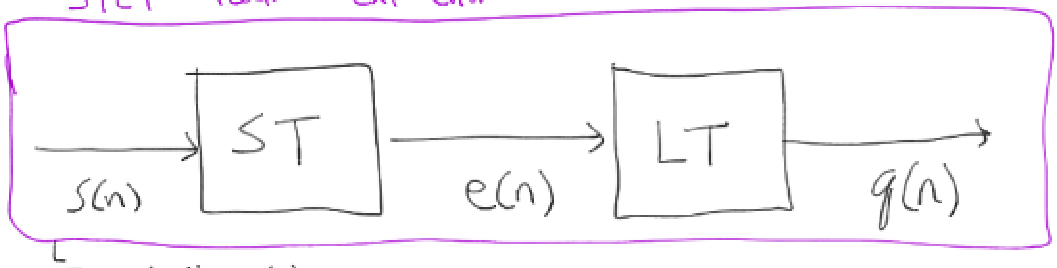
STLT feature extraction



$$s(n) = \sum_{i=1}^{L} a_i s(n-i) + e(n)$$

* a_i : all-poles filter의 계수

* $e(n)$: source excitation signal → $e(n) = \underbrace{B_k}_{\text{gain factor}} e(n-\underbrace{k}_{\text{fundamental pitch period}}) + \underbrace{q(n)}_{\text{wide-band noise component (noisy residual)}}$

* L-order short-memory process로 $s(n)$의 한 샘플을 뽑을 수 있음

$$\rightarrow \quad \hat{s}(n) = \sum_{i=1}^{L} a_i s(n-i)$$

a_i가 모델과 일치하면,

$$\therefore e(n) = s(n) - \hat{s}(n)$$

* long-term predictor로 $e(n)$의 샘플 뽑으면

$$\hat{e}(n) = B_k(n-k)$$

k와 B_k가 구해지면,

$$\therefore q(n) = e(n) - \hat{e}(n)$$

$\Rightarrow$ a_i, k, B_k를 구해야 함

(a_i 구하기)

$$J_{ST}(a_i) = E[e^2(n)] = E\left[\left(s(n) - \sum_{i=1}^{L} a_i s(n-i)\right)^2\right]$$

$$\frac{\partial J_{ST}(a_i)}{\partial a_i} = r(m) - \sum_{i=1}^{L} a_i r(m-i) = 0$$

$$\Rightarrow \quad \sum_{i=1}^{L} a_i r(m-i) = r(m)$$

$$\begin{bmatrix} a_1 \\ a_2 \\ \vdots \\ a_L \end{bmatrix} = \begin{pmatrix} r(0) & r(-1) & \cdots & r(1-L) \\ \vdots & \vdots & & \vdots \\ r(L) & r(L-1) & \cdots & r(0) \end{pmatrix}^{-1} \begin{bmatrix} r(1) \\ r(2) \\ \vdots \\ r(L) \end{bmatrix}$$

$$a = R^{-1} r$$

Levinson-Durbin recursive 알고리즘으로 계산됨

(k, β_k 구하기)

$$J_{LT}(k) = E[q^2(n)] = E[(e(n) - \beta_k e(n-k))^2]$$

$$\frac{\partial J_{LT}(k)}{\partial k} = \cdots = 0$$

k 구하면,

$$\beta_k = \frac{r(k)}{r(0)}$$

마지막 수정: 오후 4:19