

## EC3400: Computer Project 7

**Introduction.** This computer project addresses the problem of designing a multistage low pass filter for improved efficiency. A particular problem of interest is in Sigma Delta Modulation, introduced in Chapter 2 in the textbook, which is at the basis of high quality digital recording.

**Problem.** The file `SDM_DATA.MAT` has been generated by oversampling a CD quality signal by a factor of 64. As a consequence the sampling frequency is  $64 \times 44.1\text{kHz} = 2.8224\text{MHz}$ . The sampled data is also binary, ie it has only one bit per sample.

Q1: by taking the FFT of the data, verify that most of the noise due to the low resolution is outside the bandwidth of the data (20kHz);

Q2: filter and downsample the data back to 44.1kHz, in 3 stages, each one downsampled by  $D=4$ . At each stage, use equiripple filters, and make sure you keep the complexity low, as explained in class.

Q3: compare the data with the original data `GIVEN_DATA_44.MAT`. Notice that the error due to quantization is very small, in spite of the fact that we used only one bit per sample.