

Assignment 9

In this assignment, we develop a behavioral model of an ideal first order delta-sigma modulator in Simulink.

Setup

Download the Simulink sigma-delta tool box from the Mathworks website (www.mathworks.com). The toolbox was put together by Simona Brigati from the University Of Pavia, Italy. Familiarize yourself with setting up the models and simulating them in Simulink. Explore the Simulink library to see the functions available. Also, look under the masks of the models downloaded to see their construction.

Simulation

In a new directory, construct an ideal first order delta-sigma modulator using the sine wave source, subtractor, ideal integrator and relay available in the toolbox. Remember to have all the Matlab files available under the downloaded directory Functions in your new directory. Set the input to an amplitude of 0.5, frequency of 1 KHz (in rads/ sec) and a sampling time of $2.5\mu\text{s}$. Set a saturation voltage of 1.5V and a sampling time of $2.5\mu\text{s}$ for the ideal integrator. In the relay, set the trip point = 0V and $\pm V_{\text{ref}} = \pm 1\text{V}$. Simulate the ADC and use the scope function from the sinks library to view the wave forms. Check the output of the integrator for saturation.

Use the Matlab routines written earlier to plot spectrum of the ADC (variable you use in the model) and the SNR. Do the results make sense?

Now change the input frequency to 10 KHz and re-plot the spectrum. What do you observe? Change the signal amplitude to 0.2V and 1.0V and observe both the output of the integrator and the spectrum. How does the spectrum change when the integrator saturates?