Monophonic MIDI Transcriber

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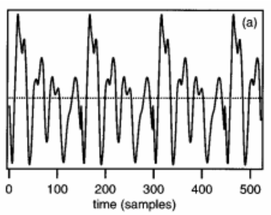
Introduction/Steps

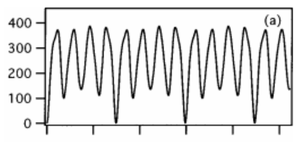
- Takes single channel monophonic input
- Detects pitch information
- Detects beat Information
- Displays pitch and beat information in a graph
- Averages pitch between onsets
- Treats each onset as new note
- Compares note frequency to MIDI value frequencies
- Assign MIDI note number
- Outputting MIDI file

Pitch Detection - YIN Method

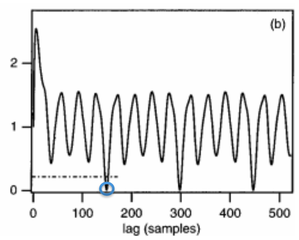
1. Calculate Difference Function for each Frame
2. Cumulative Mean Normalized Difference Function
3. Set Absolute Threshold
4. First Dip that Exceeds Threshold is Period
5. Find Fundamental Frequency based on Sampling Frequency



$$d_t(\tau)=\sum_{j=1}^{W}(x_j-x_{j+\tau})^2,$$



$$d'_t(\tau)=\begin{cases}1, & \text{if } \tau=0,\\ d_t(\tau)\Big/\left[(1/\tau)\sum_{j=1}^{\tau}d_t(j)\right] & \text{otherwise.}\end{cases}$$



Pitch Detection - Sample Output

- Pitch Probability found at each frame
- Eliminates noise and inharmonic frames
- Easier for user to understand this way

```
%calculating probability that the current frame contians pitch info
pitch_prob(j) = 1-min(dprime);
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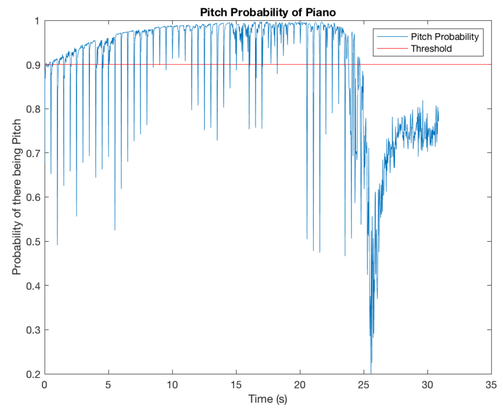
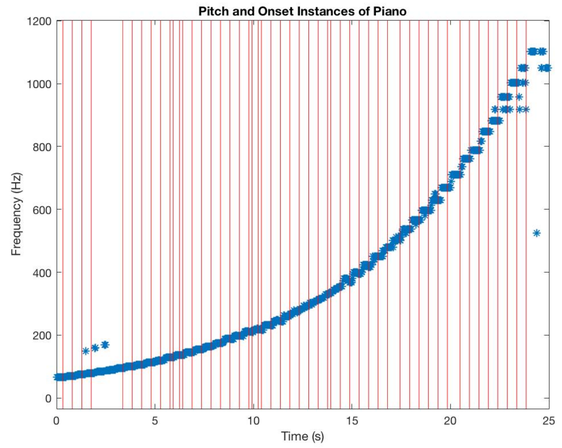


Beat Detection

1. Use Optional Preprocessing if the Dominant Instrument in Determining the Beat has a *clear* and *non-clashing* frequency band.

2. Passing the original/pre-processed signal into the Onset detection function to retrieve onsets and their relative strengths in frames.

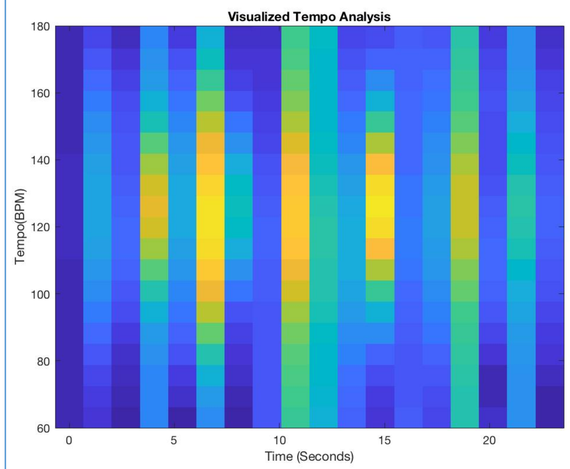
3. There are three methods for onset detections, “Spectral”, “Energy” and “Phase”. Energy works very precisely with monophonic detections.



- Red Vertical Lines Marks the Onsets in the Audio File
- Note Detections Plotted along with the Onsets

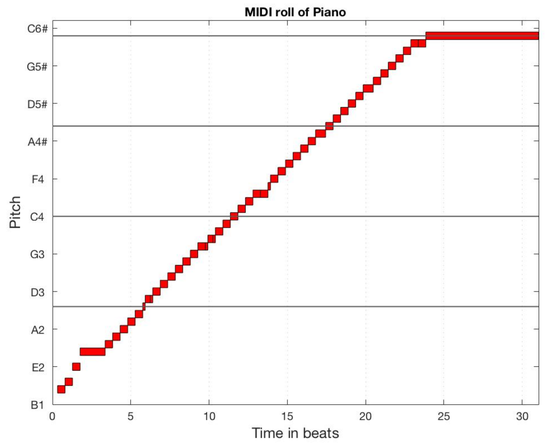
Tempo Estimation

1. Apply Segmentation to the Onset Strengths detection.
2. Calculate Frequency Components in Each Frame and Display Spectrogram of Onset Strengths using FFT.
3. Transform Frequencies into BPM using Period of the Frequencies
4. Visually Analyze Tempo Throughout the Different Frames of Onset Strengths. In this Case the Strongest BPM occurs around 120 BPM.

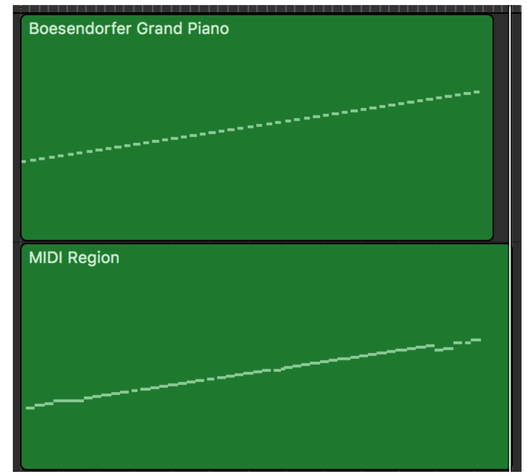


Results

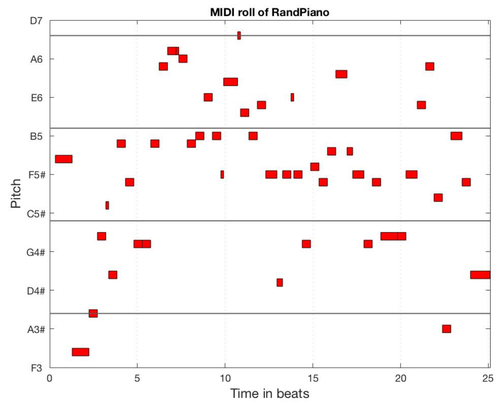
1. Averaging Pitch Between Two Consecutive Onsets
2. Compare Frequencies Detected with Midi Notes Frequencies
3. Assign Midi note value
4. Output Midi Message According to Previously Estimated Tempo.



Results Evaluation



Comparison Between Detected Results and Original Midi File (Steady Rise)



Algorithm also Detects Notes Generated at a Random Pattern

Future Work

1. Improve for Multi-Pitch Analysis
2. Time Signature Detection
3. Velocity Implementation
4. Pitch Bend Implementation
5. Models for Detecting Different Performing Techniques

References

- de Cheveigne, A., & Kawahara, H. (2002). YIN, a fundamental frequency estimator for speech and music. JASA.
- J. Bello, L. Daudet, S. Abdallah, C. Duxbury, M. Davies, and M. B. Sandler, “A tutorial on onset detection in music signals,” IEEE Trans. on Speech and Audio Processing, vol. 13, no. 5, 2005.