scipy.signal.periodogram

scipy.signal.periodogram(*x*, *fs=1.0*, *window='boxcar'*, *nfft=None*, *detrend='constant'*, *return_onesided=True*, *scaling='density'*, *axis=- 1*) **[source] (https://github.com/scipy/scipy/blob/v1.6.0/scipy/signal/spectral.py#L158-L288)**

Estimate power spectral density using a periodogram.

Parameters: **x** : *array_like*

Time series of measurement values

fs : *float, optional*

Sampling frequency of the *x* time series. Defaults to 1.0.

window : *str or tuple or array_like, optional*

Desired window to use. If *window* is a string or tuple, it is passed to **get_window** (scipy.signal.get_window.html#scipy.signal.get_window) to generate the window values, which are DFT-even by default. See **get_window** (scipy.signal.get_window.html#scipy.signal.get_window) for a list of windows and required parameters. If *window* is array_like it will be used directly as the window and its length must be nperseg. Defaults to 'boxcar'.

nfft : *int, optional*

Length of the FFT used. If *None* the length of *x* will be used.

detrend : *str or function or False, optional*

Specifies how to detrend each segment. If **detrend** (scipy.signal.detrend.html#scipy.signal.detrend) is a string, it is passed as the *type* argument to the **detrend** (scipy.signal.detrend.html#scipy.signal.detrend) function. If it is a function, it takes a segment and returns a detrended segment. If **detrend** (scipy.signal.detrend.html#scipy.signal.detrend) is *False*, no detrending is done. Defaults to 'constant'.

return_onesided : *bool, optional*

If *True*, return a one-sided spectrum for real data. If *False* return a two-sided spectrum. Defaults to *True*, but for complex data, a two-sided spectrum is always returned.

scaling : *{ 'density', 'spectrum' }, optional*

Selects between computing the power spectral density ('density') where *Pxx* has units of V**2/Hz and computing the power spectrum ('spectrum') where *Pxx* has units of V**2, if *x* is measured in V and *fs* is measured in Hz. Defaults to ‘density’

axis : *int, optional*

Axis along which the periodogram is computed; the default is over the last axis (i.e. `axis=-1`).

Returns:

f : *ndarray*

Array of sample frequencies.

Pxx : *ndarray*

Power spectral density or power spectrum of *x*.

See also:

welch (scipy.signal.welch.html#scipy.signal.welch) Estimate power spectral density using Welch’s method

lombscargle (scipy.signal.lombscargle.html#scipy.signal.lombscargle) Lomb-Scargle periodogram for unevenly sampled data

Notes

New in version 0.12.0.

Examples

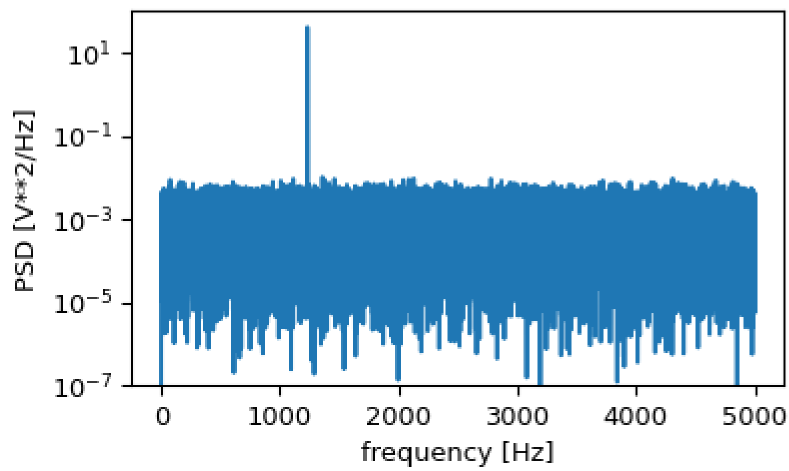
```
>>> from scipy import signal
>>> import matplotlib.pyplot as plt
>>> np.random.seed(1234)
```

Generate a test signal, a 2 Vrms sine wave at 1234 Hz, corrupted by 0.001 V**2/Hz of white noise sampled at 10 kHz.

```
>>> fs = 10e3
>>> N = 1e5
>>> amp = 2*np.sqrt(2)
>>> freq = 1234.0
>>> noise_power = 0.001 * fs / 2
>>> time = np.arange(N) / fs
>>> x = amp*np.sin(2*np.pi*freq*time)
>>> x += np.random.normal(scale=np.sqrt(noise_power), size=time.shape)
```

Compute and plot the power spectral density.

```
>>> f, Pxx_den = signal.periodogram(x, fs)
>>> plt.semilogy(f, Pxx_den)
>>> plt.ylim([1e-7, 1e2])
>>> plt.xlabel('frequency [Hz]')
>>> plt.ylabel('PSD [V**2/Hz]')
>>> plt.show()
```

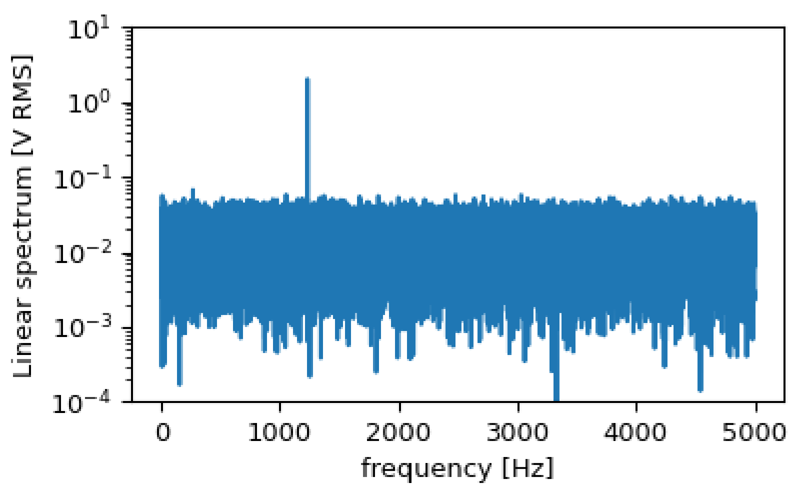


If we average the last half of the spectral density, to exclude the peak, we can recover the noise power on the signal.

```
>>> np.mean(Pxx_den[25000:])
0.00099728892368242854
```

Now compute and plot the power spectrum.

```
>>> f, Pxx_spec = signal.periodogram(x, fs, 'flattop', scaling='spectrum')
>>> plt.figure()
>>> plt.semilogy(f, np.sqrt(Pxx_spec))
>>> plt.ylim([1e-4, 1e1])
>>> plt.xlabel('frequency [Hz]')
>>> plt.ylabel('Linear spectrum [V RMS]')
>>> plt.show()
```



The peak height in the power spectrum is an estimate of the RMS amplitude.

```
>>> np.sqrt(Pxx_spec.max())
2.0077340678640727
```