Çankaya University – ECE Department – ECE 376

2013 Spring Term **March 2013**

Experiment 4 : Obtaining Orthonormal Waveforms according to GS Procedure

Experiment coded in MATLAB is available on the course webpage.

1. Copy the experiment file into the directory of your name.
2. Run the file, observe the OPs, do not record anything yet. Try to follow what is intended and what is happening. Presently the orthonormalized fiunctions $\psi_1(t)\cdots\psi_N(t)$ of the four signals $s_1(t)\cdots s_4(t)$ given in Example 1.1 of lecture notes entitled "ECE376_Dimensinality of Signals_ASK_PSK_QAM_FSK_Jan 2013_HTE". Observe that this is working OK and the output for $\psi_1(t)\cdots\psi_3(t)$ is exactly the same as given in Fig. 1.1b of those lecture notes. Also test that $\psi_1(t)\cdots\psi_3(t)$ satisfy the orthogonality and have unit energy, the signal vectors $\mathbf{s}_1\cdots\mathbf{s}_4$ have the components as given in (1.17) of the notes. Write the necessary lines in the Matlab file to compute distances between $\mathbf{s}_1\cdots\mathbf{s}_4$ and verify that they are as given in (1.17).
3. Now solve Exercise 1.2 of the lecture notes by taking $s_1(t)\cdots s_4(t)$ given in Fig. 1.4 of the notes. Find M and N and $\psi_1(t)\cdots\psi_N(t)$ for the signal set $s_1(t)\cdots s_4(t)$. Test that $\psi_1(t)\cdots\psi_N(t)$ satisfy the orthogonality condition and have unit energy. Write $s_1(t)\cdots s_4(t)$ in terms of $\psi_1(t)\cdots\psi_N(t)$. Find the related signal vectors $\mathbf{s}_1\cdots\mathbf{s}_4$ and their components along the orthogonal axes, show signal vectors $\mathbf{s}_1\cdots\mathbf{s}_4$ on signal space diagram. Compute the energies of $\mathbf{s}_1\cdots\mathbf{s}_4$ and the distances between them. Verify that the energies found from $\mathbf{s}_1\cdots\mathbf{s}_4$ are the same as the energies found from time waveforms $s_1(t)\cdots s_4(t)$.
4. Comment on what type of modulation the waveforms, $s_1(t)\cdots s_4(t)$ of Exercise 1.2 of the notes represents.
5. Record all your findings in your lab notebook.