Spectral-based
Sound Transformations

Xavier Serra

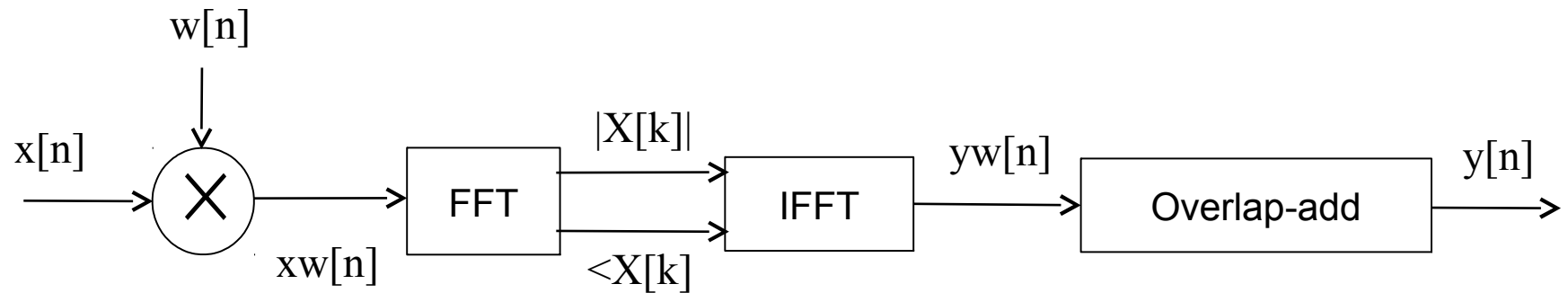Music Technology Group

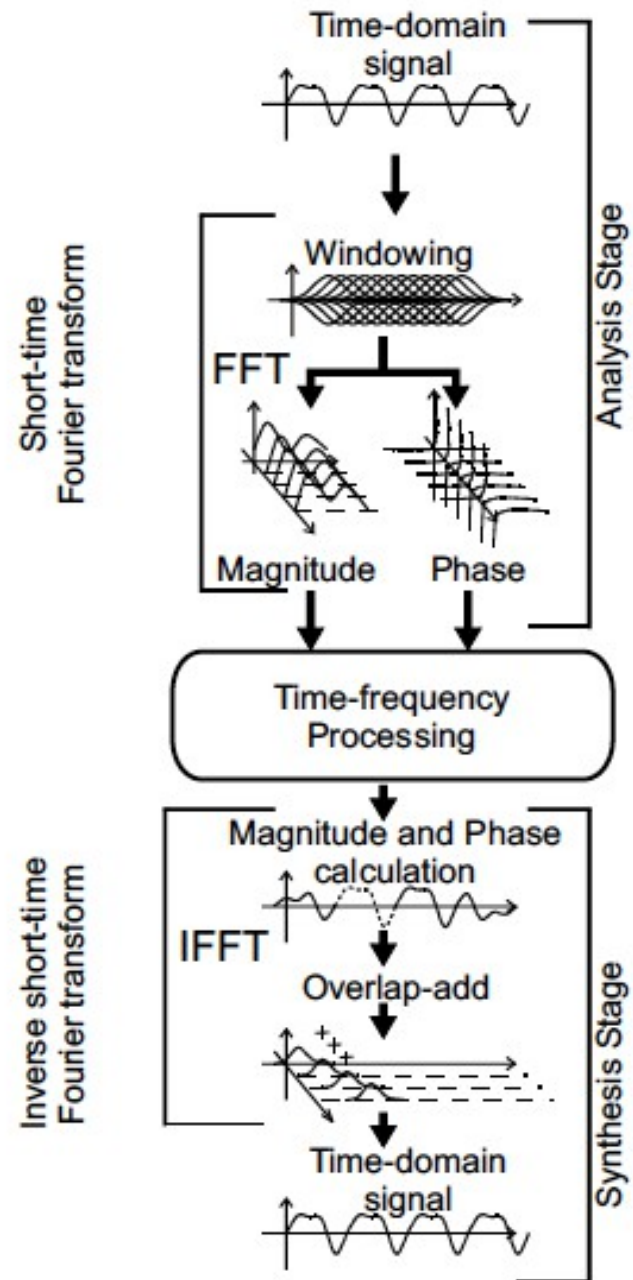Universitat Pompeu Fabra, Barcelona

http://mtg.upf.edu

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- Filtering
- Morphing
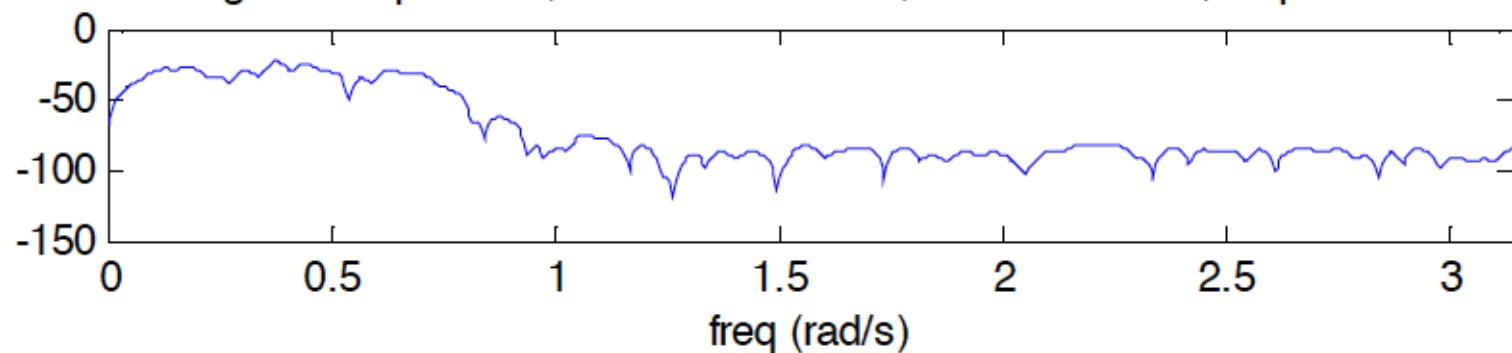- Frequency scaling
- Time stretching
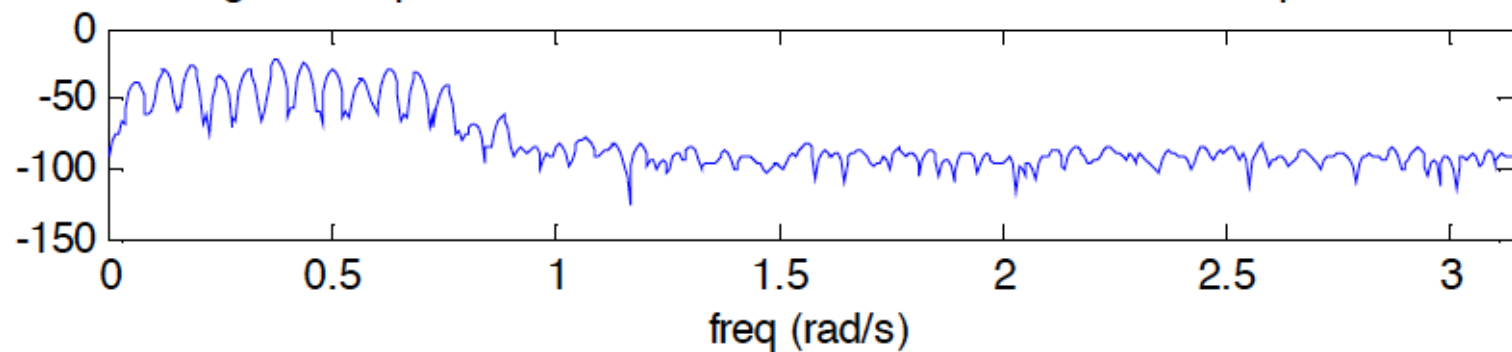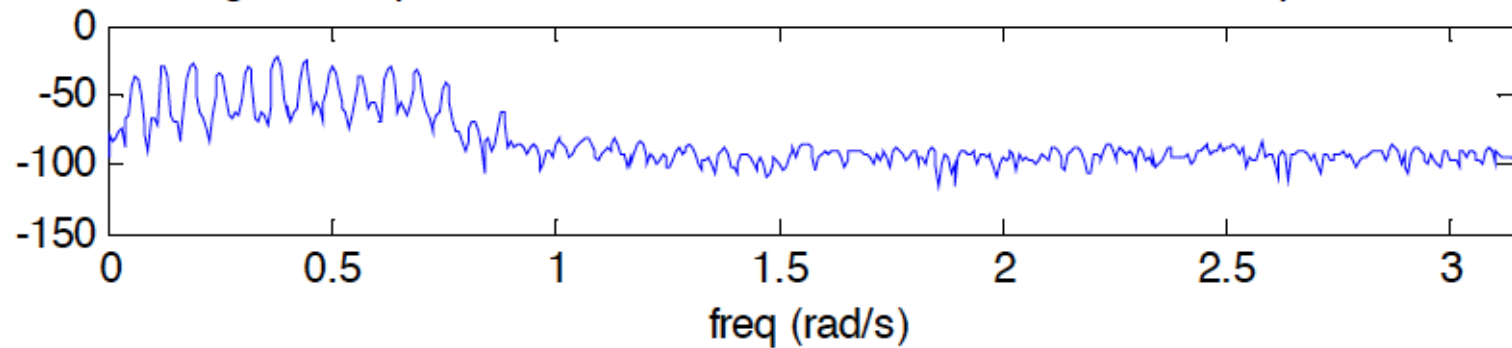
Short-time Fourier transform

STFT

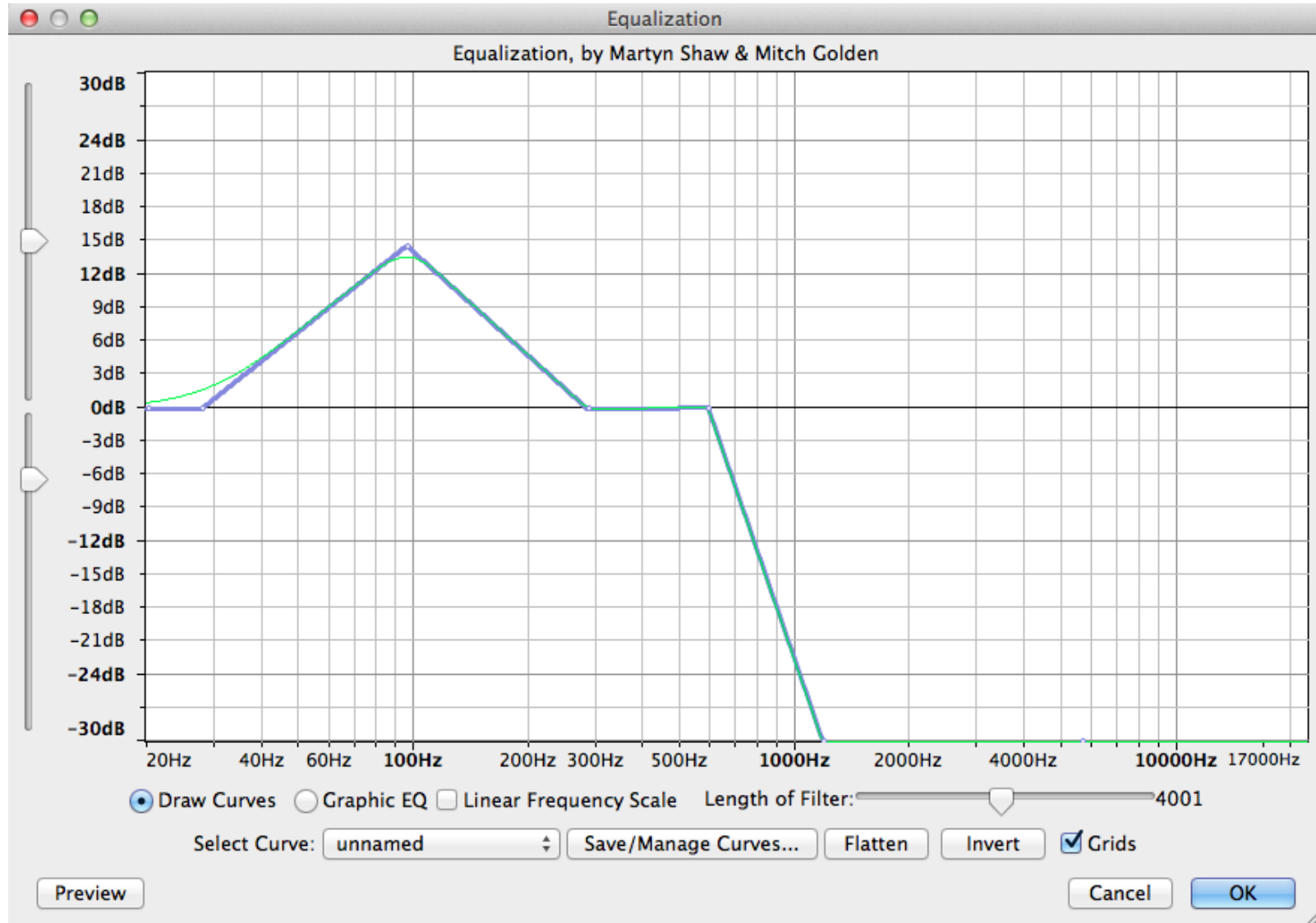## Magnitude spectrum, Window Size 201, FFT Size 1024, Hop size 50

freq (rad/s)

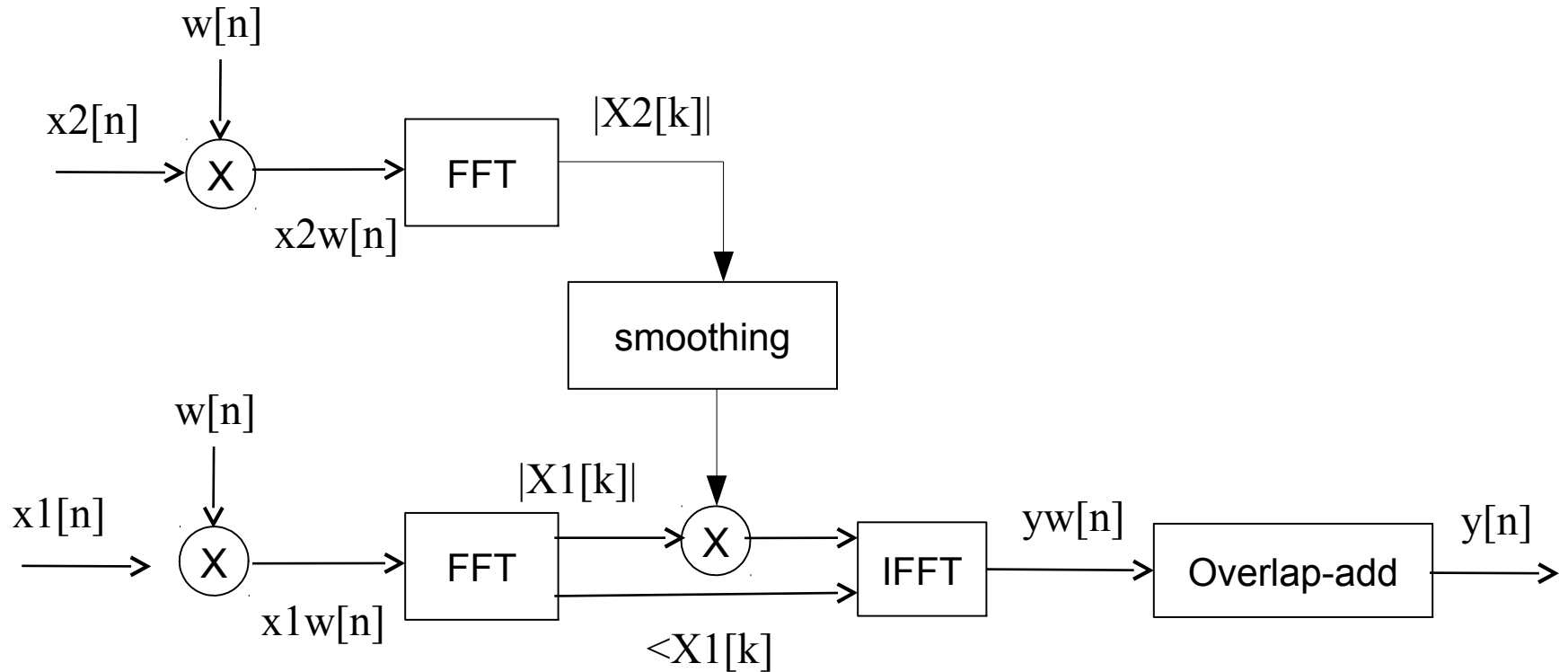## Magnitude spectrum, Window Size 501, FFT Size 1024, Hop size 50

freq (rad/s)

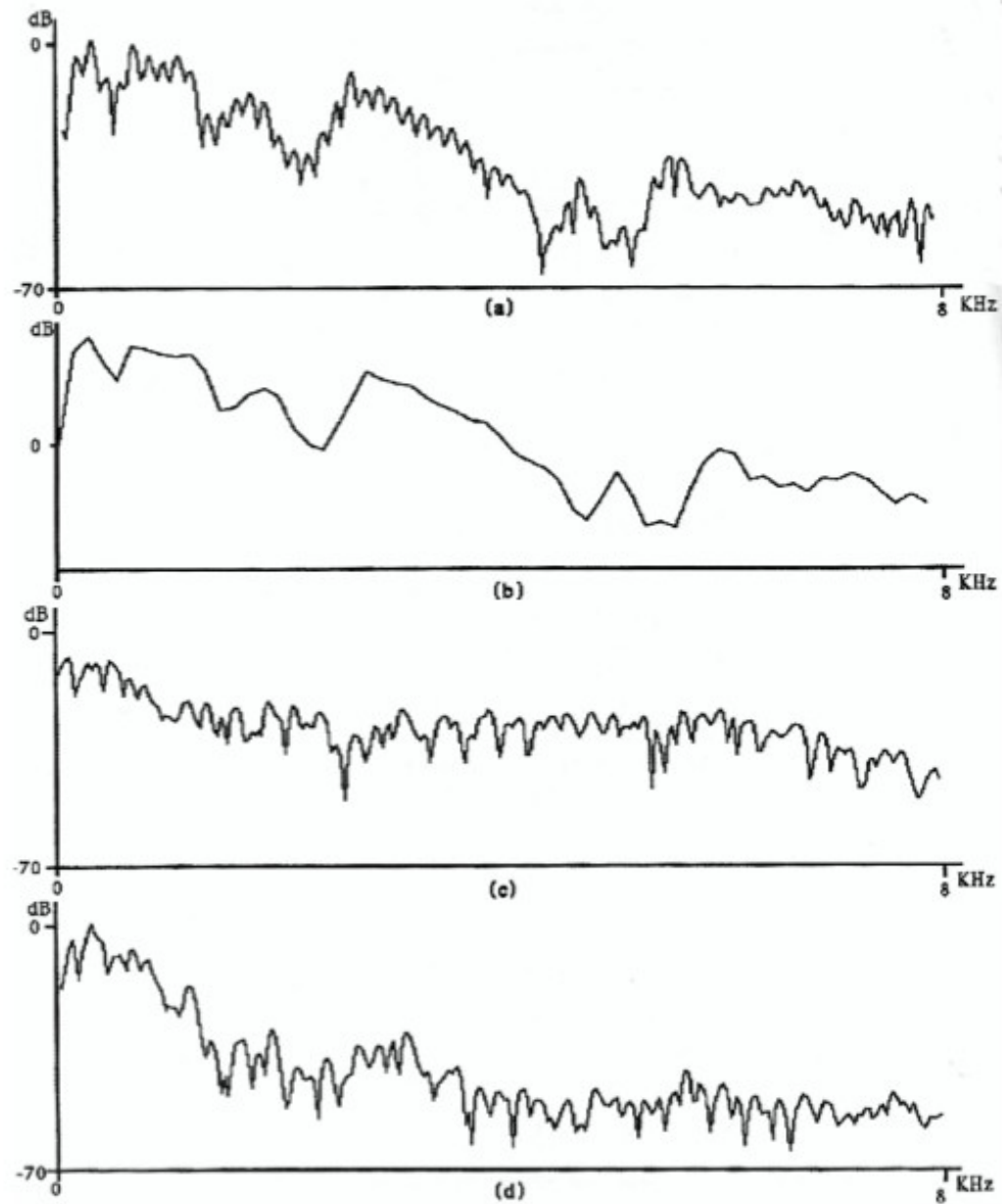## Magnitude spectrum, Window Size 801, FFT Size 1024, Hop size 50

freq (rad/s)
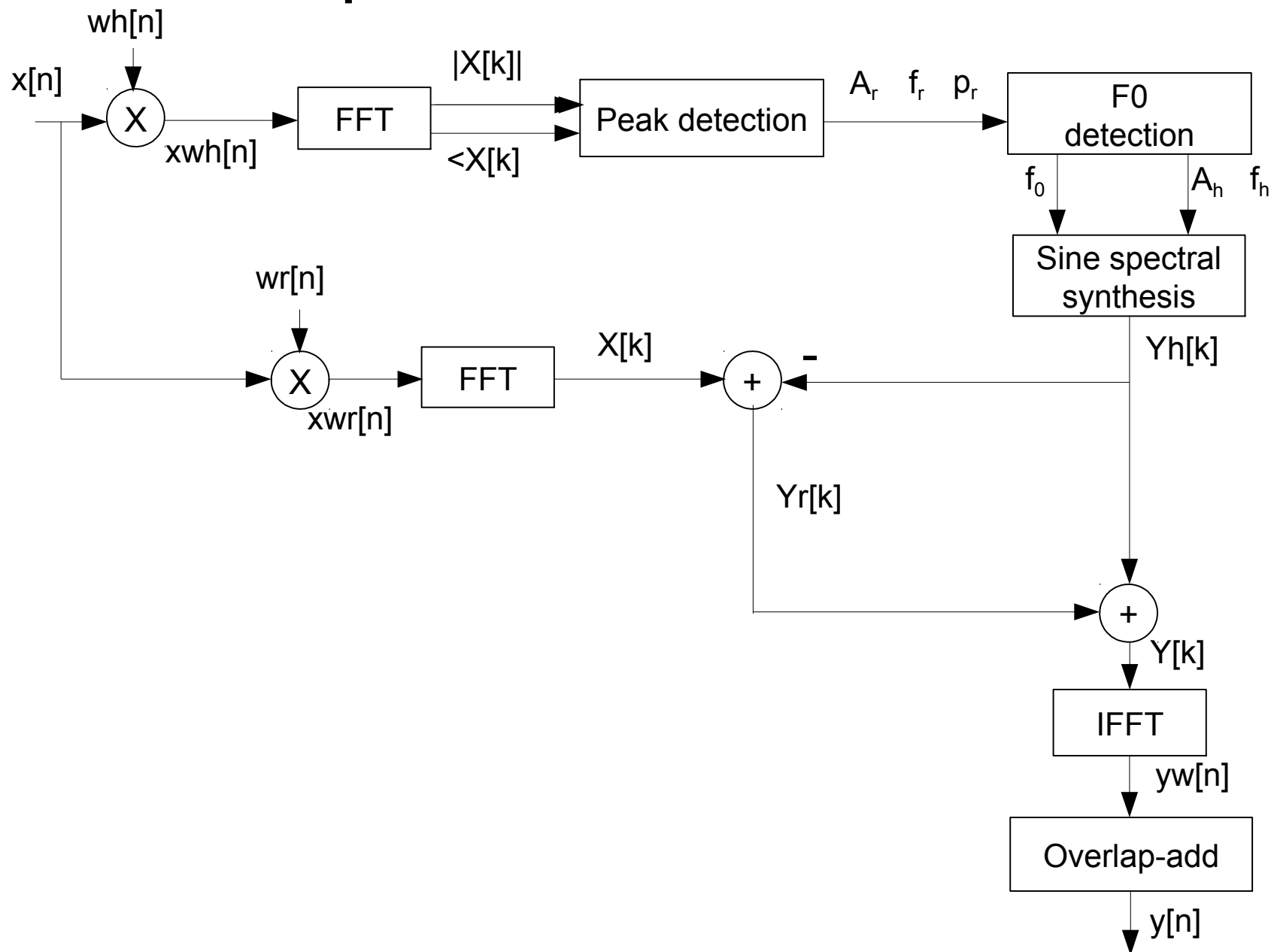
Filtering: Equalization
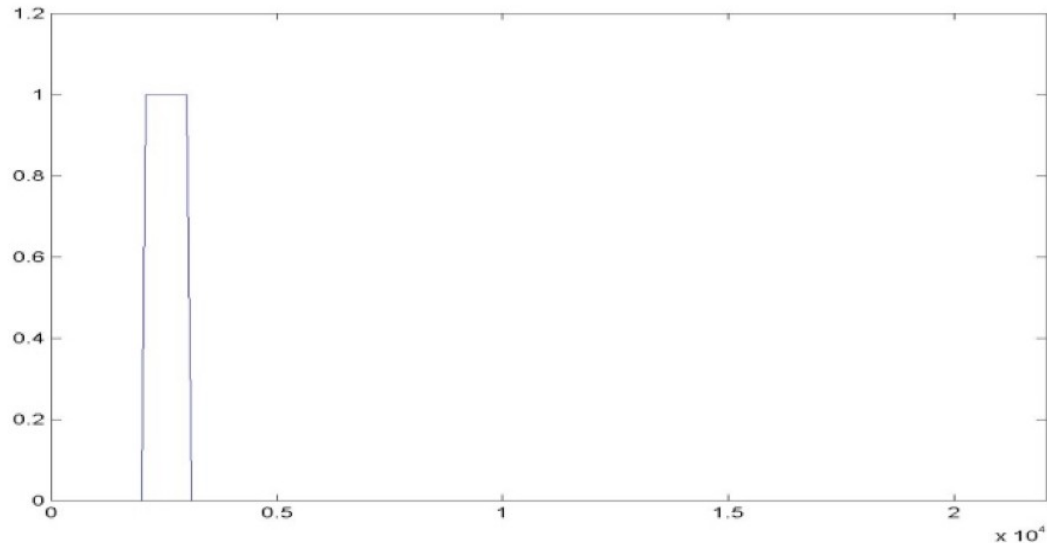
Morphing with STFT

Morphing

Harmonic plus residual model

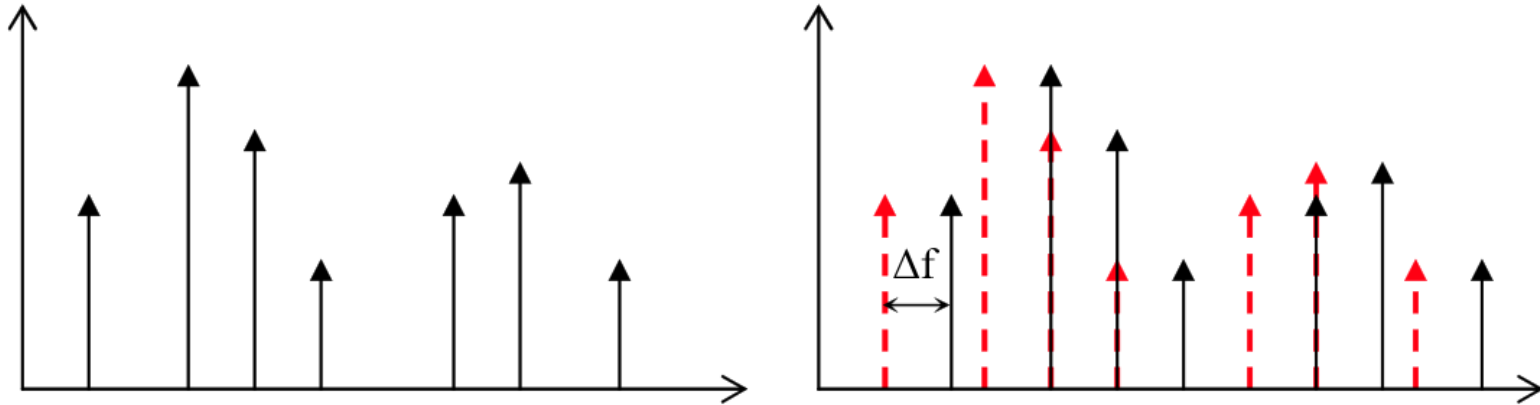# Filtering sine waves

Hz = np.array([0, 2099, 2100, 3000, 3001, fs/2]) # Hz
dB = np.array([-200, -200, 0, 0, -200, -200])   # dB
Filter = np.asarray((Hz, dB))
ysmag += np.interp(ysloc/Ns*fs, Filter[0,:],Filter[1,:])

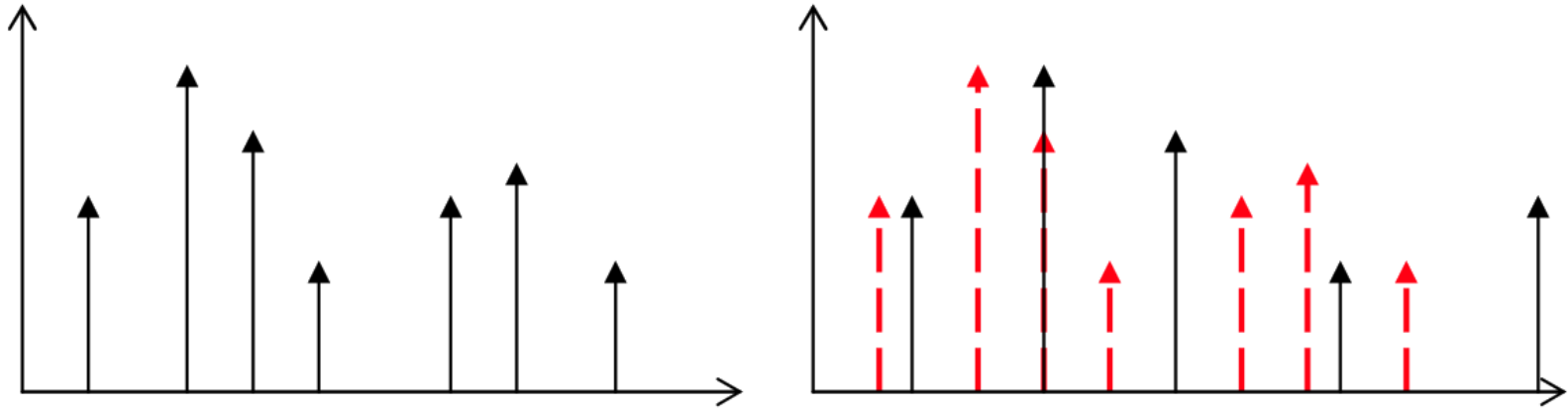# Frequency shifting of sine waves

fshift = 100.0
ysloc = (ysloc>0) * (ysloc + fshift/fs*Ns)

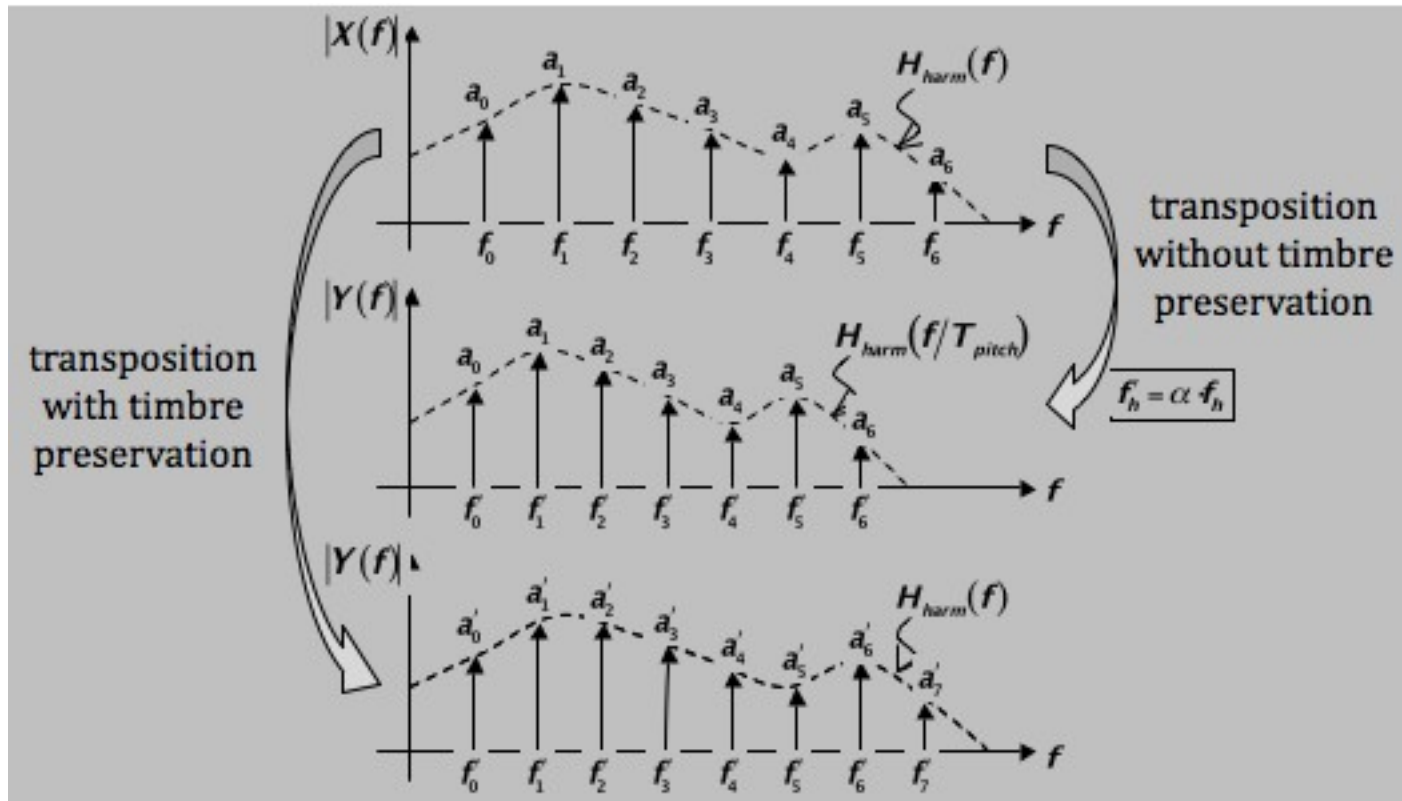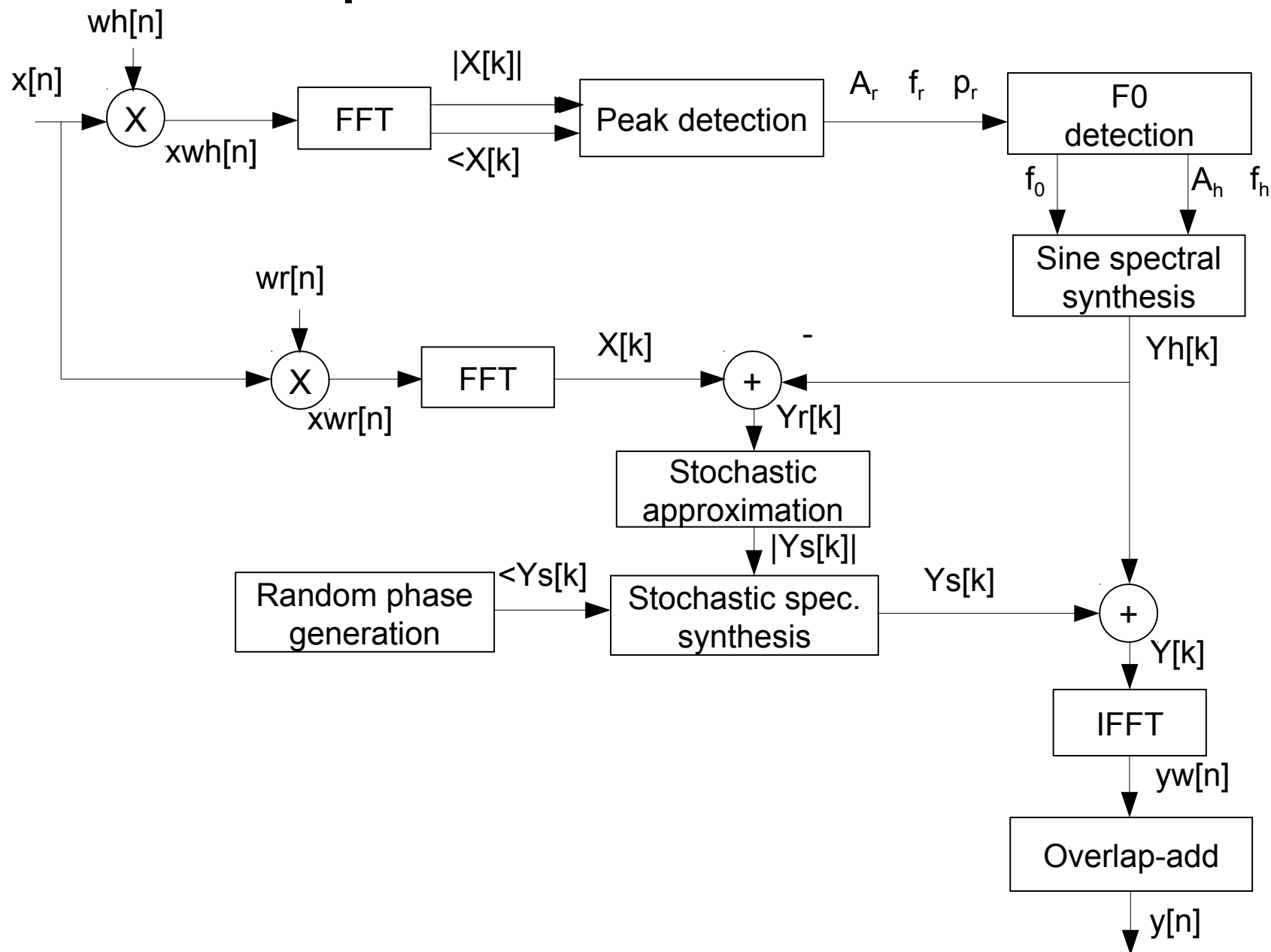# Frequency stretching of sine waves

fstretch = 1.1
ysloc = ysloc * (fstretch**np.arange(0, ysloc.size))

Pitch transposition with timbre preservation
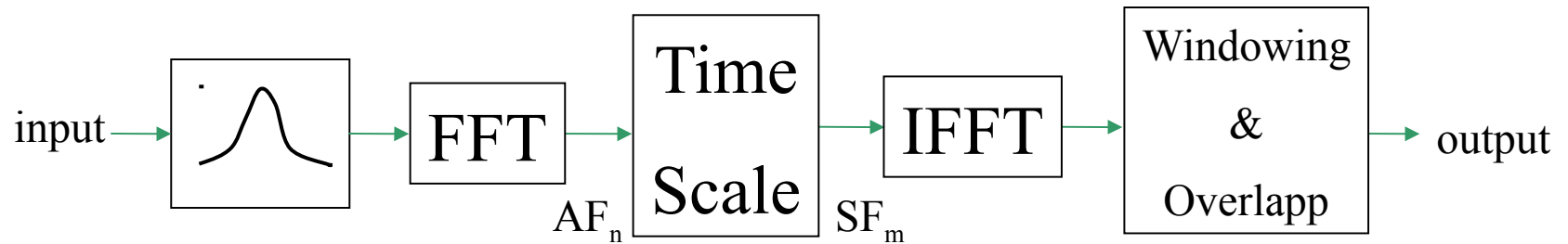
Harmonic plus Stochastic model

Time scaling

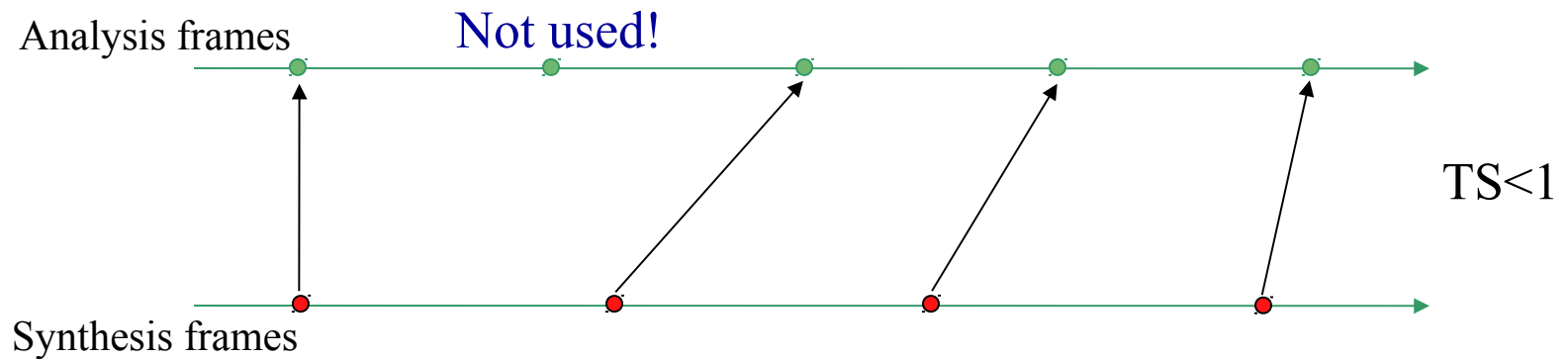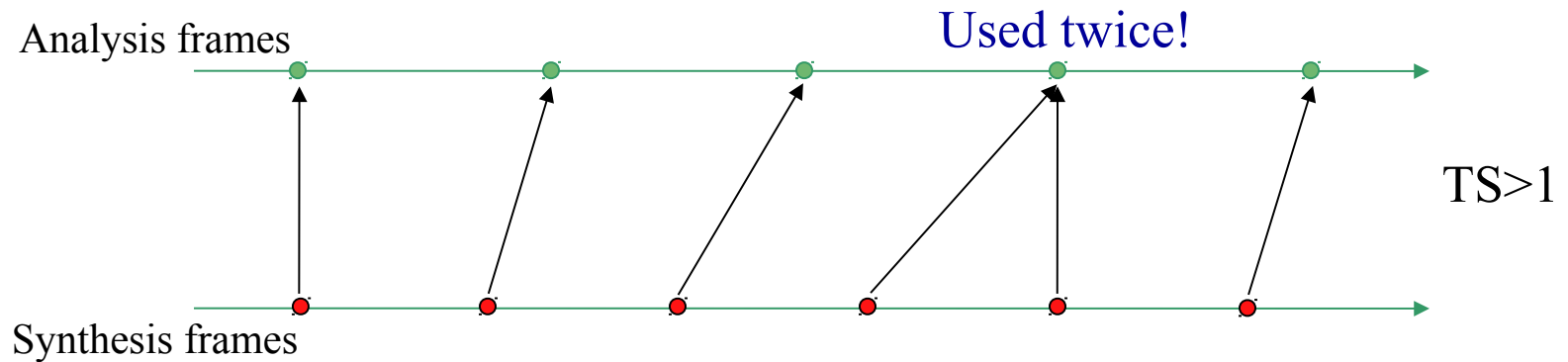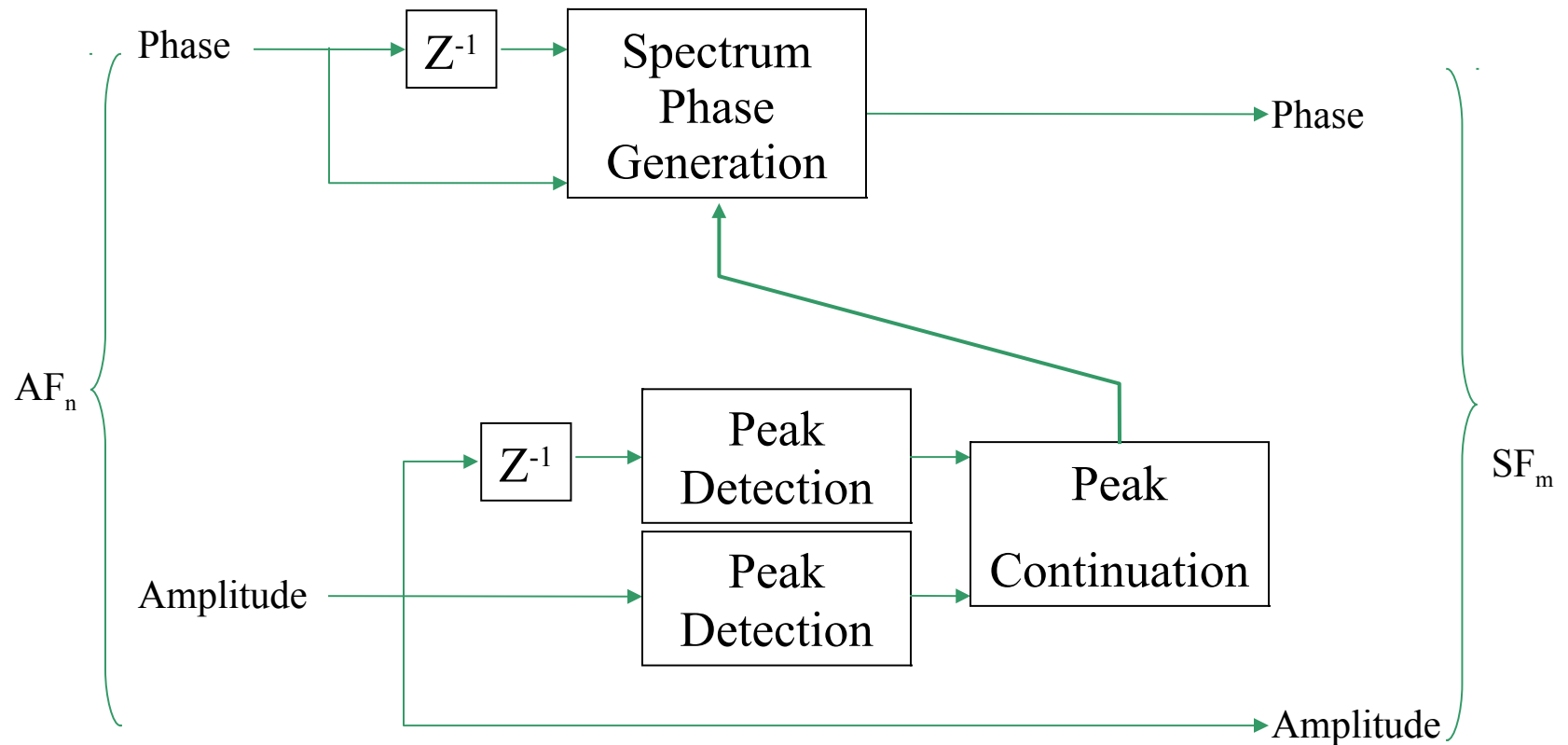- It's a frame based frequency domain technique

AF_n = Analysis Frame number n
SF_m = Analysis Frame number m

Analysis and synthesis processes must use the same window size and window type

Frame positions

Analysis frames

Used twice!

TS>1

Synthesis frames

Analysis frames

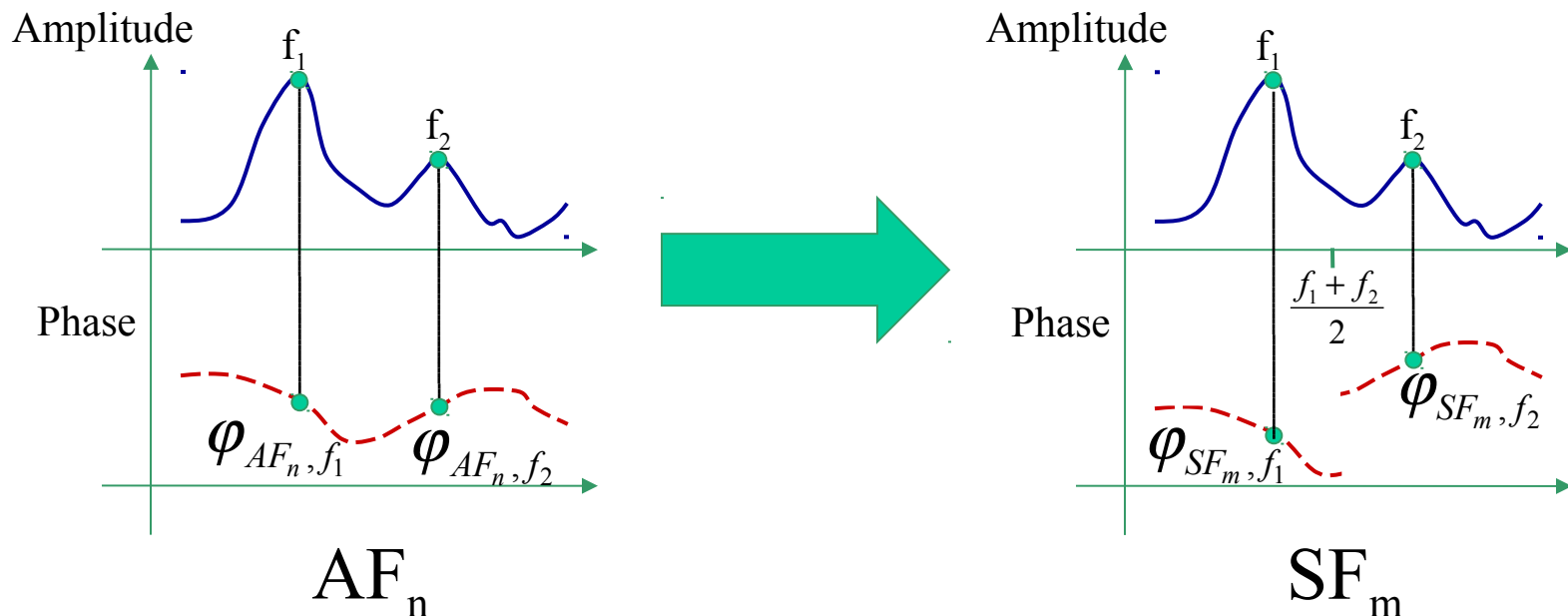Not used!

TS<1

Synthesis frames

The Time-Scale module

Delta phase around each peak

- The phase around each peak is obtained applying the delta phase function of the original frame

References

- http://en.wikipedia.org/wiki/Sound_effects

- http://en.wikipedia.org/wiki/Equalization_filter

- http://en.wikipedia.org/wiki/Audio_timescale-pitch_modification

Credits

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