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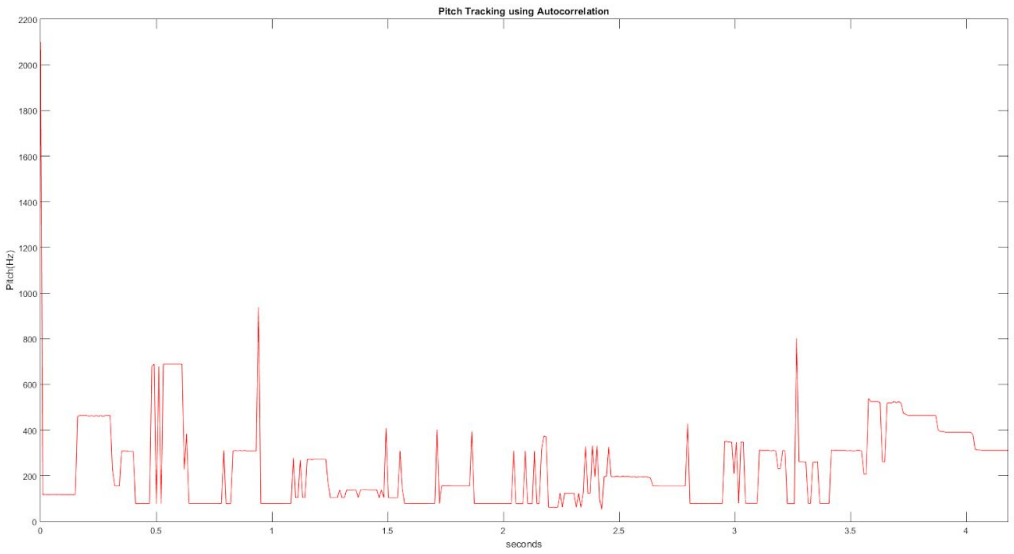
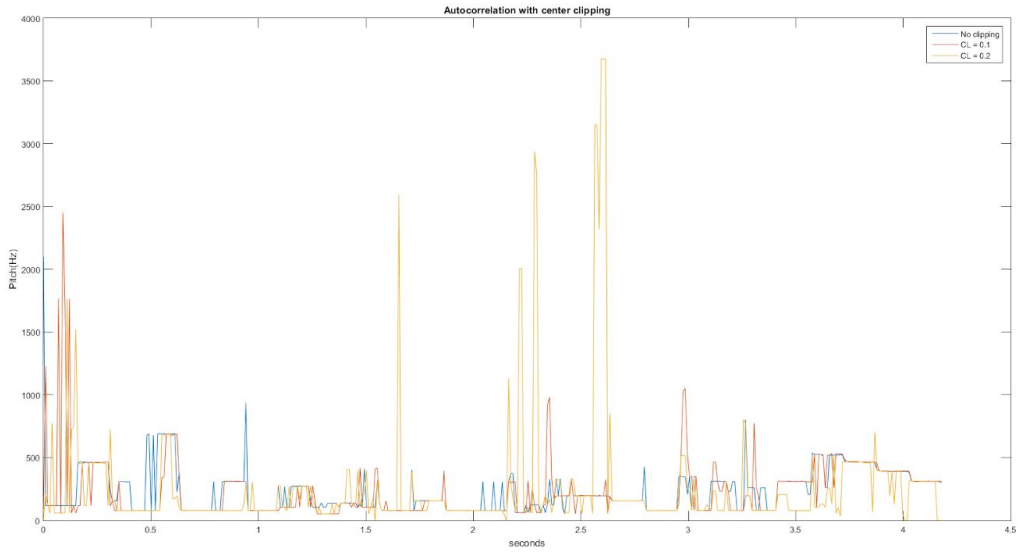
Machine Exercise 6 Pitch Estimation

1. **Given the specifications, how many frames will be analyzed in the audio file?**
   There will be 418 frames to be analyzed when each frame is 30ms long and has a hop size of 20ms.

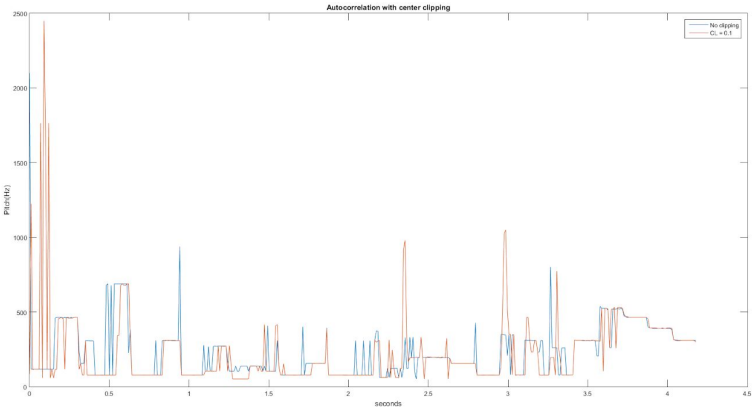
2. **Determine the fundamental frequency per analysis frame using the definition described previously. Plot the results where the x-axis and y-axis correspond to time and fundamental frequency respectively.**
   By getting the reciprocal of the difference of the two highest peaks of each frame, we can get their fundamental frequency. The graph below shows the computed fundamental frequencies.

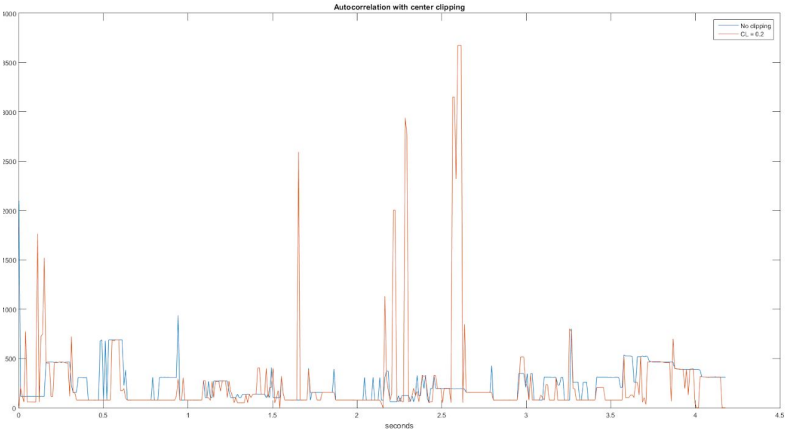


3. **Set CL to 0.1. Determine the fundamental frequencies and plot the results. How does this compare with the results in number 2? Change CL to 0.2, how does this new value affect the results?**
   The fundamental frequencies of the unclipped, clipped with CL = 0.1, and clipped with CL = 0.2 are shown below.



Meanwhile, the graphs below compares the unclipped waveform with each of the clipped waveforms.





It can be seen that the pitch detected is more accurate when clipped, since the autocorrelation of a clipped waveform will only show the most significant peaks, and avoid confusion with regards to finding the secondary peak.

4. **If the frame size and hop size are increased to 60 msec and 40 msec respectively, how do these changes affect the estimates in numbers 2 and 3? Plot the fundamental frequency estimates.**
   As seen in the graph below, having a larger frame size and hop size results in a less accurate pitch estimation. Ideally, to get the actual pitch, we should compare the frequencies of each sample. And as we increase the number of samples being autocorrelated, more frequencies will appear and the pitch will differ and will not accurately represent the pitch at a given sample/time.