Onset Detection for Music Transcription Based on Neural Networks

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Abstract

- Generally speaking, onset detection is the task of determining the physical starting time of notes or other musical events as they occur in a music recording.
- The three main state-of-the-art approaches for music onset detection are: energy-based approach, spectral-based approach and phase-based approach.
- A recurrent neural network is a network with feedback, which means that it is feedforward with the backward connections.

Proposed Method

AUDIO SIGNAL

Preprocessing & Reduction

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SPECTRAL FLUX

Training in a recurrent neural network

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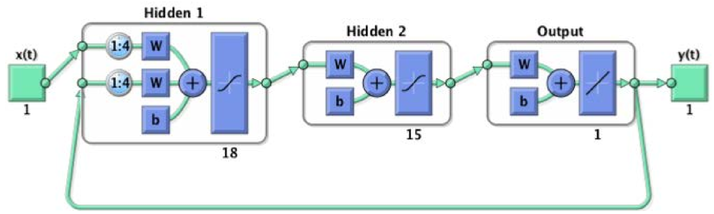
DETECTED ONSET

Peak-picking compared with ground truth

Recurrent Neural Network

- The corresponding tool, neural network which type is nonlinear autoregressive with external (exogenous) input (NARX) could be used in MATLAB toolbox.



Structure of the Recurrent Neural Network

Spectral-based Approach

- Spectral flux: a measure of how quickly the power spectrum of a signal is changing, calculated by comparing the power spectrum for one frame against the power spectrum from the previous frame.
- The idea of spectral-based novelty detection is to firstly convert the signal into a time-to-frequency representation and then to capture spectral changes in the frequency content.
- This yields the spectral-based function $\Delta_{Spectral} : \mathbb{Z} \to \mathbb{R}$ defined by

$$\Delta_{Spectral}(n) := \sum_{k=0}^{K} |\, y(n+1,k) - y(n,k) \,|_{\geq 0}$$

for $n \in \mathbb{Z}$.

Results

First Panel: Found onsets

Second Panel: Ground truth

A segment of comparison in frame

Red: After peak-picking

Blue: Before peak-picking

A segment of found onsets in time

Measurement	Precision	Recall	F-measure
Results	71.45%	76.41%	73.85%

Conclusion

- The paper researched music onset detection using spectral-based approach combined with a recurrent neural network.
- Future work: applying bidirectional long short-term memory to improve the network.

Reference

F. Eyben, S. Böck, B. Schuller and A. Graves: “Universal Onset Detection with Bidirectional Long Short-Term Memory Neural Networks,” *ISMIR*, 2010.