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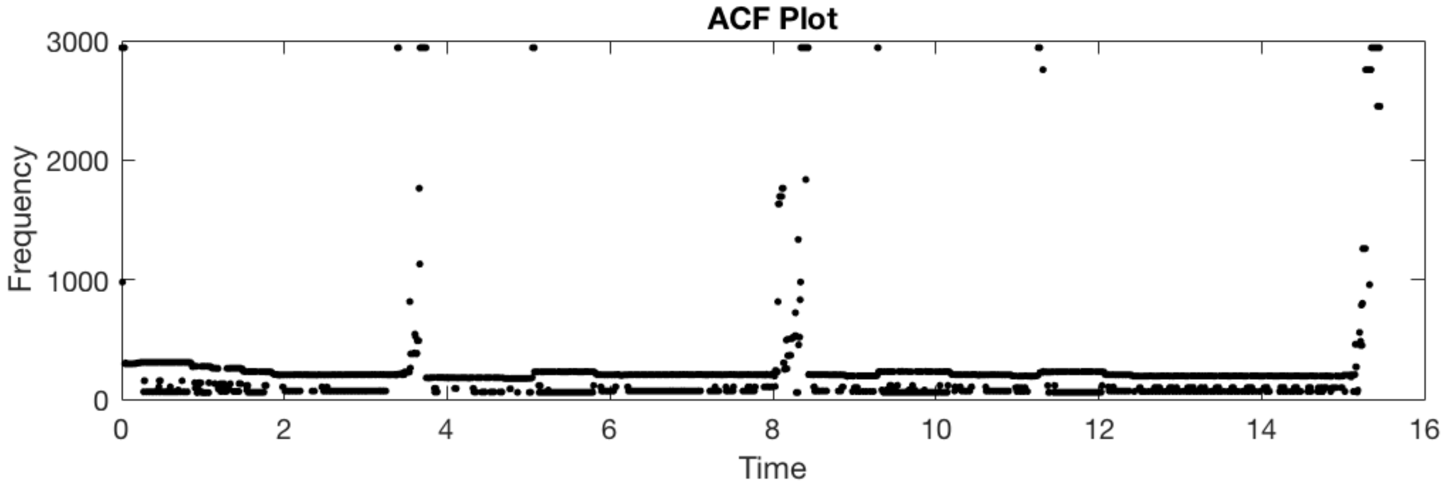
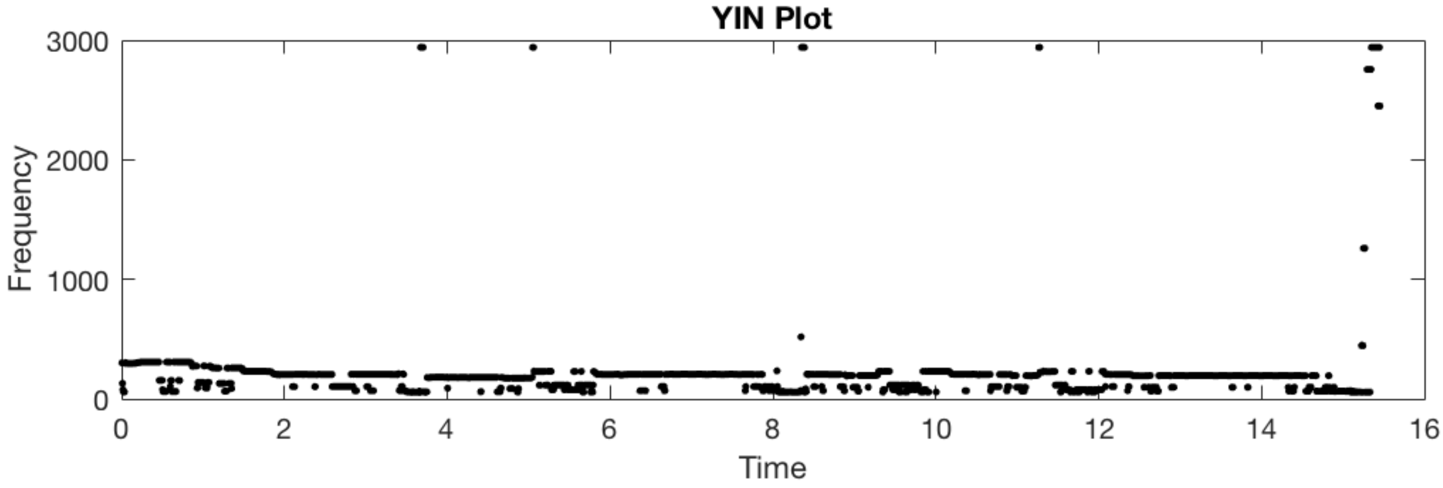
November 8, 2018
MIR - Assignment 4 – Analysis

* Warning: Under default parameters, my implementations took around 29.06 minutes to run. A summary of the operations and computation times are attached. Optimized parameters reduced run time by 6x.

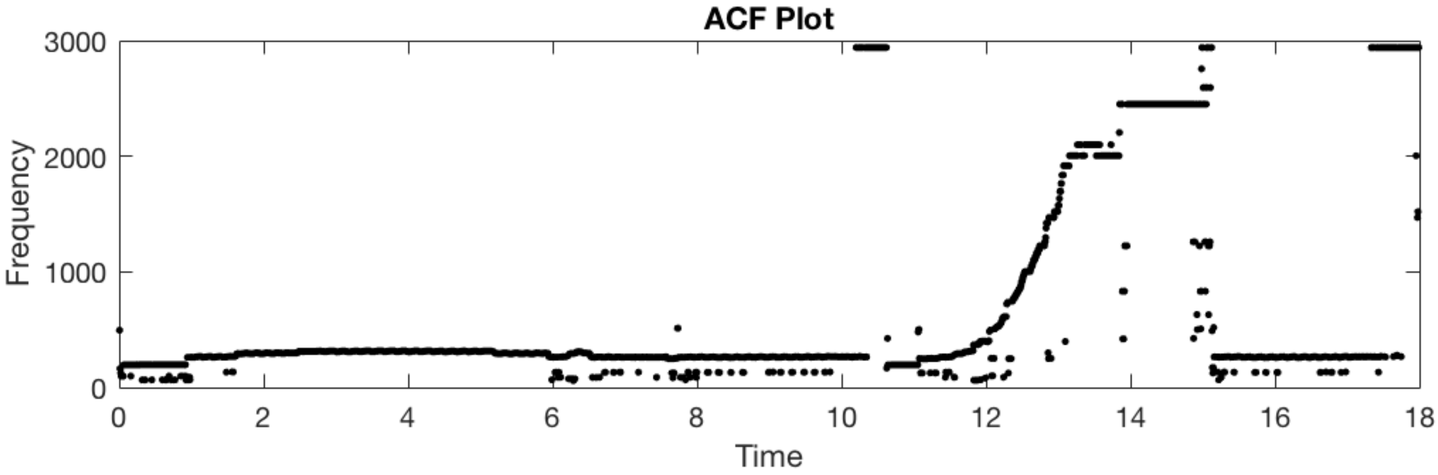
1. Pitch of two monophonic signals was estimated by maximizing a short-term auto-correlation (ACF) and minimizing a short-term YIN function. Results are below.
   a. Default Parameters:
   - Window size = 2048
   - Hop size = 256
   - Minimum lag = 15
   - Maximum lag = 800

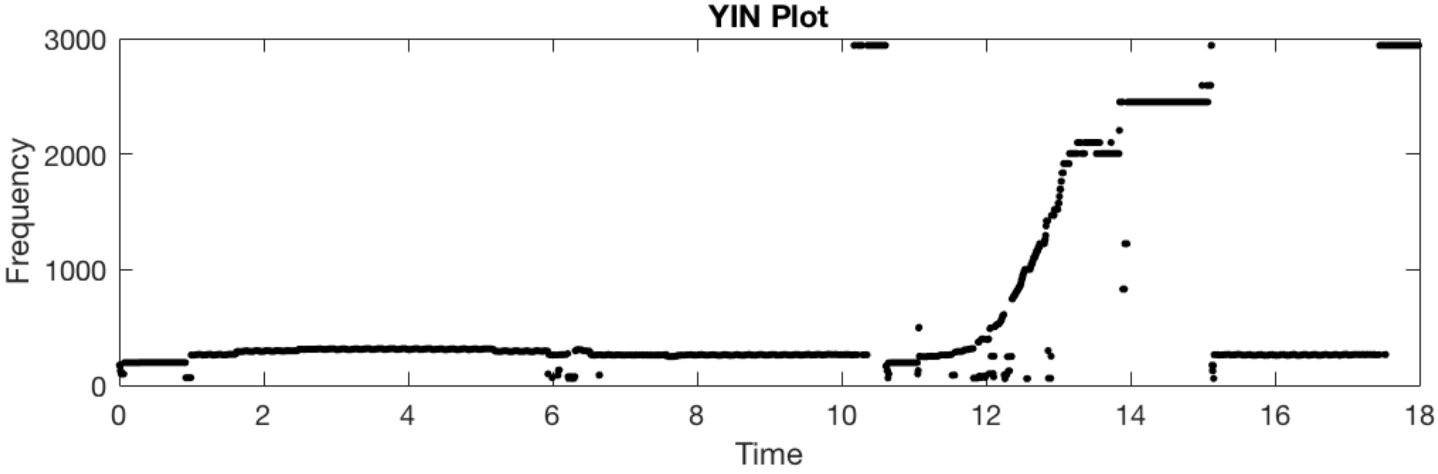
File: jazz2REF.wav





File: T08-violin.wav

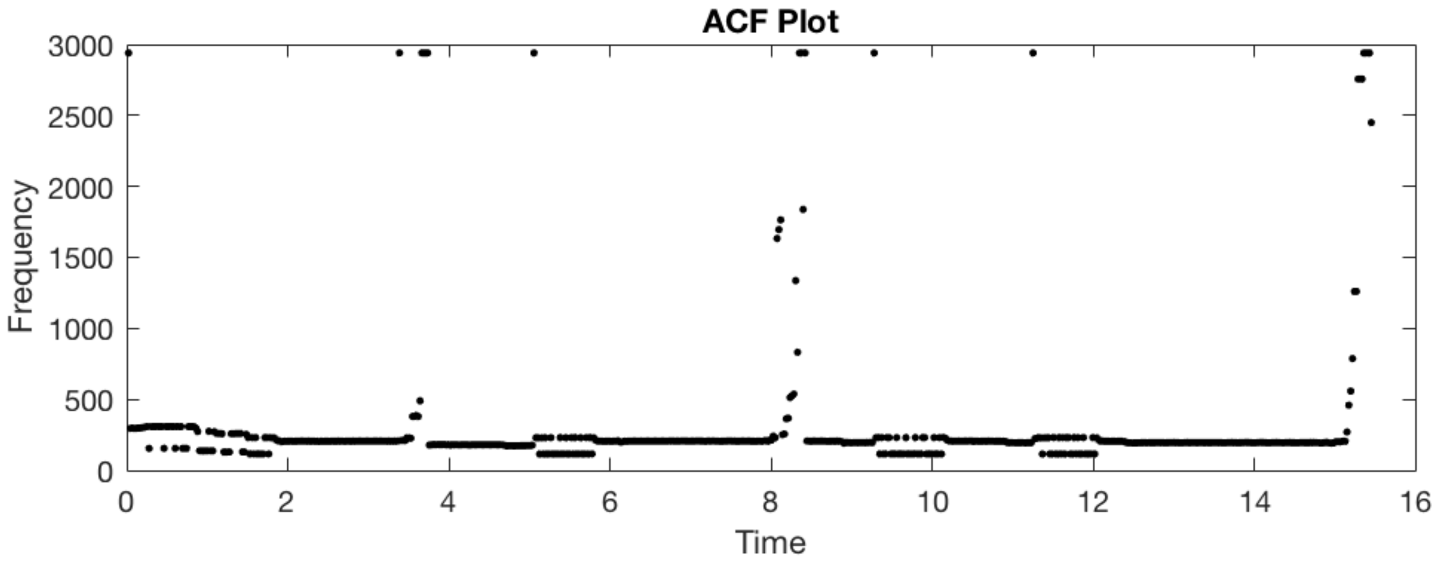


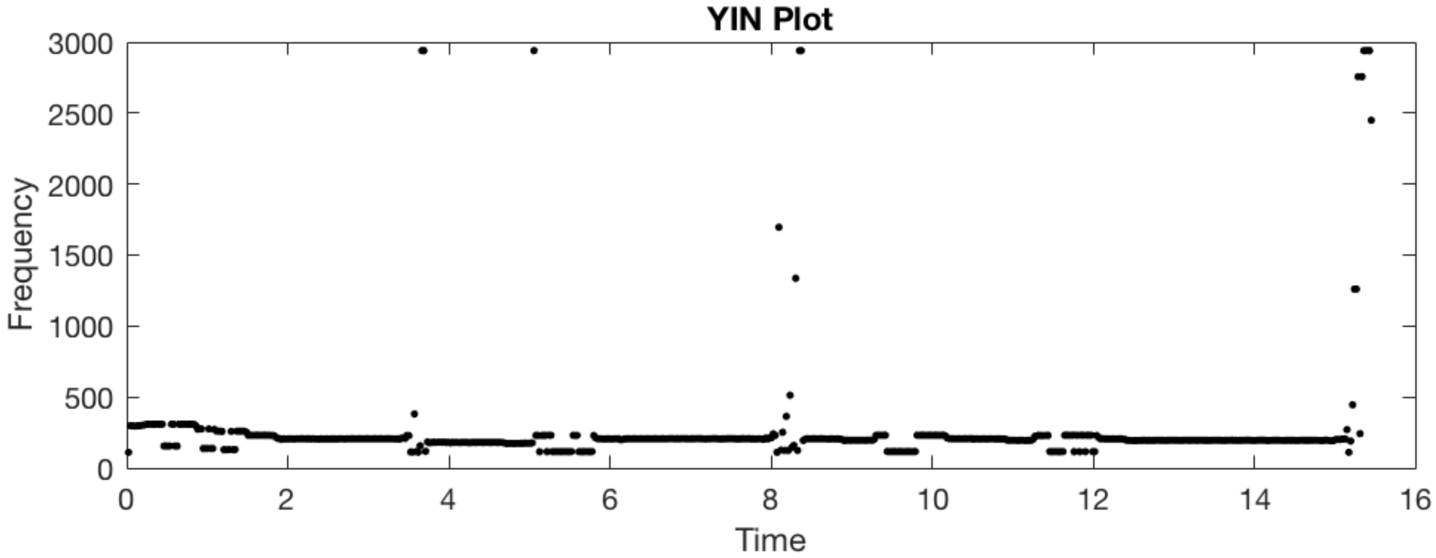


2. Each of the pitch detection functions are successful in estimating the signals' pitches. However both commit errors in the presence of silence (pauses) in the signals. In silence, the ACF adds far more noisy estimates than the YIN function. While the YIN function also incorrectly estimates these sections of silence, they are less noisy here and appear as actual sustained pitches. Also noticeable in the graphs are the additional pitches that 'underlap' the fundamental frequencies. These are presumed to be octaves of the fundamental frequencies, describing a level of harmonic error in both functions. Clearly the YIN function outperforms the ACF in this harmonic error.

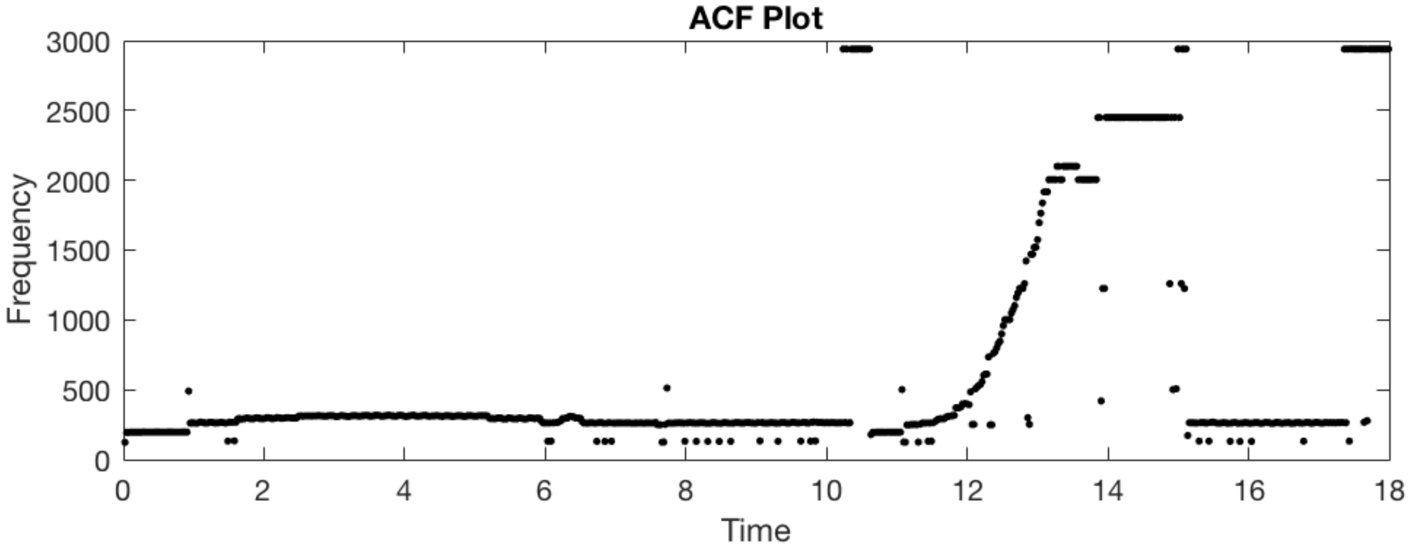
3. To compute each function as short-time systems, I used the MATLAB buffer function. Erroneously, I initially used a hop size equal to *hop_size* instead of *win_size – hop_size.* With this error, the functions produced less octave errors and incorrect estimations in the silent sections. This led to my first experiment of increasing hop size—also the run time of the program drastically reduced with a larger hop size (fewer frames = fewer computations). The inverse relationship of time and frequency resolution here produced results where vibrato and small changes in pitch are more noticeable.
   a. Experiment Parameters:
   - Window size = 2048
   - Hop size = 1024
   - Minimum lag = 15
   - Maximum lag = 400

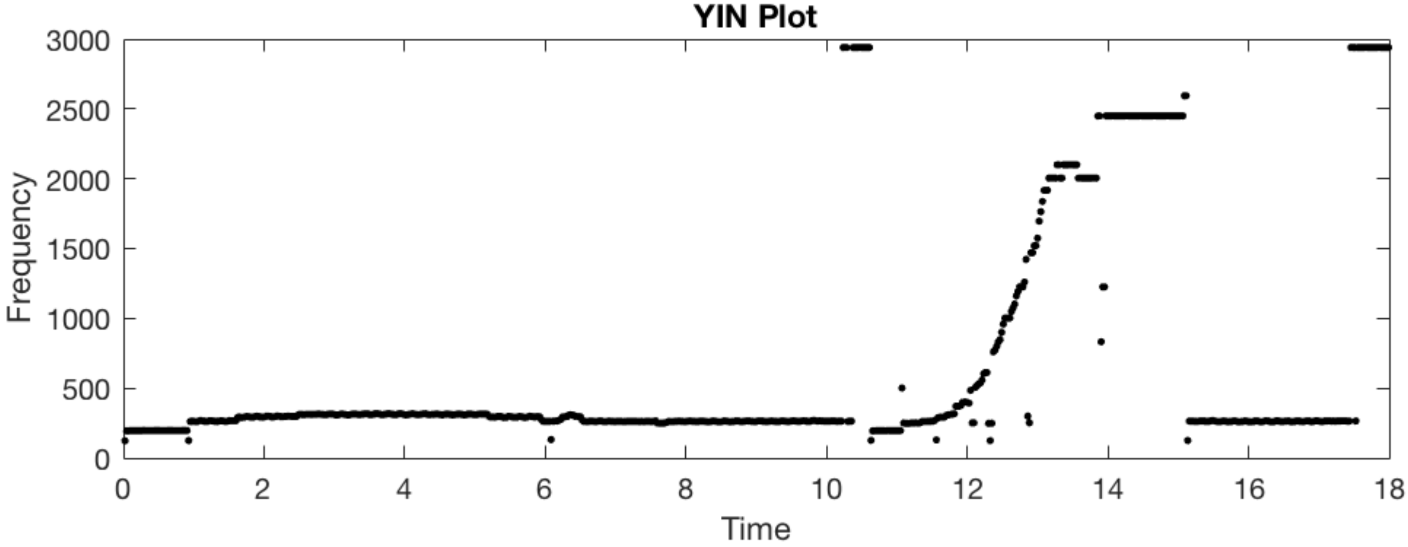
File: jazz2REF.wav





File: T08-violin.wav





Profile Summary

Generated 27-Nov-2018 20:32:48 using performance time.

Function Name	Calls	**Total Time**	Self Time*	Total Time Plot (dark band = self time)
assignment4	1	1743.921 s	0.002 s	
plot_pitch	2	1743.918 s	0.099 s	
padarray	9059436	1649.038 s	91.113 s	
detect_pitch_acf	2	875.233 s	46.277 s	
detect_pitch_yin	2	867.400 s	47.254 s	
padarray>ParseInputs	9059436	615.589 s	315.173 s	
stringToChar	9059436	495.705 s	377.889 s	
images/private/padarray_algo	9059436	446.630 s	28.464 s	
images/private/padarray_algo>ConstantPad	9059436	418.166 s	239.897 s	
validatestring	9059438	300.417 s	77.706 s	
images/private/mkconstarray	9059436	178.270 s	178.270 s	
validatestring>checkString	9059438	137.339 s	137.339 s	
stringToChar>@(x)convertToChar(x)	36237744	117.817 s	74.766 s	
validatestring>checkInputs	9059438	85.371 s	85.371 s	
stringToChar>convertToChar	36237744	43.051 s	43.051 s	
audioread	2	1.008 s	0.017 s	
PluginManager>PluginManager.getInstance	6	0.909 s	0.001 s	
...anager>PluginManager.PluginManager	1	0.908 s	0.217 s	
+file/private/mexAudioPluginManager (MEX-file)	3	0.685 s	0.685 s	
subplot	4	0.097 s	0.024 s	
buffer (MEX-file)	4	0.063 s	0.063 s	
subplot>addAxesToGrid	4	0.040 s	0.022 s	