
pysptk Documentation

Release 0.1.3

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Aug 03, 2018

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A python wrapper for Speech Signal Processing Toolkit (SPTK).

<https://github.com/r9y9/pysptk>

CHAPTER 1

Full documentation

A full documentation of SPTK is available at <http://sp-tk.sourceforge.net>.

The wrapper is based on a modified version of SPTK (r9y9/SPTK)

2.1 Installation guide

The latest release is available on pypi. You can install it by:

```
pip install pysptk
```

Note that you have to install `numpy` to build C-extensions.

If you want the latest development version, run:

```
pip install git+https://github.com/r9y9/pysptk
```

or:

```
git clone https://github.com/r9y9/pysptk
cd pysptk
python setup.py develop # or install
```

This should resolve the package dependencies and install `pysptk` properly.

Note: If you use the development version, you need to have `cython` (and C compiler) installed to compile cython module(s).

2.1.1 For Windows users

There are some binary wheels available on pypi, so you can install `pysptk` via `pip` **without cython and C compiler** if there exists a binary wheel that matches your environment (depends on bits of system and python version). For now, wheels are available for:

- Python 2.7 on 32 bit system

- Python 2.7 on 64 bit system
- Python 3.4 on 32 bit system

If there is no binary wheel available for your environment, you can build `pysptk` from the source distribution, which is also available on pypi. Note that in order to compile `pysptk` from source in Windows, it is highly recommended to use [Anaconda](#) , since installation of numpy, cython and other scientific packages is really easy. In fact, continuous integration in Windows on AppVeyor uses Anaconda to build and test `pysptk`. See [pysptk/appveyor.yml](#) for the exact build steps.

3.1 API

3.1.1 Core SPTK API

All functionality in `pysptk.sptk` is directly accesible from the top-level `pysptk.*` namespace.

Note: Almost all of `pysptk` functions assume that the input array is **C-contiguous** and has `float64` element type.

Library routines

<code>agexp</code>	Magnitude squared generalized exponential function
<code>gexp</code>	Generalized exponential function
<code>glog</code>	Generalized logarithmic function
<code>mseq</code>	M-sequence

`pysptk.sptk.agexp`

`pysptk.sptk.agexp()`
Magnitude squared generalized exponential function

Parameters

- r** [float] Gamma
- x** [float] Real part
- y** [float] Imaginary part

Returns

Value

pysptk.sptk.gexp

`pysptk.sptk.gexp()`
Generalized exponential function

Parameters

r [float] Gamma
x [float] Arg

Returns

Value

pysptk.sptk.glog

`pysptk.sptk.glog()`
Generalized logarithmic function

Parameters

r [float] Gamma
x [float] Arg

Returns

Value

pysptk.sptk.mseq

`pysptk.sptk.mseq()`
M-sequence

Returns

A sample of m-sequence

Adaptive cepstrum analysis

<i>acep</i>	Adaptive cepstral analysis
<i>agcep</i>	Adaptive generalized cepstral analysis
<i>amcep</i>	Adaptive mel-cepstral analysis

pysptk.sptk.acep

`pysptk.sptk.acep()`
Adaptive cepstral analysis

Parameters

x [double] A input sample

c [array, shape(`order` + 1)] Cepstrum. The result is stored in place.

lambda_coef [float, optional] Leakage factor. Default is 0.98.

step [float, optional] Step size. Default is 0.1.

tau [float, optional] Momentum constant. Default is 0.9.

pd [int, optional] Order of pade approximation. Default is 4.

eps [float, optional] Minimum value for epsilon. Default is 1.0e-6.

Returns

prederr [float] Prediction error

Raises

ValueError if invalid order of pade approximation is specified

See also:

pysptk.sptk.uels, *pysptk.sptk.gcep*, *pysptk.sptk.mcep*, *pysptk.sptk.mgcep*,
pysptk.sptk.amcep, *pysptk.sptk.agcep*, *pysptk.sptk.lmadf*

pysptk.sptk.agcep

`pysptk.sptk.agcep()`

Adaptive generalized cepstral analysis

Parameters

x [float] A input sample

c [array, shape(`order` + 1), optional] Cepstrum. The result is stored in-place.

stage [int, optional] -1 / gamma. Default is 1.

lambda_coef [float, optional] Leakage factor. Default is 0.98.

step [float, optional] Step size. Default is 0.1.

tau [float, optional] Momentum constant. Default is 0.9.

eps [float, optional] Minimum value for epsilon. Default is 1.0e-6.

Returns

prederr [float] Prediction error

Raises

ValueError if invalid number of stage is specified

See also:

pysptk.sptk.acep, *pysptk.sptk.amcep*, *pysptk.sptk.glsadf*

pysptk.sptk.amcep

`pysptk.sptk.amcep()`

Adaptive mel-cepstral analysis

Parameters

x [float] A input sample

b [array, shape(`order` + 1), optional] MLSA filter coefficients. The result is stored in-place.

alpha [float, optional] All-pass constant. Default is 0.35.

lambda_coef [float, optional] Leakage factor. Default is 0.98.

step [float, optional] Step size. Default is 0.1.

tau [float, optional] Momentum constant. Default is 0.9.

pd [int, optional] Order of pade approximation. Default is 4.

eps [float, optional] Minimum value for epsilon. Default is 1.0e-6.

Returns

prederr [float] Prediction error

Raises

ValueError if invalid order of pade approximation is specified

See also:

`pysptk.sptk.acep`, `pysptk.sptk.agcep`, `pysptk.sptk.mc2b`, `pysptk.sptk.b2mc`,
`pysptk.sptk.mlsadf`

Mel-generalized cepstrum analysis

<code>mcep</code>	Mel-cepstrum analysis
<code>gcep</code>	Generalized-cepstrum analysis
<code>mgcep</code>	Mel-generalized cepstrum analysis
<code>uels</code>	Unbiased estimation of log spectrum
<code>fftcep</code>	FFT-based cepstrum analysis
<code>lpc</code>	Linear prediction analysis

`pysptk.sptk.mcep`

`pysptk.sptk.mcep()`
Mel-cepstrum analysis

Parameters

windowed [array, shape (`frame_len`)] A windowed frame

order [int, optional] Order of mel-cepstrum. Default is 25.

alpha [float, optional] All pass constant. Default is 0.35.

miniter [int, optional] Minimum number of iteration. Default is 2.

maxiter [int, optional] Maximum number of iteration. Default is 30.

threshold [float, optional] Threshold in theq. Default is 0.001.

etype [int, optional]

Type of parameter **eps**

0. not used

1. initial value of log-periodogram

2. floor of periodogram in db

Default is 0.

eps [float, optional] Initial value for log-periodogram or floor of periodogram in db. Default is 0.0.

min_det [float, optional] Minimum value of the determinant of normal matrix. Default is $1.0e-6$

itype [float, optional]

Input data type

- 0. windowed signal
- 1. log amplitude in db
- 2. log amplitude
- 3. amplitude
- 4. periodogram

Default is 0.

Returns

mc [array, shape (order + 1)] Mel-cepstrum

Raises

ValueError

- if invalid `itype` is specified
- if invalid `etype` is specified
- if nonzero `eps` is specified when `etype = 0`
- if negative `eps` is specified
- if negative `min_det` is specified

RuntimeError

- if zero(s) are found in periodogram
- if error happened in theq

See also:

pysptk.sptk.uels, pysptk.sptk.gcep, pysptk.sptk.mgcep, pysptk.sptk.mlsadf

pysptk.sptk.gcep

`pysptk.sptk.gcep()`
Generalized-cepstrum analysis

Parameters

windowed [array, shape (frame_len)] A windowed frame

order [int, optional] Order of generalized-cepstrum. Default is 25.

gamma [float, optional] Parameter of generalized log function. Default is 0.0.

miniter [int, optional] Minimum number of iteration. Default is 2.

maxiter [int, optional] Maximum number of iteration. Default is 30.

threshold [float, optional] Threshold in theq. Default is 0.001

etype [int, optional]

Type of parameter eps

0. not used
1. initial value of log-periodogram
2. floor of periodogram in db

Default is 0.

eps [float, optional] Initial value for log-periodogram or floor of periodogram in db. Default is 0.0.

min_det [float, optional] Minimum value of the determinant of normal matrix. Default is 1.0e-6.

itype [float, optional]

Input data type

0. windowed signal
1. log amplitude in db
2. log amplitude
3. amplitude
4. periodogram

Default is 0.

Returns

gc [array, shape (order + 1)] Generalized cepstrum

Raises

ValueError

- if invalid `itype` is specified
- if invalid `etype` is specified
- if nonzero `eps` is specified when `etype = 0`
- if negative `eps` is specified
- if negative `min_det` is specified

RuntimeError

- if error happened in theq

See also:

`pysptk.sptk.uels`, `pysptk.sptk.mcep`, `pysptk.sptk.mgcep`, `pysptk.sptk.glsadf`

pysptk.sptk.mgcep`pysptk.sptk.mgcep()`

Mel-generalized cepstrum analysis

Parameters**windowed** [array, shape (frame_len)] A windowed frame**order** [int, optional] Order of mel-generalized cepstrum. Default is 25.**alpha** [float, optional] All pass constant. Default is 0.35.**gamma** [float, optional] Parameter of generalized log function. Default is 0.0.**num_recursions** [int, optional] Number of recursions. Default is $\text{len}(\text{windowed}) - 1$.**miniter** [int, optional] Minimum number of iteration. Default is 2.**maxiter** [int, optional] Maximum number of iteration. Default is 30.**threshold** [float, optional] Threshold. Default is 0.001.**etype** [int, optional]**Type of parameter e**

- 0. not used
- 1. initial value of log-periodogram
- 2. floor of periodogram in db

Default is 0.

eps [float, optional] Initial value for log-periodogram or floor of periodogram in db. Default is 0.0.**min_det** [float, optional] Minimum value of the determinant of normal matrix. Default is $1.0e-6$.**itype** [float, optional]**Input data type**

- 0. windowed signal
- 1. log amplitude in db
- 2. log amplitude
- 3. amplitude
- 4. periodogram

Default is 0.

otype [int, optional]**Output data type**

- 0. mel generalized cepstrum: $(c_0 \dots c_m)$
- 1. MGLSA filter coefficients: $b_0 \dots b_m$
- 2. $K, c_1 \dots c_m$
- 3. $K, b_1 \dots b_m$
- 4. $K, g_1 \dots g_m$

5. $K, g*b'1...g*b'm$

Default is 0.

Returns

mgc [array, shape (order + 1)] mel-generalized cepstrum

Raises

ValueError

- if invalid `itype` is specified
- if invalid `etype` is specified
- if nonzero `eps` is specified when `etype` = 0
- if negative `eps` is specified
- if negative `min_det` is specified
- if invalid `otype` is specified

RuntimeError

- if error happened in theq

See also:

`pysptk.sptk.uels`, `pysptk.sptk.gcep`, `pysptk.sptk.mcep`, `pysptk.sptk.freqt`,
`pysptk.sptk.gc2gc`, `pysptk.sptk.mgc2mgc`, `pysptk.sptk.gnorm`, `pysptk.sptk.mglisadf`

pysptk.sptk.uels

`pysptk.sptk.uels()`

Unbiased estimation of log spectrum

Parameters

windowed [array, shape (frame_len)] A windowed frame

order [int, optional] Order of cepstrum. Default is 25.

miniter [int, optional] Minimum number of iteration. Default is 2.

maxiter [int, optional] Maximum number of iteration. Default is 30.

threshold [float, optional] Threshold in theq. Default is 0.001

etype [int, optional]

Type of parameter **eps**

0. not used
1. initial value of log-periodogram
2. floor of periodogram in db

Default is 0.

eps [float, optional] Initial value for log-periodogram or floor of periodogram in db. Default is 0.0.

itype [float, optional]

Input data type

0. windowed signal
1. log amplitude in db
2. log amplitude
3. amplitude
4. periodogram

Default is 0.

Returns

c [array, shape (order + 1)] cepstrum estimated by uels

Raises**ValueError**

- if invalid `itype` is specified
- if invalid `etype` is specified
- if nonzero `eps` is specified when `etype` = 0
- if negative `eps` is specified

RuntimeError

- if zero(s) are found in periodogram

See also:

[pysptk.sptk.gcep](#), [pysptk.sptk.mcep](#), [pysptk.sptk.mgcep](#), [pysptk.sptk.lmadf](#)

pysptk.sptk.fftcep

`pysptk.sptk.fftcep()`

FFT-based cepstrum analysis

Parameters

logsp [array, shape (frame_len)] Log power spectrum
order [int, optional] Order of cepstrum. Default is 25.
num_iter [int, optional] Number of iteration. Default is 0.
acceleration_factor [float, optional] Acceleration factor. Default is 0.0.

Returns

c [array, shape (order + 1)] Cepstrum

See also:

[pysptk.sptk.uels](#)

pysptk.sptk.lpc

`pysptk.sptk.lpc()`

Linear prediction analysis

Parameters

windowed [array, shape (frame_len)] A windowed frame

order [int, optional] Order of LPC. Default is 25.

min_det [float, optional] Minimum value of the determinant of normal matrix. Default is 1.0e-6.

Returns

a [array, shape (order + 1)] LPC

Raises

ValueError

- if negative min_det is specified

RuntimeError

- if error happened in levdur

See also:

pysptk.sptk.lpc2par, pysptk.sptk.par2lpc, pysptk.sptk.lpc2c, pysptk.sptk.lpc2lsp, pysptk.sptk.ltcdf, pysptk.sptk.lspdf

MFCC

<i>mfcc</i>	MFCC
-------------	------

pysptk.sptk.mfcc

`pysptk.sptk.mfcc()`

MFCC

Parameters

x [array] A input signal

order [int, optional] Order of MFCC. Default is 14.

fs [int, optional] Sampling frequency. Default is 160000.

alpha [float, optional] Pre-emphasis coefficient. Default is 0.97.

eps [float, optional] Flooring value for calculating $\log(x)$ in filterbank analysis. Default is 1.0.

window_len [int, optional] Window length. Default is `len(x)`.

frame_len [int, optional] Frame length. Default is `len(x)`.

num_filterbanks [int, optional] Number of mel-filter banks. Default is 20.

cepslift [int, optional] Liftering coefficient. Default is 22.

use_dft [bool, optional] Use DFT (not FFT) or not. Default is False.

use_hamming [bool, optional] Use hamming window or not. Default is False.

czero [bool, optional] If True, `mfcc` returns 0-th coefficient as well. Default is False.

power [bool, optional] If True, `mfcc` returns power coefficient as well. Default is False.

Returns

cc [array] MFCC vector, which is ordered as:

`mfcc[0]`, `mfcc[1]`, `mfcc[2]`, ... `mfcc[order-1]`, `c0`, Power.

Note that `c0` and Power are optional.

Shape of `cc` is:

- `order` by default.
- `order + 1` if `czero` or `power` is set to True.
- `order + 2` if both `czero` and `power` is set to True.

Raises

ValueError if `num_filterbanks` is less than or equal to `order`

See also:

`pysptk.sptk.gcep`, `pysptk.sptk.mcep`, `pysptk.sptk.mgcep`

LPC, LSP and PARCOR conversions

<i><code>lpc2c</code></i>	LPC to cepstrum
<i><code>lpc2lsp</code></i>	LPC to LSP
<i><code>lpc2par</code></i>	LPC to PARCOR
<i><code>par2lpc</code></i>	PARCOR to LPC
<i><code>lsp2sp</code></i>	LSP to spectrum

`pysptk.sptk.lpc2c`

`pysptk.sptk.lpc2c()`

LPC to cepstrum

Parameters

lpc [array] LPC

order [int, optional] Order of cepstrum. Default is `len(lpc) - 1`.

Returns

ceps [array, shape (`order + 1`)] cepstrum

See also:

`pysptk.sptk.lpc`, `pysptk.sptk.lspdf`

pysptk.sptk.lpc2lsp

`pysptk.sptk.lpc2lsp()`

LPC to LSP

Parameters

lpc [array] LPC

numsp [int, optional] Number of unit circle. Default is 512.

maxiter [int, optional] Maximum number of iteration. Default is 4.

eps [float, optional] End condition for iteration. Default is 1.0e-6.

loggain [bool, optional] whether the converted lsp should have loggain or not. Default is False.

fs [int, optional] Sampling frequency. Default is None and unused.

otype [int, optional]

Output format LSP

0. normalized frequency (0 ~ pi)
1. normalized frequency (0 ~ 0.5)
2. frequency (kHz)
3. frequency (Hz)

Default is 0.

Returns

lsp [array, shape (order + 1)] LSP

Raises

ValueError if `fs` is not specified when `otype` = 2 or 3.

See also:

pysptk.sptk.lpc, pysptk.sptk.lspdf

pysptk.sptk.lpc2par

`pysptk.sptk.lpc2par()`

LPC to PARCOR

Parameters

lpc [array] LPC

Returns

par [array, shape (same as lpc)] PARCOR

See also:

pysptk.sptk.lpc, pysptk.sptk.par2lpc, pysptk.sptk.ltcdf

pysptk.sptk.par2lpc

`pysptk.sptk.par2lpc()`
PARCOR to LPC

Parameters

par [array] PARCOR

Returns

lpc [array, shape (same as par)] LPC

See also:

pysptk.sptk.lpc, pysptk.sptk.lpc2par

pysptk.sptk.lsp2sp

`pysptk.sptk.lsp2sp()`
LSP to spectrum

Parameters

lsp [array] LSP

ffflen [int, optional] FFT length

TODO: consider “otype“ optional argument

Returns

sp [array, shape] Spectrum. $\ln|H(z)|$.

See also:

pysptk.sptk.lpc2par

Notes

It is assumed that `lsp` has loggain at `lsp[0]`.

Mel-generalized cepstrum conversions

<i>mc2b</i>	Mel-cepstrum to MLSA filter coefficients
<i>b2mc</i>	MLSA filter coefficients to mel-cepstrum
<i>c2acr</i>	Cepstrum to autocorrelation
<i>c2ir</i>	Cepstrum to impulse response
<i>ic2ir</i>	Impulse response to cepstrum
<i>c2ndps</i>	Cepstrum to Negative Derivative of Phase Spectrum (NDPS)
<i>ndps2c</i>	Cepstrum to Negative Derivative of Phase Spectrum (NDPS)
<i>gc2gc</i>	Generalized cepstrum transform
<i>gnorm</i>	Gain normalization
<i>ignorm</i>	Inverse gain normalization

Continued on next page

Table 6 – continued from previous page

<i>freqt</i>	Frequency transform
<i>mgc2mgc</i>	Mel-generalized cepstrum transform
<i>mgc2sp</i>	Mel-generalized cepstrum transform
<i>mgclsp2sp</i>	MGC-LSP to spectrum

pysptk.sptk.mc2b

`pysptk.sptk.mc2b()`

Mel-cepsrum to MLSA filter coefficients

Parameters

mc [array, shape] Mel-cepstrum.

alpha [float, optional] All-pass constant. Default is 0.35.

Returns

b [array, shape(same as mc)] MLSA filter coefficients

See also:

pysptk.sptk.mlsadf, *pysptk.sptk.mgladf*, *pysptk.sptk.b2mc*, *pysptk.sptk.mcep*,
pysptk.sptk.mgcep, *pysptk.sptk.amcep*

pysptk.sptk.b2mc

`pysptk.sptk.b2mc()`

MLSA filter coefficients to mel-cepsrum

Parameters

b [array, shape] MLSA filter coefficients

alpha [float, optional] All-pass constant. Default is 0.35.

Returns

mc [array, shape (same as b)] Mel-cepstrum.

See also:

pysptk.sptk.mc2b, *pysptk.sptk.mcep*, *pysptk.sptk.mlsadf*

pysptk.sptk.c2acr

`pysptk.sptk.c2acr()`

Cepstrum to autocorrelation

Parameters

c [array] Cepstrum

order [int, optional] Order of cepstrum. Default is `len(c) - 1`.

ffflen [int, optional] FFT length. Default is 256.

Returns

r [array, shape (order + 1)] Autocorrelation

Raises

ValueError if non power of 2 `fftlen` is specified

See also:

pysptk.sptk.uels, pysptk.sptk.c2ir, pysptk.sptk.lpc2c

pysptk.sptk.c2ir

`pysptk.sptk.c2ir()`

Cepstrum to impulse response

Parameters

c [array] Cepstrum

length [int, optional] Length of impulse response. Default is 256.

Returns

h [array, shape (length)] impulse response

See also:

pysptk.sptk.c2acr

pysptk.sptk.ic2ir

`pysptk.sptk.ic2ir()`

Impulse response to cepstrum

Parameters

h [array] Impulse response

order [int, optional] Order of cepstrum. Default is 25.

Returns

c [array, shape (order + 1)] Cepstrum

See also:

pysptk.sptk.c2ir

pysptk.sptk.c2ndps

`pysptk.sptk.c2ndps()`

Cepstrum to Negative Derivative of Phase Spectrum (NDPS)

Parameters

c [array] Cepstrum

fftlen [int, optional] FFT length. Default is 256.

Returns

ndps [array, shape (fftlen // 2 + 1)] NDPS

Raises

ValueError if non power of 2 `fftlen` is specified

See also:

`pysptk.sptk.mgcep`, `pysptk.sptk.ndps2c`

pysptk.sptk.ndps2c

`pysptk.sptk.ndps2c()`

Cepstrum to Negative Derivative of Phase Spectrum (NDPS)

Parameters

ndps [array, shape (`fftlen` // 2 + 1)] NDPS

order [int, optional] Order of cepstrum. Default is 25.

Returns

c [array, shape (`order` + 1)] Cepstrum

Raises

ValueError if non power of 2 `fftlen` is detected

See also:

`pysptk.sptk.mgc2sp`, `pysptk.sptk.c2ndps`

pysptk.sptk.gc2gc

`pysptk.sptk.gc2gc()`

Generalized cepstrum transform

Parameters

src_ceps [array] Generalized cepstrum.

src_gamma [float, optional] Gamma of source cepstrum. Default is 0.0.

dst_order [int, optional] Order of destination cepstrum. Default is `len(src_ceps) - 1`.

dst_gamma [float, optional] Gamma of destination cepstrum. Default is 0.0.

Returns

dst_ceps [array, shape (`dst_order` + 1)] Converted generalized cepstrum

Raises

ValueError

- if invalid `src_gamma` is specified
- if invalid `dst_gamma` is specified

See also:

`pysptk.sptk.gcep`, `pysptk.sptk.mgcep`, `pysptk.sptk.freqt`, `pysptk.sptk.mgc2mgc`, `pysptk.sptk.lpc2c`

pysptk.sptk.gnorm

`pysptk.sptk.gnorm()`

Gain normalization

Parameters

ceps [array] Generalized cepstrum.

gamma [float, optional] Gamma. Default is 0.0.

Returns

dst_ceps [array, shape(same as ceps)] Normalized generalized cepstrum

Raises

ValueError if invalid gamma is specified

See also:

pysptk.sptk.ignorm, pysptk.sptk.gcep, pysptk.sptk.mgcep, pysptk.sptk.gc2gc, pysptk.sptk.mgc2mgc, pysptk.sptk.freqt

pysptk.sptk.ignorm

`pysptk.sptk.ignorm()`

Inverse gain normalization

Parameters

c [array] Normalized generalized cepstrum

gamma [float, optional] Gamma. Default is 0.0.

Returns

dst_ceps [array, shape (same as ceps)] Generalized cepstrum

Raises

ValueError if invalid gamma is specified

See also:

pysptk.sptk.gnorm, pysptk.sptk.gcep, pysptk.sptk.mgcep, pysptk.sptk.gc2gc, pysptk.sptk.mgc2mgc, pysptk.sptk.freqt

pysptk.sptk.freqt

`pysptk.sptk.freqt()`

Frequency transform

Parameters

ceps [array] Cepstrum.

order [int, optional] Desired order of transformed cepstrum. Default is 25.

alpha [float, optional] All-pass constant. Default is 0.0.

Returns

dst_ceps [array, shape(order + 1)] frequency transformed cepstrum (typically mel-cepstrum)

See also:

pysptk.sptk.mgc2mgc

pysptk.sptk.mgc2mgc

`pysptk.sptk.mgc2mgc()`
Mel-generalized cepstrum transform

Parameters

src_ceps [array] Mel-generalized cepstrum.
src_alpha [float, optional] All-pass constant of source cepstrum. Default is 0.0.
src_gamma [float, optional] Gamma of source cepstrum. Default is 0.0.
dst_order [int, optional] Order of destination cepstrum. Default is `len(src_ceps) - 1`.
dst_alpha [float, optional] All-pass constant of destination cepstrum. Default is 0.0.
dst_gamma [float, optional] Gamma of destination cepstrum. Default is 0.0.

Returns

dst_ceps [array, shape(dst_order + 1)] Converted mel-generalized cepstrum

Raises

ValueError

- if invalid `src_gamma` is specified
- if invalid `dst_gamma` is specified

See also:

pysptk.sptk.uels, *pysptk.sptk.gcep*, *pysptk.sptk.mcep*, *pysptk.sptk.mgcep*,
pysptk.sptk.gc2gc, *pysptk.sptk.freqt*, *pysptk.sptk.lpc2c*

pysptk.sptk.mgc2sp

`pysptk.sptk.mgc2sp()`
Mel-generalized cepstrum transform

Parameters

ceps [array] Mel-generalized cepstrum.
alpha [float, optional] All-pass constant. Default is 0.0.
gamma [float, optional] Gamma. Default is 0.0.
fftlens [int, optional] FFT length. Default is 256.

Returns

sp [array, shape(fftlens // 2 + 1)] Complex spectrum

Raises

ValueError

- if invalid `gamma` is specified
- if non power of 2 `fftl` is specified

See also:

`pysptk.sptk.mgc2mgc`, `pysptk.sptk.gc2gc`, `pysptk.sptk.freqt`, `pysptk.sptk.gnorm`,
`pysptk.sptk.lpc2c`

pysptk.sptk.mgclsp2sp

`pysptk.sptk.mgclsp2sp()`
 MGC-LSP to spectrum

Parameters

- lsp** [array] MGC-LSP
- alpha** [float, optional] All-pass constant. Default is 0.0.
- gamma** [float, optional] Gamma. Default is 0.0.
- fftl** [int, optional] FFT length. Default is 256.
- gain** [bool, optional] Whether the input MGC-LSP should have loggain or not. Default is True.

Returns

sp [array, shape (fftl $\div$ 2 + 1)] Complex spectrum

Raises

ValueError

- if invalid `gamma` is specified
- if non power of 2 `fftl` is specified

See also:

`pysptk.sptk.mgc2mgc`

F0 analysis

swipe

SWIPE' - A Saw-tooth Waveform Inspired Pitch Estimation

pysptk.sptk.swipe

`pysptk.sptk.swipe()`
 SWIPE' - A Saw-tooth Waveform Inspired Pitch Estimation

Parameters

- x** [array] A whole audio signal
- fs** [int] Sampling frequency.
- hopsize** [int] Hop size.
- min** [float, optional] Minimum fundamental frequency. Default is 50.0

max [float, optional] Maximum fundamental frequency. Default is 800.0

threshold [float, optional] Voice/unvoiced threshold. Default is 0.3.

otype [int, optional] Output format (0) pitch (1) f0 (2) log(f0). Default is 1.

Returns

f0 [array, shape(len(x) / frame_shift+1)] Estimated f0 trajectory

Raises

ValueError if invalid otype is specified

Examples

Window functions

<i>blackman</i>	Blackman window
<i>hamming</i>	Hamming window
<i>hanning</i>	Hanning window
<i>bartlett</i>	Bartlett window
<i>trapezoid</i>	Trapezoid window
<i>rectangular</i>	Rectangular window

pysptk.sptk.blackman

pysptk.sptk.**blackman**()

Blackman window

Parameters

n [int] Window length

normalize [int, optional]

Normalization flag

0. don't normalize

1. normalize by power

2. normalize by magnitude

Default is 0.

Returns

w [array, shape (n,)] blackman window

pysptk.sptk.hamming

pysptk.sptk.**hamming**()

Hamming window

Parameters

n [int] Window length

normalize [int, optional]

Normalization flag

- 0. don't normalize
- 1. normalize by power
- 2. normalize by magnitude

Default is 0.

Returns

w [array, shape (n,)] hamming window

pysptk.sptk.hanning

`pysptk.sptk.hanning()`
Hanning window

Parameters

n [int] Window length

normalize [int, optional]

Normalization flag

- 0. don't normalize
- 1. normalize by power
- 2. normalize by magnitude

Default is 0.

Returns

w [array, shape (n,)] hanning window

pysptk.sptk.bartlett

`pysptk.sptk.bartlett()`
Bartlett window

Parameters

n [int] Window length

normalize [int, optional]

Normalization flag

- 0. don't normalize
- 1. normalize by power
- 2. normalize by magnitude

Default is 0.

Returns

w [array, shape (n,)] bartlett window

pysptk.sptk.trapezoid

`pysptk.sptk.trapezoid()`

Trapezoid window

Parameters

n [int] Window length

normalize [int, optional]

Normalization flag

0. don't normalize

1. normalize by power

2. normalize by magnitude

Default is 0.

Returns

w [array, shape (n,)] trapezoid window

pysptk.sptk.rectangular

`pysptk.sptk.rectangular()`

Rectangular window

Parameters

n [int] Window length

normalize [int, optional]

Normalization flag

0. don't normalize

1. normalize by power

2. normalize by magnitude

Default is 0.

Returns

w [array, shape (n,)] rectangular window

Waveform generation filters

<i>poledf</i>	All-pole digital filter
<i>lmadf</i>	LMA digital filter
<i>lspdf</i>	LSP synthesis digital filter
<i>ltcdf</i>	All-pole lattice digital filter
<i>glsadf</i>	GLSA digital filter
<i>mlsadf</i>	MLSA digital filter
<i>mglسادf</i>	MGLSA digital filter

pysptk.sptk.poledf

`pysptk.sptk.poledf()`

All-pole digital filter

Parameters

x [float] A input sample

a [array] AR coefficients

delay [array] Delay

Returns

y [float] A filtered sample

Raises

ValueError if invalid delay length is supplied

See also:

pysptk.sptk.lpc, pysptk.sptk.ltcdf, pysptk.sptk.lmadf

pysptk.sptk.lmadf

`pysptk.sptk.lmadf()`

LMA digital filter

Parameters

x [float] A input sample

c [array] Cepstrum

pd [int] Order of pade approximation

delay [array] Delay

Returns

y [float] A filtered sample

Raises

ValueError

- if invalid order of pade approximation is specified
- if invalid delay length is supplied

See also:

pysptk.sptk.uels, pysptk.sptk.acep, pysptk.sptk.poledf, pysptk.sptk.ltcdf, pysptk.sptk.glsadf, pysptk.sptk.mlsadf, pysptk.sptk.mgladf

pysptk.sptk.lspdf

`pysptk.sptk.lspdf()`

LSP synthesis digital filter

Parameters

x [float] A input sample

f [array] LSP coefficients

delay [array] Delay

Returns

y [float] A filtered sample

Raises

ValueError if invalid delay length is supplied

See also:

pysptk.sptk.lpc2lsp

pysptk.sptk.ltcdtf

`pysptk.sptk.ltcdtf()`

All-pole lattice digital filter

Parameters

x [float] A input sample

k [array] PARCOR coefficients.

delay [array] Delay

Returns

y [float] A filtered sample

Raises

ValueError if invalid delay length is supplied

See also:

pysptk.sptk.lpc, *pysptk.sptk.lpc2par*, *pysptk.sptk.lpc2lsp*, *pysptk.sptk.poledf*,
pysptk.sptk.lspdf

pysptk.sptk.glsadf

`pysptk.sptk.glsadf()`

GLSA digital filter

Parameters

x [float] A input sample

c [array] Geneeraized cepstrum

stage [int] -1 / gamma

delay [array] Delay

Returns

y [float] A filtered sample

Raises

ValueError

- if invalid number of stage is specified
- if invalid delay length is supplied

See also:

pysptk.sptk.ltcdf, *pysptk.sptk.lmadf*, *pysptk.sptk.lspdf*, *pysptk.sptk.mlsadf*,
pysptk.sptk.mglsadf

pysptk.sptk.mlsadf

`pysptk.sptk.mlsadf()`

MLSA digital filter

Parameters

- x** [float] A input sample
- b** [array] MLSA filter coefficients
- alpha** [float] All-pass constant
- pd** [int] Order of pade approximation
- delay** [array] Delay

Returns

- y** [float] A filtered sample

Raises**ValueError**

- if invalid order of pade approximation is specified
- if invalid delay length is supplied

See also:

pysptk.sptk.mcep, *pysptk.sptk.amcep*, *pysptk.sptk.poledf*, *pysptk.sptk.ltcdf*,
pysptk.sptk.lmadf, *pysptk.sptk.lspdf*, *pysptk.sptk.glsadf*, *pysptk.sptk.mglsadf*

pysptk.sptk.mglsadf

`pysptk.sptk.mglsadf()`

MGLSA digital filter

Parameters

- x** [float] A input sample
- b** [array] MGLSA filter coefficients
- alpha** [float] All-pass constant
- stage** [int] -1 / gamma
- delay** [array] Delay

Returns

- y** [float] A filtered sample

Raises

ValueError

- if invalid number of stage is specified
- if invalid delay length is supplied

See also:

pysptk.sptk.mgcep, *pysptk.sptk.poledf*, *pysptk.sptk.ltcdf*, *pysptk.sptk.lmadf*, *pysptk.sptk.lspdf*, *pysptk.sptk.mlsadf*, *pysptk.sptk.glsadf*

Utilities for waveform generation filters

<i>poledf_delay</i>	Delay for poledf
<i>lmadf_delay</i>	Delay for lmadf
<i>lspdf_delay</i>	Delay for lspdf
<i>ltcdf_delay</i>	Delay for ltcdf
<i>glsadf_delay</i>	Delay for glsadf
<i>mlsadf_delay</i>	Delay for mlsadf
<i>mglsadf_delay</i>	Delay for mglsadf

pysptk.sptk.poledf_delay

`pysptk.sptk.poledf_delay()`

Delay for poledf

Parameters

order [int] Order of poledf filter coefficients

Returns

delay [array] Delay

pysptk.sptk.lmadf_delay

`pysptk.sptk.lmadf_delay()`

Delay for lmadf

Parameters

order [int] Order of lmadf filter coefficients

pd [int] Order of pade approximation.

Returns

delay [array] Delay

pysptk.sptk.lspdf_delay

`pysptk.sptk.lspdf_delay()`

Delay for lspdf

Parameters

order [int] Order of lspdf filter coefficients

Returns

delay [array] Delay

pysptk.sptk.ltcdf_delay

`pysptk.sptk.ltcdf_delay()`
Delay for ltcdf

Parameters

order [int] Order of ltcdf filter coefficients

Returns

delay [array] Delay

pysptk.sptk.glsadf_delay

`pysptk.sptk.glsadf_delay()`
Delay for glsadf

Parameters

order [int] Order of glsadf filter coefficients

stage [int] -1 / gamma

Returns

delay [array] Delay

pysptk.sptk.mlsadf_delay

`pysptk.sptk.mlsadf_delay()`
Delay for mlsadf

Parameters

order [int] Order of mlsadf filter coefficients

pd [int] Order of pade approximation.

Returns

delay [array] Delay

pysptk.sptk.mglisadf_delay

`pysptk.sptk.mglisadf_delay()`
Delay for mglisadf

Parameters

order [int] Order of mglisadf filter coefficients

stage [int] -1 / gamma

Returns

delay [array] Delay

Other conversions

<code>mgc2b(mgc[, alpha, gamma])</code>	Mel-generalized cepstrum to MGLSA filter coefficients
---	---

pysptk.conversion.mgc2b

`pysptk.conversion.mgc2b(mgc, alpha=0.35, gamma=0.0)`

Mel-generalized cepstrum to MGLSA filter coefficients

Parameters

mgc [array, shape] Mel-generalized cepstrum

alpha [float] All-pass constant. Default is 0.35.

gamma [float] Parameter of generalized log function. Default is 0.0.

Returns

b [array, shape(same as mgc)] MGLSA filter coefficients

See also:

pysptk.sptk.mlsadf, pysptk.sptk.mglسادf, pysptk.sptk.mc2b, pysptk.sptk.b2mc, pysptk.sptk.mcep, pysptk.sptk.mgcep, pysptk.sptk.mgcep

3.1.2 High-level interface for waveform synthesis

Module `pysptk.synthesis` provides high-level interface that wraps low-level SPTK waveform synthesis functions (e.g. `mlسادf`),

Synthesizer

class `pysptk.synthesis.Synthesizer(filt, hopsize)`

Speech waveform synthesizer

Attributes

filt [SynthesisFilter] A speech synthesis filter

hopsize [int] Hop size

synthesis (*source, b*)

Synthesize a waveform given a source excitation and sequence of filter coefficients (e.g. cepstrum).

Parameters

source [array] Source excitation

b [array] Filter coefficients

Returns

y [array, shape (same as *source*)] Synthesized waveform

synthesis_one_frame (*source, prev_b, curr_b*)

Synthesize one frame waveform

Parameters

source [array] Source excitation

prev_b [array] Filter coefficients of previous frame

curr_b [array] Filter coefficients of current frame

Returns

y [array] Synthesized waveform

SynthesisFilters

LMADF

class pysptk.synthesis.**LMADF** (*order=25, pd=4*)

LMA digital filter that wraps `lmadf`

Attributes

pd [int] Order of pade approximation. Default is 4.

delay [array] Delay

filt (*x, coef*)

Filter one sample using using `lmadf`

Parameters

x [float] A input sample

coef: array LMA filter coefficients (i.e. Cepstrum)

Returns

y [float] A filtered sample

See also:

pysptk.sptk.lmadf

MLSADF

class pysptk.synthesis.**MLSADF** (*order=25, alpha=0.35, pd=4*)

MLSA digital filter that wraps `mlsadf`

Attributes

alpha [float] All-pass constant

pd [int] Order of pade approximation. Default is 4.

delay [array] Delay

filt (*x, coef*)

Filter one sample using `mlsadf`

Parameters

x [float] A input sample

coef: array MLSA filter coefficients

Returns

y [float] A filtered sample

See also:

pysptk.sptk.mlsadf, pysptk.sptk.mc2b

MGLSADF

class pysptk.synthesis.**MGLSADF** (*order=25, alpha=0.35, stage=1*)
MGLSA digital filter that wraps mglسادف

Attributes

alpha [float] All-pass constant

stage [int] -1/gamma

delay [array] Delay

filt (*x, coef*)

Filter one sample using mglسادف

Parameters

x [float] A input sample

coef: array MGLSA filter coefficients

Returns

y [float] A filtered sample

See also:

pysptk.sptk.mglسادف

AllPoleDF

class pysptk.synthesis.**AllPoleDF** (*order=25*)
All-pole digital filter that wraps poledf

Attributes

delay [array] Delay

filt (*x, coef*)

Filter one sample using using poledf

Parameters

x [float] A input sample

coef: array LPC (with loggain)

Returns

y [float] A filtered sample

See also:

pysptk.sptk.poledf

AllPoleLatticeDF

class pysptk.synthesis.**AllPoleLatticeDF**(*order=25*)
 All-pole lattice digital filter that wraps `ltcdf`

Attributes

delay [array] Delay

filt (*x, coef*)

Filter one sample using using `ltcdf`

Parameters

x [float] A input sample

coef: array PARCOR coefficients (with loggain)

Returns

y [float] A filtered sample

See also:

pysptk.sptk.ltcdf

Synthesis filter interface

class pysptk.synthesis.**SynthesisFilter**
 Synthesis filter interface

All synthesis filters must implement this interface

filt (*x, coef*)

Filter one sample

Parameters

x [float] A input sample

coef [array] Filter coefficients

Returns

y [float] A filtered sample

3.1.3 Utilities

Audio files

example_audio_file()

Get the path to an included audio example file.

pysptk.util.example_audio_file

`pysptk.util.example_audio_file()`
 Get the path to an included audio example file.

Examples

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