Audio Information Retrieval (AIR): Speaker ID (SID)

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Mel-frequency cepstral coefficients

- MFCCs are commonly derived as follows:
- Take the Fourier transform of (a windowed excerpt of) a signal.
- Map the powers of the spectrum obtained above onto the mel scale, using triangular overlapping windows.
- Take the logs of the powers at each of the mel frequencies.
- Take the discrete cosine transform of the list of mel log powers, as if it were a signal.
- The MFCCs are the amplitudes of the resulting spectrum.

Segmenting Mulimedia Streams

- Xerox PARC - Segmenting recorded meetings into categories.
- Used multi state hidden markov model (HMM), with each speaker having a subnetwork, the interconnections, and with a Gaussian output.
- Speech vectors from MFCCs (12)
- Speaker segmentation from a Viterbi decoder, noting the times when the optimal state sequence changes between sub networks
- HMM networks must be initialized. Done with agglomerative clustering and Baum Welch training algorithm. Iterative Viterbi decoding and training greatly improves results.

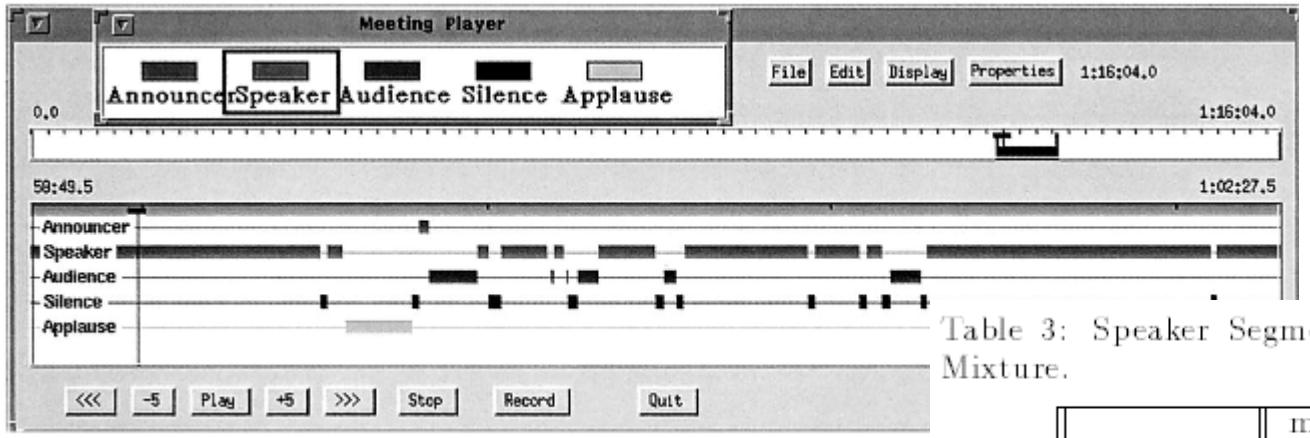


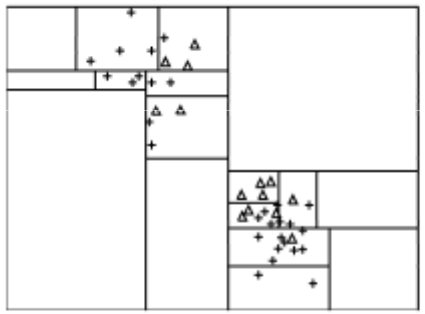
Fig. 3. PARC audio browser with speaker segmentation

Table 3: Speaker Segmentation Error for Tied Gaussian Mixture.

	maximum	recomputed	
	d_L	d_L	d_D
initial	10.7%	4.2%	4.2%
converged	.8%	.5%	.5%

Segmenting Mulimedia Streams

- Foote - rapid speaker id using discrete MMI feature quantisation
- Uses 12 MFCC coefficients plus energy
- Uses supervised training and maximized mutual information (MMI) tree for quantisation rather than k-means. Better for high dimensional space.
- Tree created by splitting one coefficient dimension at a time
- Each threshold chosen to maximize the mutual information I(X:C) between the data X and the class labels C that indicate the speaker generated
- pdf vectors created by following tree and counting elements in each cell divided by elements. Only top 3 to 303 due to silence
- Note all 13 coefficients useful rather than 2 for text. Due to nuances of vocal tract and pitch.



ight) feature space partitions.

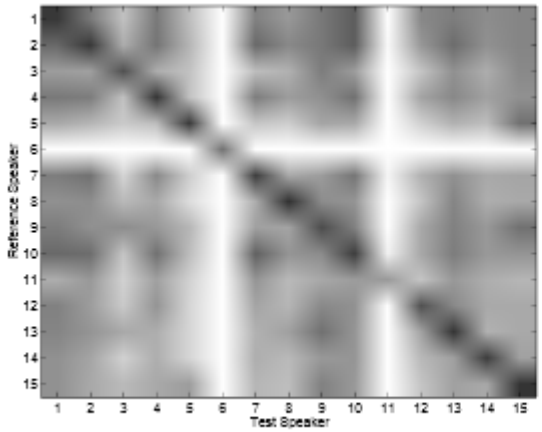


Figure 3. Speaker distance matrix (darker = closer)

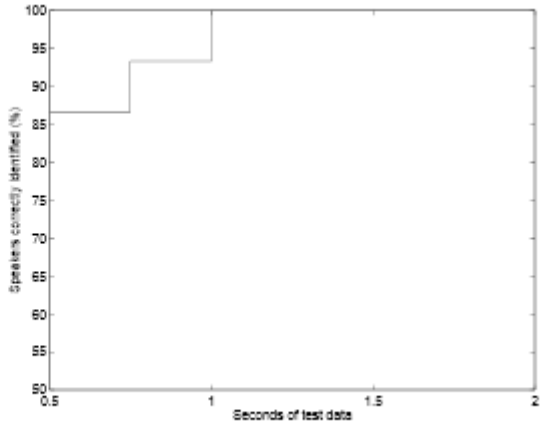


Figure 4. Speaker Identification Accuracy vs. Test Speech

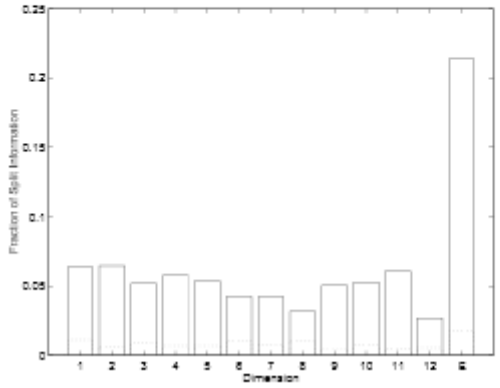


Figure 2. Fraction of mutual information by feature.