



STUDY OF LINEAR PREDICTION MODEL FOR AUDIO SYNTHESIS

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MAT-201 Media Signal Processing
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Applications of Speech Compression:

Transmission / storage

real-time transmission e.g. mobile phones

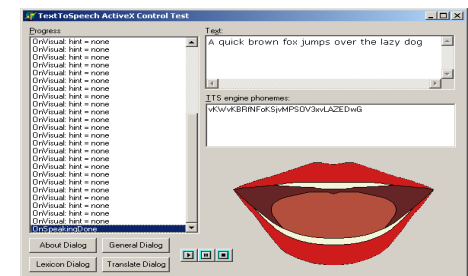
archive storage e.g. voicemail



Modification Synthesis

speech synthesis / text-to-speech
(change the words)

speech transformation/disguise
(change the speaker)



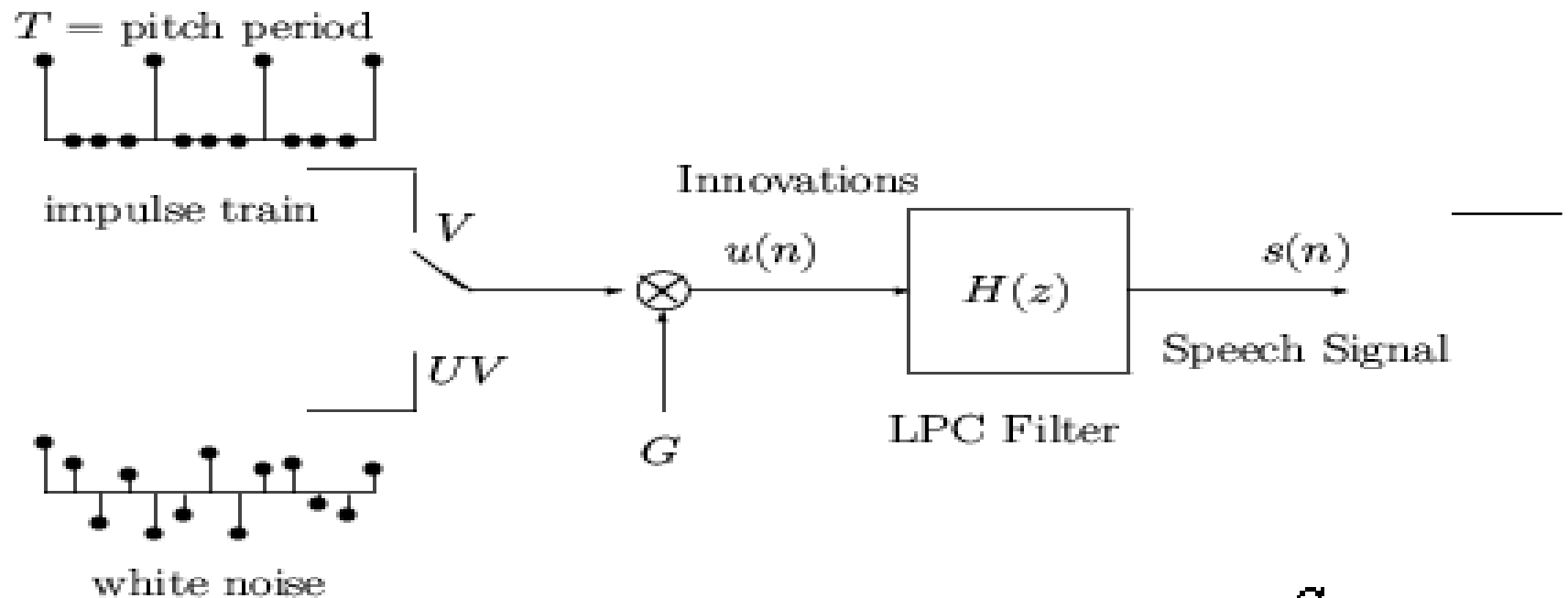
Classification / matching

speech recognition (lexical content)

other signal classification

content-based retrieval

Mathematical Model of LPC:



LPC Filter == Vocal Tract

Innovation == Air

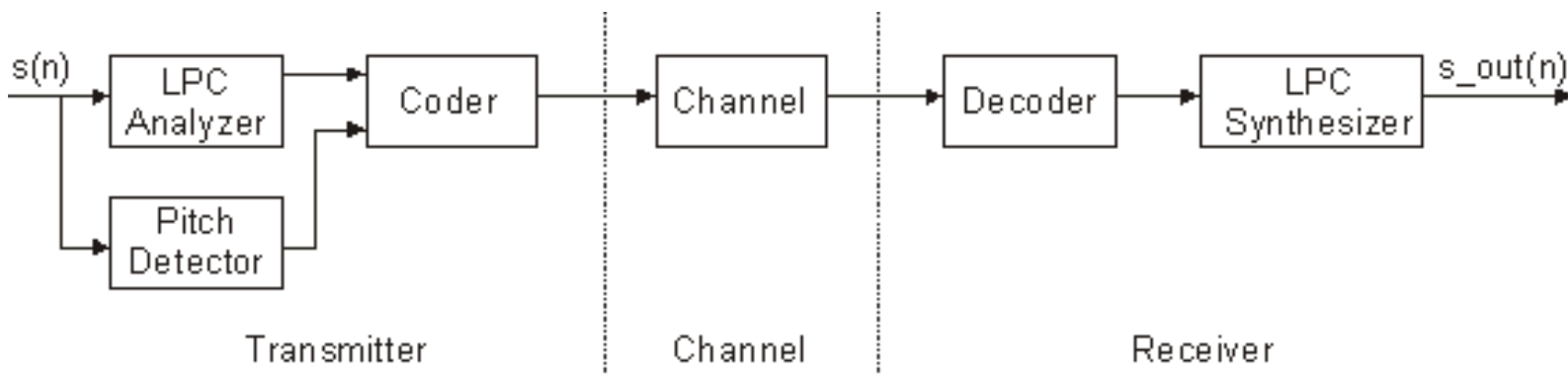
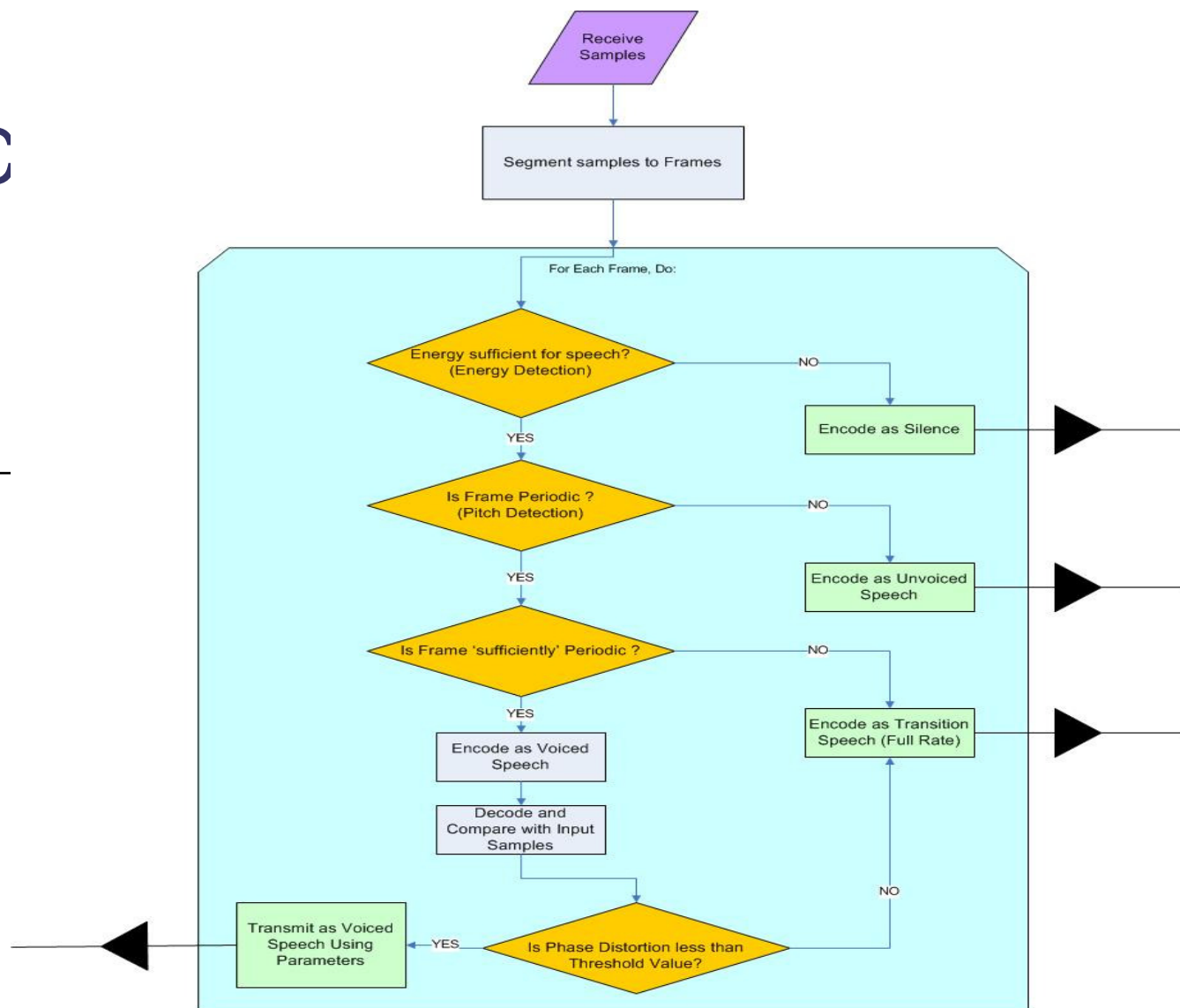
Voiced (V) == Vocal Chord Vibration

Pitch Period (T) == Vocal Chord Vibration period

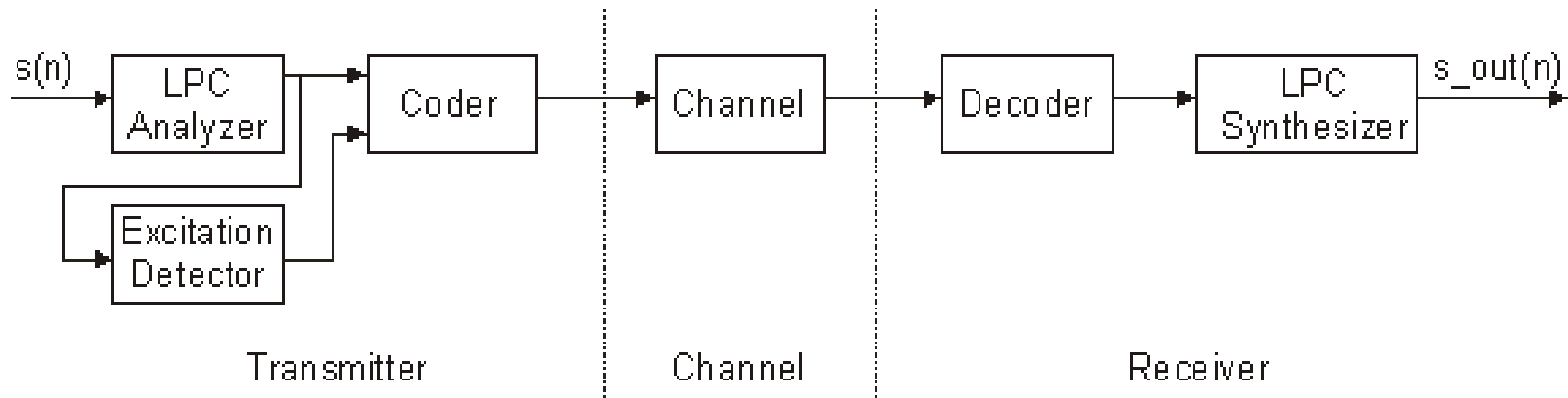
Gain (G) == Air Volume

$$H(z) = \frac{G}{1 - \sum a_k z^{-k}}$$

How does LPC Work....?



Voice Excited LPC



Block diagram of Voice Excited LPC

- Good reconstruction of the excitation requires the low frequencies
- DCT of the residual signal.
- DCT concentrates most of the energy of the signal in the first few coefficients.

Implementation

Implementation is done using Matlab:
LPC and V-LPC

Performance Evaluation parameters:

- Computational Complexity
- Overall Delay of the System

Time taken after the first speech sample is input in the system to the time first speech sample is synthesised.

- Signal to Noise Ratio
- Bit Rate

Results

SNR:

	Male	Female	Guitar	French
LPC	-12.487	-10.648	-10.366	-12.3018
V-LPC	-3.163	-3.27	-1.6734	-2.668

Bit Rate:

	Male	Female	Guitar	French
Original	128	128	128	128
LPC	8.349	8.349	8.393	8.56
V-LPC	103.44	103.312	103.312	105.21

Results

Performance of different LPC order(n):

	n =1	3	7	10	18
SNR: LPC	-16.0131	-16.65	-15.826	-14.389	-10.487
V-LPC	-6.9027	-5.4628	-3.36	-3.2011	-3.163
Bit Rate LPC	1.5947	2.3893	3.978	5.1707	8.394
VLPC	96.5573	97.352	98.9413	100.1333	103.43

Conclusion:

- Achieved bit rate in both methods is low.
- Voice-excited LPC coding roughly requires a bandwidth twice as large as the plain LPC coding.
- Computational complexity is same for both methods.
- Voice excited LPC should be improved to work at lower bit rate.



Questions....??
