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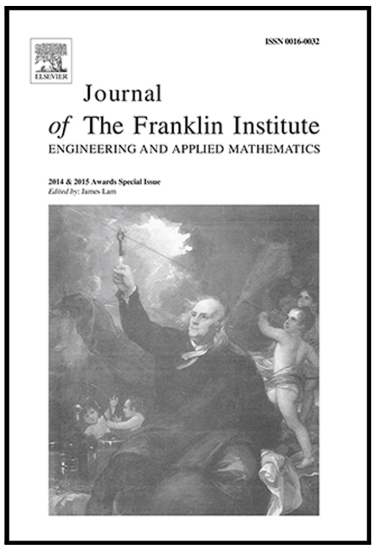

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Hierarchical Linear Dynamical Systems for Unsupervised Musical Note Recognition

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Abstract

In this paper we develop a new framework for time series segmentation based on a Hierarchical Linear Dynamical System (HLDS), and test its performance on monophonic and polyphonic musical note recognition. The center piece of our approach is the inclusion of constraints in the filter topology, instead of on the cost function as normally done in machine learning. Just by slowing down the dynamics of the top layer of an augmented (multilayer) state model, which is still compatible with the recursive update equation proposed originally by Kalman, the system learns directly from data all the musical notes, without labels, effectively creating a time series clustering algorithm that does not require segmentation. We analyze the HLDS properties and show that it provides better classification accuracy compared to current state-of-the-art approaches.

Keywords: Clustering, time series, linear dynamical systems, music information retrieval

1. Introduction

Musical signals are rich in terms of context in short time windows (spectral information); however considerable amount of information lies in the long term behavior of the sensory input that is helpful to recognize musical textures [1]. Therefore, the representation based on bag of audio features, which

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