

Final Project

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1 Introduction

2 Problem Statement

The database is a set of noisy recordings, which have poor quality for further usage. So it make sense to improve them. In order to remove the noisy, we propose to use online dictionary learning.

3 Algorithm

3.1 Data Preparation

We use **librosa** to prepare our data.

3.2 Sparse Coding

Using lasso to get

$$\alpha_t \triangleq \arg \min_{\alpha \in R^k} \frac{1}{2} \|x_t - D_{t-1} \alpha\|_2^2 + \lambda \|\alpha\|_1$$

where

Then Updating A B

$$A_t \leftarrow A_{t-1} + \alpha_t \alpha_t^T \quad A_t \leftarrow A_{t-1} + \alpha_t \alpha_t^T$$

3.3 Dictionary Update

$$D_t \triangleq \arg \min_{D \in C} \frac{1}{t} \sum \frac{1}{2} \|x_i - D \alpha_i\|_2^2 + \lambda \|\alpha\|_1$$

Where $C \triangleq D \in R^{m \times k} s.t. \forall j = 1, \dots, k, d_j^T d_j \leq 1$ to ensure the convex.

Using block-coordinate descent to update dictionary

for each column from $j = 1 \Rightarrow k$

$$u_j \leftarrow \frac{1}{A[j,j]} (b_j - D a_j) + d_j$$

$$d_j \leftarrow \frac{1}{\max(\|u_j\|_2, 1)} u_j$$