10T2: Review

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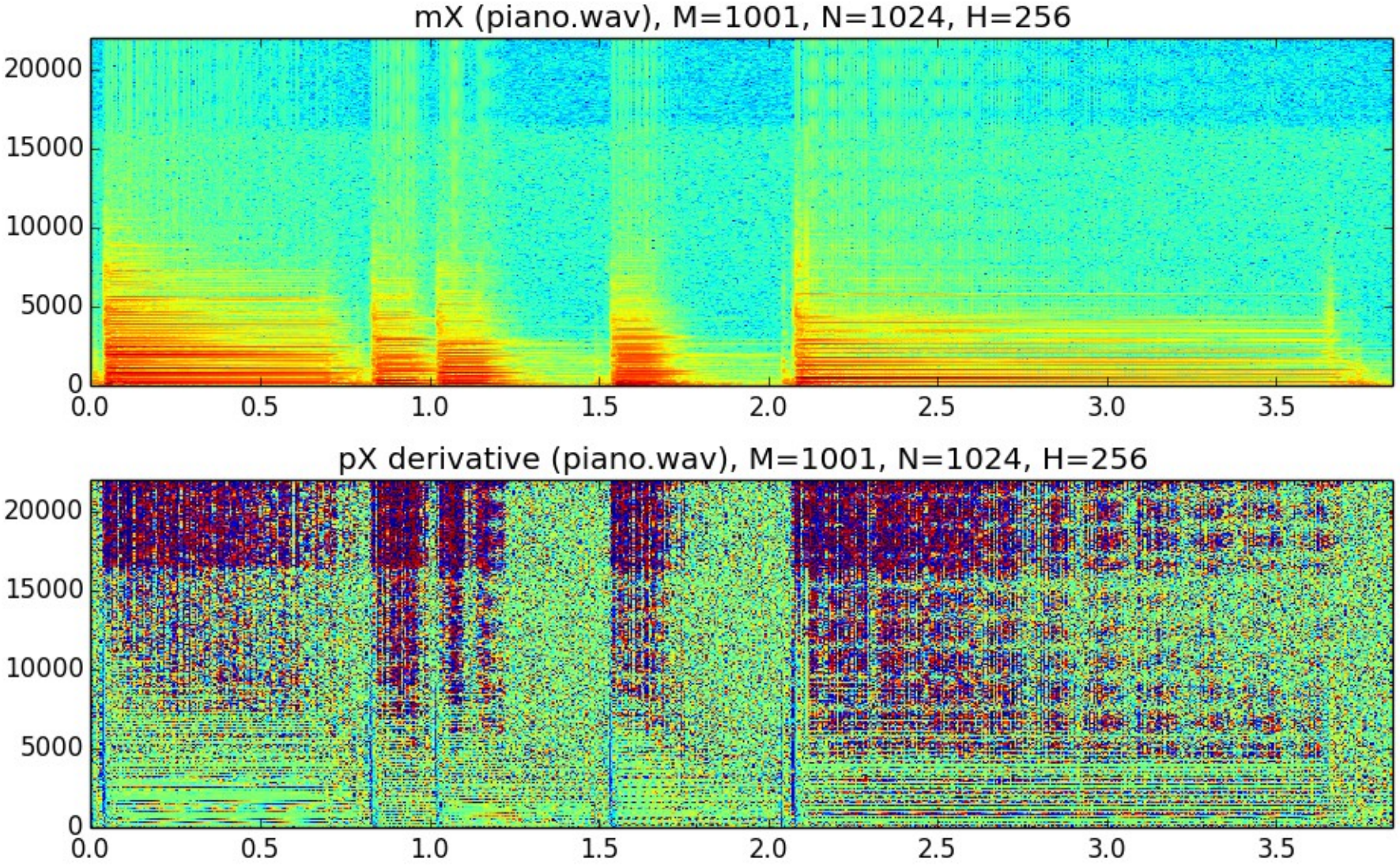
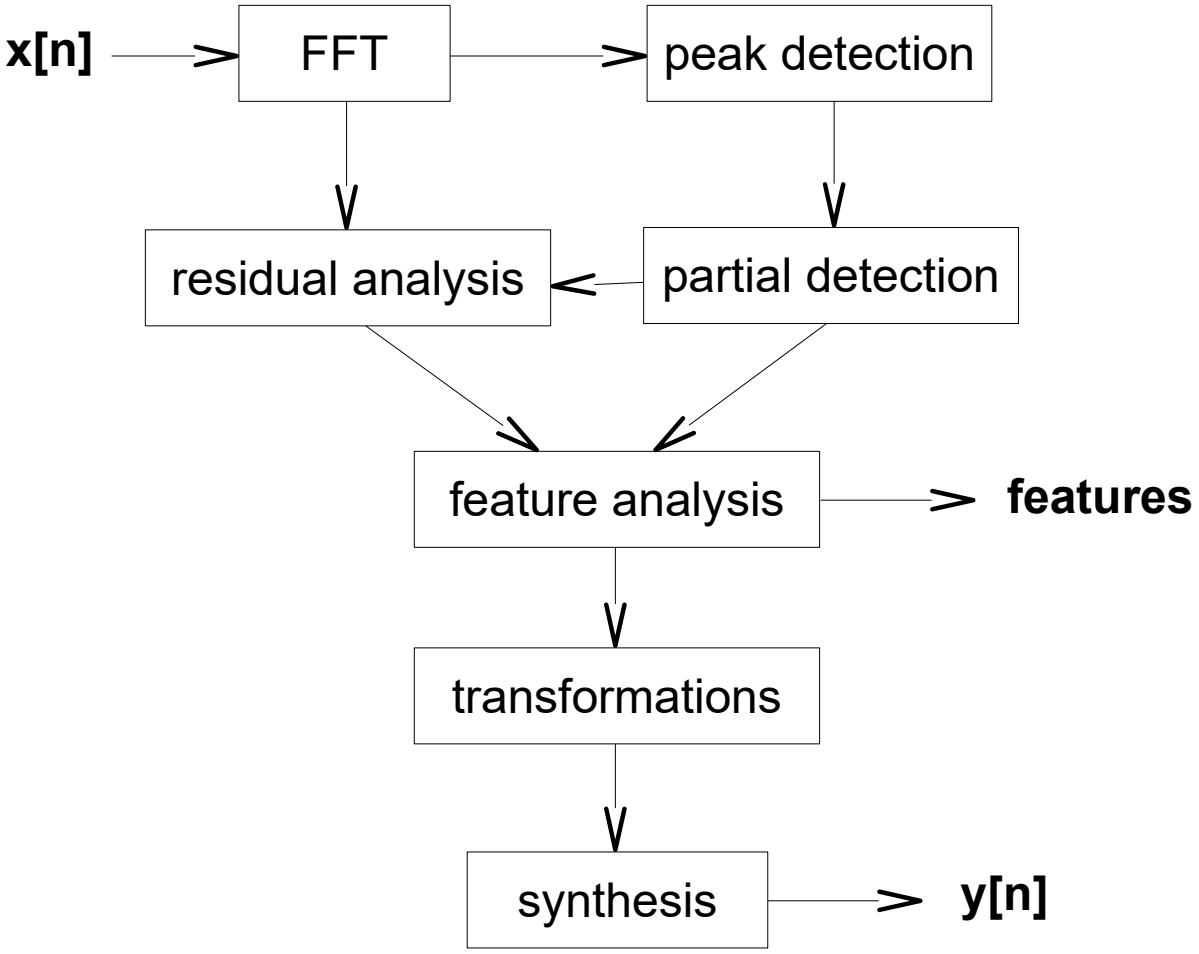
A spectral view of sound and music



Framework covered in this course



Sound spectra

Discrete Fourier Transform:

$$X[k] = \sum_{n=0}^{N-1} x[n] e^{-j 2\pi kn/N} \qquad k = 0, \ldots, N-1$$

Short-time Fourier Transform:

$$X_l[k] = \sum_{n=-N/2}^{N/2-1} w[n] x[n + lH] e^{-j 2\pi kn/N} \qquad l = 0, 1, \ldots,$$

Sinusoids and harmonics

Sinusoidal model:

$$y[n]=\sum_{r=1}^{R} A_r[n]\cos\left(2\pi f_r[n]n\right)$$

Harmonic model:

$$yh[n]=\sum_{r=1}^{R} A_r[n]\cos\left(2\pi rf_0[n]n\right)$$

Residual and stochastic components

Sinusoidal plus residual model:

$$y[n]=\sum_{r=1}^{R} A_r[n]\cos\left(2\pi f_r[n]n\right)+xr[n]$$

Sinusoidal plus stochastic model:

$$y[n]=\sum_{r=1}^{R} A_r[n]\cos\left(2\pi f_r[n]n\right)+\sum_{k=0}^{N-1} u[n]h_l[n-k]$$

Transforming sounds

manipulating sinusoids and stochastic component:

$$\bar{f}_h[q] = s f_h[l] f_t[st_h[l]l]$$
$$\bar{A}_h[q] = s A_h[l] + A_t[st_h[l]l]$$
$$\bar{\phi}_h[q] = \phi_h[q-1] + f_h[q]$$
$$\bar{st}_k[q] = s st_k[l] st_k[st_k[l]l]$$

Describing sounds and music

cognitive	emotion, music style, semantic concepts			
formal	melody, key, tonality	rhythmic patterns, tempo, meter	instrument, voice	articulation
perceptual	successive and simultaneous intervals	time (beat)	timbre (spectral envelope)	dynamics
sensorial	pitch	time	timbre	loudness
physical	frequency	duration (onset)	spectrum (centroid)	intensity

...and beyond

...audio signal processing is more than this

...sounds and music is more than audio

References and credits

- Slides released under CC Attribution-Noncommercial-Share Alike license and available from https://github.com/MTG/sms-tools

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