

2018

01

Thursday

Week 5

February

JANUARY 2018

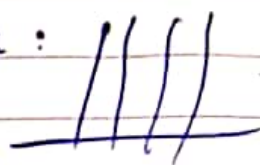
S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

* Speech production:

→ vowels are voiced

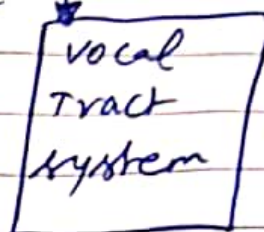
→ some consonants are voiced & some are unvoiced

→ We assume that our Vocal Tract is LTI



Excitation is like

Impulse



Random noise

Excitation is like

$$\hat{s}(n) = \sum_{k=1}^P a_k s(n-k) \rightarrow \text{Linear prediction}$$

Important for speech coding

error = actual - predicted

$$e(n) = s(n) - \hat{s}(n) \\ = s(n) - \sum_{k=1}^P a_k s(n-k)$$

$$E(z) = S(z) \left[1 - \sum_{k=1}^P a_k z^{-k} \right]$$

$$\frac{S(z)}{E(z)} = \frac{1}{1 - \sum_{k=1}^P a_k z^{-k}}$$

All pole system

Nearest model we can predict

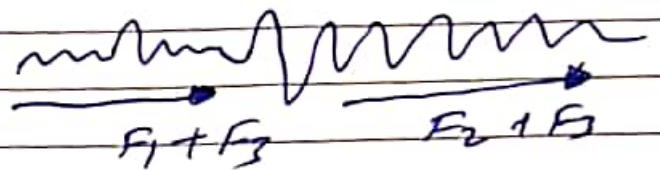
2018

02

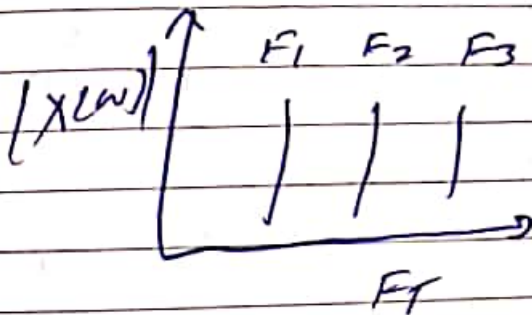
Friday

S	M	T	W	T	F	S
	5	6	7	8	9	10
4	12	13	14	15	16	17
11	19	20	21	22	23	24
18	26	27	28	29	30	31
25						

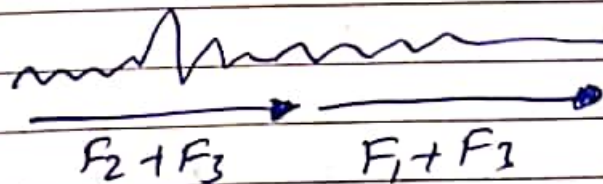
* Fourier Transform → To convert into frequency domain & get information



↙ Gives some amplitude at F_1, F_2, F_3



also gives same spectrum



misses time information

works for stationary signals

Advantage of FT

↓
uses frequency information

Disadvantage ↗

2018

05

Monday

Week 6

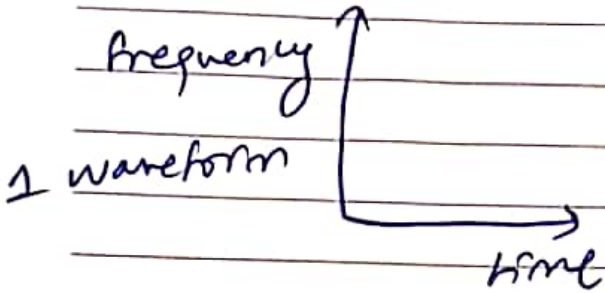
February

JANUARY 2018

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

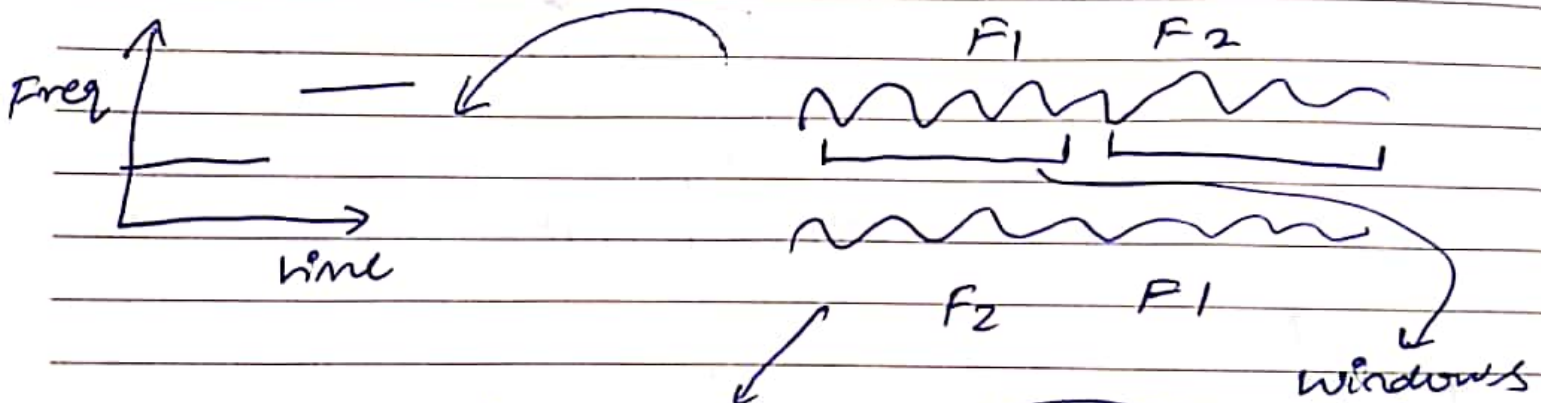
→ Hence, we

Joint Time vs Frequency



To extend,

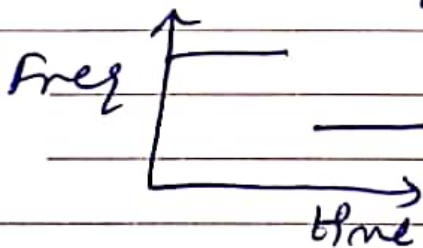
Instead of applying FT for entire signal, apply FT for windowed signal



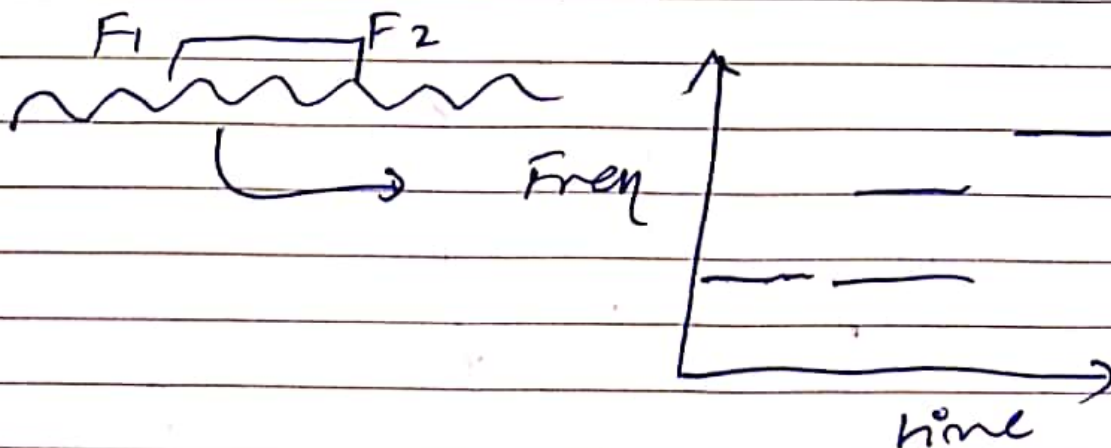
2018

06

Tuesday



Short-term Fourier Transform



MARCH 2018

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

Week 6

February

07

Wednesday

2018

→ STFT works if within the window signal is stationary

→ spectrum depends on window shape & size

↓
plots obtained are called spectrograms

General window size = 20ms

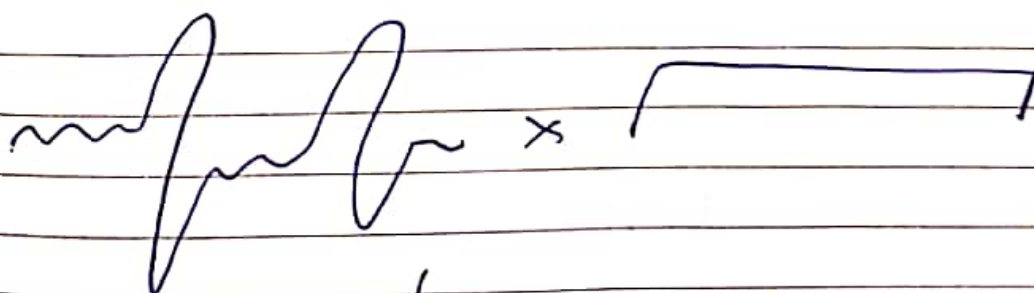
↪ pitch cycles = 6-9ms

→ If sampling is at f_s , we can see frequencies till $f_s/2$ in spectrogram

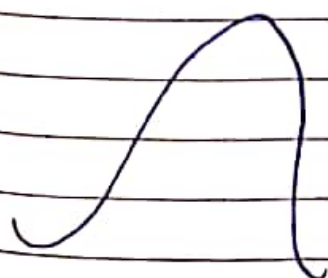
08

Thursday

2018



↪ resultant spectrum is convolution



→ Hamming window

2018

09

Friday

Week 6

February

JANUARY 2018

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

Time information well \rightarrow narrow window
 Frequency information well \rightarrow wider window

$$* 20ms \rightarrow 8kHz \rightarrow 160 \xrightarrow[\text{2 power}]{\text{nearby}} 256$$

Formant 2

Dominant resonances
 of vocal tract
 system

Wavelet \rightarrow small wave

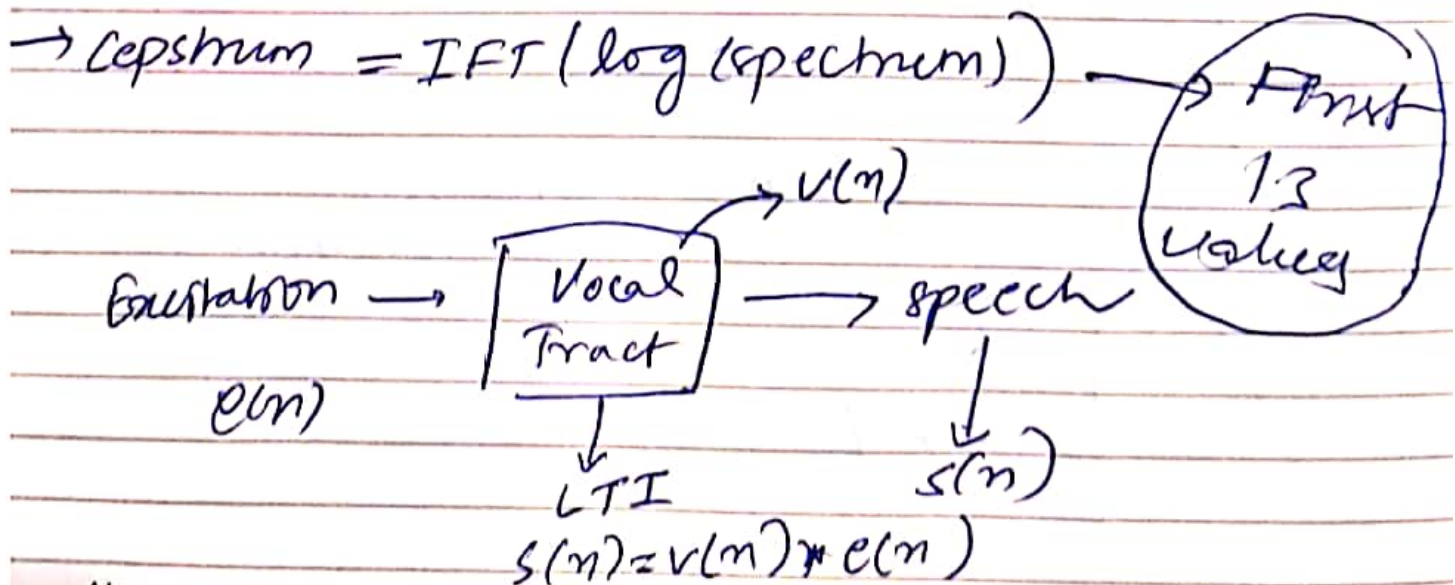
* LP analysis

smooth curves

to identify formants

10

Saturday



Always verify accuracy and completeness of information before sharing with others.

$$S(n) = V(n) \cdot E(n)$$

$$\log S(n) = \log V(n) + \log E(n)$$

↓
separated both