HYBRID FEATURES COMBINATION FOR AUDIO DATA CLASSIFICATION

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INTRODUCTION

Unsupervised Features Learning + Mel-Frequency Cepstral Coefficients
MEL FREQUENCY CEPSTRAL COEFFICIENTS (MFCC)

- Based on Mel-Scale
  - Take the Fourier Transform of Windowed Signal

\[ f_{mel} = 2595 \times \log \left(1 + \frac{f}{700Hz}\right) \]

- Map the power on the Mel Scale
- Take the Log of the power
- Take the DCT

- To capture the dynamics, Delta and Delta-Delta coefficients are also computed.
MEL FREQUENCY CEPSTRAL COEFFICIENTS (MFCC) – MEL FILTER BANK

- 30 Filters, with Fs=8000 Hz, and Nfft=512
MEL FREQUENCY CEPSTRAL COEFFICIENTS (MFCC)
RESTRICTED BOLTZMANN MACHINE

\[
p(h_j|v) = \text{sigmoid}\left(\frac{1}{\sigma^2}(b_j + w_j^T v)\right)
\]

\[
p(v_i|vh) = N(b_j + w_j^T v, \sigma^2)
\]
RESTRICTED BOLTZMANN MACHINE

- $P(v, h) = \frac{1}{Z} e^{-E(v, h)}$
- Gaussian Visible Units
- Binary Hidden Units
- Contrastive Divergence to learn the parameters
- $(W, b_j, c_i)$
MOTIVATION

- Two very interested tasks;

  Gender Classification

  Speaker Classification
METHODOLOGY

Audio Input → Raw Features → PCA → RBM → kNN + MFCC → SVM → Output
# RESULTS

- RBM + MFCC outperforms Raw Features and MFCC

### Gender Classification
- RBM Accuracy = 82.5 %
- MFCC Accuracy = 95 %
- RBM + MFCC Accuracy = 97%

### Speaker Classification
- RBM Accuracy = 83 %
- MFCC Accuracy = 87 %
- RBM + MFCC Accuracy = 88.88 %
VISUALIZATIONS
A Brief overview on the i-vector challenge
  • Organized by National Institute of Standards and Technology (NIST).

https://ivectorchallenge.nist.gov/

Performance metric is Discrete Cosine Function (DCF).
  • $DCF = \frac{\text{No. of misses (threshold}=t\text{)}}{\text{No. of target trials}} + \frac{\text{No. of false alarms (threshold}=t\text{)}}{\text{No. of non-target trials}} \times 100$
  • Baseline system, $DCF=0.386$
  • Deadline for submissions, 7th April, 2014.
PART II

Overview of Machine Learning and Data Analytics Symposium
Organized by QCRI and Boeing
3-4 March, 2014
Doha, Qatar