Project Assignment

1. Find a paper describing the implementation of a filter that can be used in a Quadrature Mirror Filter

   - Look in IEEE Transactions on Circuits and Systems II: Analog and Digital Signal Processing
   - Dr. Bazuin must approve of all papers/filters selected.

2. Implement the filter using MATLAB

   - Provide a function that generates the filter coefficients based on a desired set of input criteria (i.e. filtercoef=Name(inputparameters))
   - Verify that you have generated the correct filter coefficients by comparing them to values or curves provided in the paper.

3. Use the QMF analysis-synthesis MATLAB script that will be developed or provided in class to characterize the results of your filter.

   - Post-analysis filter ripple, bandwidth, stopbands, etc.
   - Post-synthesis initial input data to synthesized output data error, error frequency response, etc.

Note: Alternate projects that are based on iterative optimization algorithms for filters used in communications and applied for filter-decimation or interpolation-filtering may be considered. You must discuss and have approved the project, plan, and demonstration to be performed.

![Diagram of QMF analysis-synthesis process]
Project Reports and Submissions

Submit a project report, e-mail MATLAB code, and present an oral project summary to the class.

- **Project Report:**
  - Introduction: what paper is being used, what are the unique aspects of the paper and approach?
  - Need and Significance: describe the QMF structure of interest, the goals of perfect (or near perfect) reconstruction.
  - Description: how does the algorithm work? What are the steps that must be taken, are there any assumptions or other papers that are need to understand what to do? If so what are they?
  - MATLAB code overview: how does your code work (multiple iterations, when is it done), does your code generate the same coefficients or results as the paper. (eigenvalues, curl computations, matrices, etc.)
  - Performance analysis: how well does your filter work in analyzing a test signal and then resynthesizing the original signal from the analyzed signal using MATLAB such as FFTANAL_SYNTH.m. How do your results compare to filter weights provided by Dr. Bazuin
  - Conclusions: how well did your MATLAB work, is this paper and algorithm a good approach, is the paper a good paper, etc.

- **Provide MATLAB routines for Dr. Bazuin’s collection:**
  - e-mail Dr. Bazuin your MATLAB code: include the filter generation code and all required routines, include any modified code needed to compare your filter to Dr. Bazuin’s (i.e. FFTANAL_SYNTH.m modifications or others)

- **Oral Report. (15 min.)**
  - Introduction: what paper is being used, what are the unique aspects of the paper and approach (1-2 slides)
  - Need and Significance: describe the QMF structure of interest, the goals of perfect (or near perfect) reconstruction (2-3 slides)
  - Description: how does the algorithm work, what are the steps that must be taken, are there any assumptions or other papers that are need to understand what to do? if so what (1-3 slides)
  - MATLAB code overview: how does your code work (multiple iterations, when is it done), does your code generate the same coefficients or results as the paper. (1-3 slides)
  - Performance analysis: how well does your filter work in FFTANAL_SYNTH.m, how do your results compare to filter weights provided by Dr. Bazuin (3-4 slides)
  - Conclusions: how well did your MATLAB work, is this paper and algorithm a good approach, is the paper a good paper, etc. (1-2 slides)
Note:

The principal requirements for the project must be met:

1) Define the filter coefficients based on the paper.

2) Perform full-bandwidth, uniform-channel size channelization using coefficients from one prototype filter. [Your paper may allow non-uniform channel sizes and unique filters for each of the channels, but the project and test system will not allow this flexibility.]

3) Perform full-bandwidth, uniform-channel size synthesis (interpolation-filtering for all channels) using coefficients from one prototype filter. [You may use a different synthesis filter than channelizer/analysis filter. Others should be using the same filter for both, but your paper should define whether separate analysis and synthesis filter are used.]

4) Meet the filter design requirements ...

   – minimize aliasing in all adjacent channels (approximately -40 dB 1st channel, >-60 dB 2nd adjacent channel) in the channelizer

   – minimize analysis-synthesis reconstruction error (zero would be nice, -50 dB is expected)

   – Dr. Bazuin will provide a QMF window for comparison simulation. Do you do better or worse than this window?