ECE462 – Lecture 25

4.8 Kbps CELP Coder

- CELP: Code Excited Linear Predicts
- Similar to LPC Vocoder, however,
- 1. Frame size is 30 msec (240 samples)
- *2.* ϵ_n is coded directly
- 3. More bits are needed
- 4. Computationally more complex
- 5. A long term (pitch) prediction filter is included
- 6. Vector quantization (codebook) concept is used



- The vocal tract model utilizes both
- Long term Linear Prediction (LTLP) Minimize: $E\{(y_n g_0, y_{n-i})^2\}$
- Short term Linear Prediction (STLP) Minimize: $E\{(y_n \sum_{i=1}^M b_i y_{n-i})^2\}$
- For voiced speech LTLP models pitch periodicity

Structure of CELP system

- Excitation Codebook: Collection of random vectors actually a set of independent identically distributed Guassian random vectors with zero mean, unit variance.
- Motivation:

Let P(z), B(z) be the z-transform of the long term and short term filters Let P⁻¹(z), B⁻¹(z) – be the inverse filters



Mode of operation

- 1. Vocal tract model parameters are derived from a short segment of the input speech.
- 2. Each the excitation vectors stored in the excitation codebook is used to excite the vocal track model.
- 3. The excitation vector which generates the synthetic output closer to the input speech (in the MSE sense) is selected and its index is used to encode the excitation signal.
- 4. At the 30 msec/frame, 4.8 kbps is equivalent to 144 bits/frame

SLP	34578
LLP	4-8 bits
Codebook indicep	36 bits
Grains	Jobits
Synchronizations tobal	ちらお
	144 bits

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