presetManager | pm | interface to pattrstorage |
| probTable | ptable | probability table with uniform sum distribution |
| randomBPF | randBPF | random BPF generator |
| spectralBatchAnalyzer | n/a | converter for creating jitter-format FFT matrices from audio vectors |

## Effects

|  |  |  |
| --- | --- | --- |
| module name | prefix | description |
| additive | add | partial tracking additive resynthesis |
| AM | am | random amplitude modulation |
| combFilter | comb | comb filter |
| combMulti | mcomb | 5 parallel comb filters |
| compressor | comp | side-chain compatible look-ahead compressor |
| degrader | deg | distortion by downsampling and bit quantization |
| delay | del | multi-tap (up to 128 taps) delay |
| delay16 | del | multi-tap (up to 16 taps) delay with noise-free variable delay algorithm |
| delayLong | ldel | multi-tap (up to 128 taps) delay with a 60-second delay line |
| EQ | eq | 3-band stereo equalizer |
| filter | filter | state-variable filter |
| FOF | fof | spectral analysis and fof resynthesis |
| gater | gater | signal gater |
| grainCloudDelay | gcdel | grain delay based on asynchronous granular synthesis |
| grainDelay | gdel | grain delay based on synchronous granular synthesis |
| harmonizer | harm | harmonizer based on the algorithm in Zack Settel’s harmv1~ |
| harmonizer2 | harm2 | harmonizer using noise-free variable delay algorithm |
| KS | ks | Karplus-Strong physical modeling |
| modDelay | mdel | modulated delay |
| overdrive | ovd | overdrive |
| phaser | phaser | 8-stage phase shifter |
| pitchShifter | pshift | pitch shifter |
| resonator | reson | 24-band resonator |
| reverb | rev | reverb |
| reverser | revs | reverse playback of past x ms |
| ringMod | rm | ring modulator |
| spectralContrast | scont | frequency-domain amplitude-band scaler |
| spectralDelay | sdel | FFT bin delay |
| spectralEQ | seq | FFT bin amplitude scaling in 15 spectral bands, each 2/3 octave apart |
| spectralFilter | sfilt | FFT bin amplitude scaler |
| spectralFM | sfm | cross synthesis with continuous FM signal |
| spectralHarmonizer | sharm | harmonizer in frequency domain |
| spectralMorph | smorph | spectral interpolation between periodically analyzed FFT frames |
| spectralShift | sshift | pitch shifter in frequency domain |
| spectralWarp | swarp | spectrum warping by FFT bin transferring |
| tremolo | trem | tremolo effect |
| vocoder | voc | vocoder |

## IO

|  |  |  |
| --- | --- | --- |
| modulator | prefix | description |
| audioInput | adc | 8ch signal input |
| audioOutput | dac | 8ch signal output controllable by Mira |
| dispatcher | disp | message dispatcher for 1 x n mapping |
| echo | echo | input signal delay |
| recorder | rec | signal recorder, automatically applying short fade-in/out |
| spatializer | spat | multichannel spatializer |
| spectralDisperser | sdisp | 8ch dispersion of FFT bins |
| spectralMixer | smix | frequency domain signal mixer utility for creating a suite of spectral FX modules |
| spectralPanner | span | stochastic stereo panning of FFT bins |
| spectralRouter | sroute | matrix control module for routing signals of spectral FX modules in frequency domain, aggregating them to form a spectral FX suite |

## MIDI

|  |  |  |
| --- | --- | --- |
| module name | prefix | description |
| MIDIKeyboard | n/a | MIDI keyboard interface |
| nanoKontrol | n/a | interface to Korg nanoKontrol2 |
| VST | n/a | VST plug-in host |

## Players

|  |  |  |
| --- | --- | --- |
| module name | prefix | description |
| FM | fm | FM synthesizer |
| grainAsync | grna | asynchronous granular synthesizer |
| grainSync | grns | synchronous granular synthesizer |
| instSynth | isynth | instrumental additive synthesizer |
| macroHarp | mhp | a harp comprising 8 independent harps (Native Instruments Kontakt 5 required) |
| macroPiano | mpno | a piano comprising 8 independent pianos (Native Instrument Kontakt 5 and Galaxy Vintage D 1.2 required) |
| noiseGenerator | ng | envelope-controlled noise generator |
| PAF | paf | phase-aligned formant synthesizer |
| phaseVocoder | pvoc | phase vocoder |
| samplePlayer | splay | sample player |
| samplePlayerPoly | psplay | 8-voice polyphonic sample player |

## Sensors

|  |  |  |
| --- | --- | --- |
| module name | prefix | description |
| antescofo | asco | antescofo score follower |
| attackDetector | atd | amplitude-based note on/off detector |
| envelopeFollower | ef | envelope follower |
| kinectAnalysis | kan | (deprecated) parser for the image data from kinectInput |
| kinectInput | kin | (deprecated) intake motion data from Microsoft Kinect |
| onsetDetector | ond | onset detection of sound event through spectral flux |
| pitchTracker | ptr | pitch tracker |
| spectralCentroid | scent | descriptor for spectral centroid (barycenter of spectra) |
| spectralDecrease | sdec | descriptor for steepness of the spectral envelope decrease |
| spectralSlope | sslp | descriptor for slope of the spectral shape |
| SpectralSpread | sspr | descriptor for spectral standard deviation (instantaneous bandwidth) |

# Notes on Modules for Musical Information Retrieval

A set of modules in the “Sensors” directory provides functionalities to extract aural descriptors by analyzing the spectrum of the incoming sound. The following table shows the target descriptors and the type of module to employ for extracting them. The test patches of the corresponding modules exemplify their uses – especially yk.dispatcherBP shows a 1 x n mapping example.

|  |  |  |
| --- | --- | --- |
| Feature | Module | Remark |
| Pitch | yk.pitchTrackerBP | The module reports both of raw and new note pitches. See also the test patches of yk.attackDetectorBP and yk.onsetDetectorBP for examples of detecting new note pitches. |
| Amplitude envelope | yk.envelopeFollowerBP | Output in linear and decibel scales. |
| Amplitude peak |
| Event-onset | yk.attackDetectorBP | Event onsets are detected based on amplitude envelope in yk.attackDetectorBP and spectral flux in yk.onsetDetectorBP. |
| yk.onsetDetectorBP |
| Inter-onset interval (IOI) | See the test patch for calculating these descriptors. |
| Temporal density |
| Spectral flux |
| Spectral centroid | yk.spectralCentroidBP | Descriptor related to brightness / sharpness of sound |
| Spectral standard deviation | yk.spectralSpreadBP | Descriptor for instantaneous spectral bandwidth |
| Spectral magnitude decreasing | yk.spectralSlopeBP | Estimated by linear regression of magnitude spectrum |
| yk.spectralDecreaseBP | Spectral decrease focuses on the lower frequencies and thus more correlated to human perception than spectral slope. |

# Known Issues

None (as of ver. 1.05).

# Version Change Log

* ver. 1.08 ()
  + Updated for Max 8; not backward compatible—users with earlier version should use Max 6.1.
* ver. 1.07 (Dec 23, 2016)
  + yk.additiveBP (all versions)
    - Partial frequency randomization (shake) works when min = 0.1.
  + yk.fofBP (all versions)
    - Offline spectral data updates properly when the file is read and is sorted by frequency when the source signal is frozen.
  + yk.spatializerBP
    - Noise caused at the transition at azimuth -180/180 degree is fixed.
  + yk.noiseGeneratorBP
    - Pattrstorage recognizes BPFRand parameter.
  + yk.mpnoBP
    - noteOff message cancels the pedal states.
* ver. 1.06 (Oct 6, 2015)
  + Note
    - This version is an update for the compatibility with Max in 64-bit mode. Other fixes and modifications are listed below.
    - The updated 64-bit-compatible Max external objects, sigmund~, vbap, and fof~ are included in the lib/third-party directory.
    - yk.kinectInputBP and yk.kinectAnalysisBP are deprecated and stored in Sensors/legacy directory as they depend on a 32-bit external object.
    - The current 64-bit limitation is yk.resonatorBP for which the 64-bit external object is pending and to be available soon.
  + yk.EQ(2ch/8ch)BP
    - Gain parameter is changed from linear to decibel scaling.
  + yk.dispatcherBP
    - Mean parameter is added.
    - Monitor window updates the min and max changes.
  + yk.paf
    - A new abstraction to be used in place of paf~ external.
  + yk.pafBP
    - An abstraction yk.paf replaced the external object paf~, and this module is 64-bit compatible.
    - Fixed randomness control for shift, vibDepth, and vibFreq.
  + yk.fofBP
    - IRCAM has deprecated the 32-bit external object fofb~ and replaced it with the 64-bit external object fof~ with which the updated yk.fofBP works.
    - 2ch version is added and 8ch version is removed as a result to better work with the new external.
* ver. 1.05 (Sep 16, 2015)
  + yk.noiseGeneratorBP
    - Noise generation can be triggered by an external Max message.
  + yk.dispatcherBP
    - Linear interpolation time parameter is added for number inputs.
  + yk.audioOutputBP
    - Mira control has deprecated.
    - UI design has changed for a performance situation.
  + yk.samplePlayerPoly2(/4/8)chBP
    - An integer 0 to the left inlet stops playing all the voices.
    - Setting the file directory either by Max message or mouse interaction automatically loads the file names to coll.
  + yk.onsetDetectorBP
    - A new parameter “minPower” is added. This parameter sets the minimum required power of a FFT frame (i.e., log10 of total bin amp) to discern the detected onsets, and thus can be employed to filter out the onsets from unwanted noise.
    - Onset detection interval is fixed to 20 ms and calcInt parameter is removed.
  + yk.spectralMorphBP
    - The algorithm is thoroughly reworked. The module no longer causes crashes when used with some other Jitter objects:
      * “data” operators in gen~ are employed for the 2 dimensional arrays instead of Jitter matrices.
        + Use of Jitter matrices had required to use jit.qball in pfft~ for the data process in Max scheduler time, yet caused threading issues with other Jitter objects (e.g., jit.qt.grab, etc) and crashed Max.
      * For the use of data in gen~, the module processes the signal at 64 bit audio.
      * The spectral domain process is done entirely by signal, and thus the frame interpolation interval (which was set to 20 ms in the previous version) is synchronized with spectral signal vector size (i.e., FFTSize /2).
    - The module parameters are kept the same as before.
  + yk.spectralRouterBPTest2
    - As yk.spectralMorph has been revised, the module is a part of the test patch without an issue about threading with yk.phaseVocoderBP.
  + yk.filterBP
    - The output signal no longer peaks when the cutoff frequency is set high.
  + yk.PAFBP and yk.PAF8chBP
    - Maximum duration is extended to 60 seconds.
    - Duration parameter change does not reset its BPF.
    - The maximum amp factor of paf~ is adjusted for producing sounds at useful parameter ranges.
    - Zoom sliders are added for the envelopes.
  + yk.echoBP and yk.echo2chBP
    - delTime parameter is in the pattr preset chain.
  + yk.delay16BP (all versions)
    - Feedback circuit precedes the amplitude control of the first tap.
  + yk.compressorBP and yk.compressor2chBP
    - Linear gain scale factor is shown in the module and thus the 3rd outlet for this data is removed.
  + yk.additive(2ch/8ch)BP
    - Patter preset recall reflects the change of frequency modulation function.
  + yk.spectralRouterBP
    - Min and max values for the inGain parameter are set.
  + yk.listDel
    - The right inlet takes “stop” to cancel the delay and clears the internal buffer.
  + yk.clip.crossbarSwitch64
    - Slot names are stored in the preset object.
  + yk.clip.crossbarSwitch128
    - Slot names are stored in the preset object.
    - The text associated with the slot #65 can be properly recalled.
* ver. 1.04 (July 14, 2015)
  + New modules:
    - yk.morphingHarmonics
    - yk.AMBP
    - yk.dispatcherBP
    - yk.spectralRouterBP
      * Note that the module previously named yk.spectralRouterBP is now renamed to yk.spectralDisperserBP.
    - yk.spectralDisperserBP
    - yk.spectralCentroidBP
    - yk.spectralDecreaseBP
    - yk.spectralSlopeBP
    - yk.spectralSpreadBP
  + All of delay modules
    - The noise gate precedes the input gain control (proper signal processing order).
  + yk.pitchTrackerBP
    - Input gain control properly works.
    - Hop size is fixed to 512 samples for all FFT sizes.
    - noiseGate is added and manpower parameter is removed as being fixed to 40dB.
    - Envelope output is discontinued (use envFollower for this purpose).
    - Error picking is refined.
  + yk.noiseGate
    - 2nd outlet is added for outputting threshold crossing flags.
  + yk.spectralWarpBP
    - Spectrum transfer function can smoothly interpolate.
  + yk.chebyshev
    - The linked buffer is removed from the abstraction and can be placed outside of the abstraction.
  + yk.additiveBP
    - Options for partial waveform type are added.
    - Waveshaper feature is deprecated.
    - Number of partial tracks is variable.
  + yk.ringModBP
    - The options for modulator waveforms are removed.
  + yk.spectralMixerBP
    - 2ch and 3ch version are differentiated by the send/receive names for their independent symbolic connections.
* ver. 1.03 (May 9, 2015)
  + New modules:
    - yk.antescofoBP
    - yk.fofBP
    - yk.gaussianMixtureBP
    - yk.instSynthBP
    - yk.macroHarpBP
    - yk.samplePlayerPolyBP
    - yk.echoBP
    - yk.spectralMixerBP
    - yk.noiseGeneratorBP
    - yk.pafBP
  + yk.additiveBP
    - FFT size can be selected from 1024, 2048, 4096 (hop size is fixed to 512 for all).
  + yk.probTable
    - The size parameter properly scales the output value.
  + yk.reverbBP
    - The reverb algorithm is changed to that of gigaverb.
  + yk.KSBP
    - Damping parameter works properly.
  + yk.spectralFMBP
    - The cross-synthesis algorithm is fixed.
  + yk.spectralFilterBP
    - The module now reads the correct bin indices in the extIn modes.
    - The fundamental frequency for Chromax operation is now by MIDI pitch instead of Hz, and up to 4 fundamentals can be superposed in the spectral filter function.
    - Optimized for efficient CPU usage
  + yk.samplePlayerBP
    - Sampling rate change in DSP reflects on the playback speed properly.
  + yk.spectralMorphBP
    - The module now reads the correct bin indices in the extIn modes.
    - Down-sampling on Jitter processing on smaller arrays (reduced to 10 frames) is optimized and have significantly improved the CPU usage.
  + yk.spectralDelayBP
    - Chromax is now integrated for buffer generation.
    - Optimized for efficient CPU usage.
  + yk.grainDelayBP and yk.grainCloudDelayBP
    - Internal feedback is removed.
  + An input gain parameter is added to all the applicable effects and sensor modules.
* ver. 1.02 (Feb 22, 2015)
  + yk.spectralMorph BP
    - Spectral cross Spectral crossfading is now taken place in the low priority thread, which remedies a crash issue caused in a particular situation such as when used with jit.qt.grab.
      * This change is reverted as of ver. 1.03 for the reason described in the Known Issues section above.
* ver. 1.01 (Jan 2, 2015)
  + yk.resonatorBP
    - A new module
  + yk.reverbBP
    - Parameter changes for infinite reverb ode is treated in the background.
  + yk.vocoderBP
    - Noise issue, as found in Max 6.1.8, is resolved in 6.1.9.
  + yk.spectralWarpBP
    - Fixed the issue of the state of the function UI not recalled from a parent pattrstorage when set to changemode 1.
  + yk.morphingWave
    - Improved waveform production.
  + yk.ringModBP
    - Options added for the modulator waveforms.
  + yk.spectralBatchAnalyzerBP
    - Produces jxf files with spectral data of FFT size 2048 and overlap factor 8 which is compatible with the updated yk.phaseVocoderBP (see below); also fixed the problem of phase difference not being recorded.
  + yk.phaseVocoderBP
    - FFT overlap factor is changed from 4 to 8 for a better time resolution and a new option for a symbolic connection to subsequent spectral FX modules. So, there is a new parameter “mode” for switching between internal and external output. For more detail, see the in-patch info document.
  + yk.spectralFilterBP
    - “shift” parameter controls the fundamental frequency correctly. Also many thanks to Arshia Cont and Marco Stroppa at IRCAM for the revision of Chromax object, fixing the issues of unnecessary buffer size changes; mismatch of the number of harmonics, stretch factor affective only the 3rd harmonic and above. Note that the module uses the latest version of chromax.mxo (Dec 2014 build) - included in the “third-party” folder.
* ver. 1.00 (Sep 1, 2014)
  + First release