

## Project 6 Simulation of Delta-Sigma A/D in VisSim

### Project Statement

VisSim is a powerful software package of simulating various communication systems in variety of situations and conditions. It uses many embedded blocks for implementation of different parts of communication system. Moreover, it has some modules pertaining to signal processing operations such as discrete and continuous-time filter design, FFT, etc.

In this project you are to simulate a Delta-Sigma ADC system using VisSim:

- i) Simulate a single-stage delta-sigma ADC using VisSim. Change the OSR and observe how the OSR affects the output SNR. Show the results for OSR=8, 32 and 64 in your report. Use both single-bit and multi-bit quantizers in the delta-sigma loop and compare the results.
- ii) Use the iterative method to improve performance of the system implemented in part a. Test the method for 3, 5 and 8 iterations. Adjust  $\mu$  value for the best performance.

### Remarkable Bonus

Repeat parts a and b for two-stage delta-sigma ADC.

### Notes on VisSim Simulation

Since VisSim has a user friendly interface, one can use its features easily by a little effort. Despite that, the following comments are noteworthy.

- 1- Simulation time and sampling rate (simulation frequency) can be set in Simulate/Simulation Properties.
- 2- In order to generate a clear and distinguishable space in your sheet, you can define some blocks each of which accomplishes a specific part of the whole process. For this, you must first design the corresponding block diagram in the main sheet (together with its input and output connections). Thereafter, select the drawn block diagram by mouse and right-click on it. The associated block is created using Create Compound option.
- 3- MathCad code blocks can be inserted in a VisSim sheet. For this, you must go to Tools/Insert MathCad Object/New. You can also insert the Mathcad object solely or together with some other blocks in a compound block.

Note: in some MathCad operations such as DFT you may need to have a block of samples instead of a sample stream. In these cases you can use a buffer to convert the serial data to parallel.