ENPM 603 – Fall 2017
Term Project
Due: 12/07/2017 (4:00pm)

This group project will explore spectral notching by Modified DFT (MDFT) filter banks to suppress narrowband interference. In many applications, a wideband signal may be distorted by narrowband interference in one or more spectral regions. One way to mitigate such interference is:

i. Separate the distorted signal into its subbands
ii. Analyze the subbands to find which ones are distorted vs clean
iii. Discard the distorted subbands and combine the clean ones to reconstruct the signal

MDFT filter banks [1] can be used for subband decomposition with almost perfect or perfect reconstruction. The filter banks can also be implemented efficiently using polyphase decomposition. In this project, each group will implement polyphase MDFT analysis and synthesis structures in MATLAB, and use this implementation for narrowband interference mitigation.

Each group is expected to perform the following:

1. Read [1] to understand MDFT operation with polyphase implementation (figures 6, 9-12).
2. Implement polyphase MDFT analysis and synthesis in MATLAB for 64 subband channels (i.e., M=64). Choose an appropriate prototype filter, as explained in [1].
3. Implement spectral notching. The simplest way would be comparing the average power in each subband channel with a threshold, and replacing that signal by zeros if the average power exceeds the threshold. You may assume that you will be given the thresholds for each subband channel.
4. You will be given some distorted signals. First, analyze the signal by plotting a time-varying spectrum (e.g. STFT) and see if you can determine the start and end times and frequencies of the distortion visually.
5. Use your MDFT implementation to notch the distorted signals when the signal in a subband exceeds the given threshold. Combine the notched subband to reconstruct the signal and lot the spectrum of the reconstructed signals.

Each group will deliver:

1. The MATLAB code, including clear comments
2. Files containing filtered (i.e. reconstructed) signals
3. Plots of the time-varying spectrum of distorted and filtered signals

Reference:

[1] T. Karp and N. J. Fliege, "Modified DFT Filter Banks with Perfect Reconstruction", *IEEE Trans. on Circuits and Systems – II: Analog and Digital Signal Processing,* Vol 46, No 11, Nov. 1999.