WSCMN Features

Cepstral Mean Normalization (CMN) [9] is the simplest feature normalization technique to implement. It provides many of the benefits available in the more-advanced normalization algorithms. The LPCC cepstrums were derived using Equation (5) from the WLPC features estimated from the subband signals of each frame. Thus a sequence of cepstral vectors \( \{x_1, x_2, \ldots, x_T\} \) is obtained from a speech sample. Further these cepstral vectors were normalized using CMN. In its basic form, CMN consists of subtracting the mean feature vector \( \mu_x \) from each vector \( x_t \) and normalizing by variance \( \sigma_x \) to obtain the normalized vector \( \hat{x}_t \).

\[
\hat{x}_t = \frac{x_t - \mu_x}{\sigma_x}
\]

where

\[
\mu_x = \frac{1}{T} \sum_{t=1}^{T} x_t \quad \text{and} \quad \sigma_x^2 = \frac{1}{T} \sum_{t=1}^{T} (x_t^2 - \mu_x^2).
\]

This gives the proposed WSCMN feature vectors. Figure 2 shows the WSCMN feature extraction steps where U-WSCMN are the uniform decomposed WSCMN feature vectors and D-WSCMN are the dyadic decomposed WSCMN feature vectors.

Figure 1. WLPC Feature extraction methods : (a) DWLPC (b) UWLPC.