

EE3T Study Project: Real-Time Digital Signal Processing with TMS320C6000

Laboratory 2 – Exploring Signal Conversion

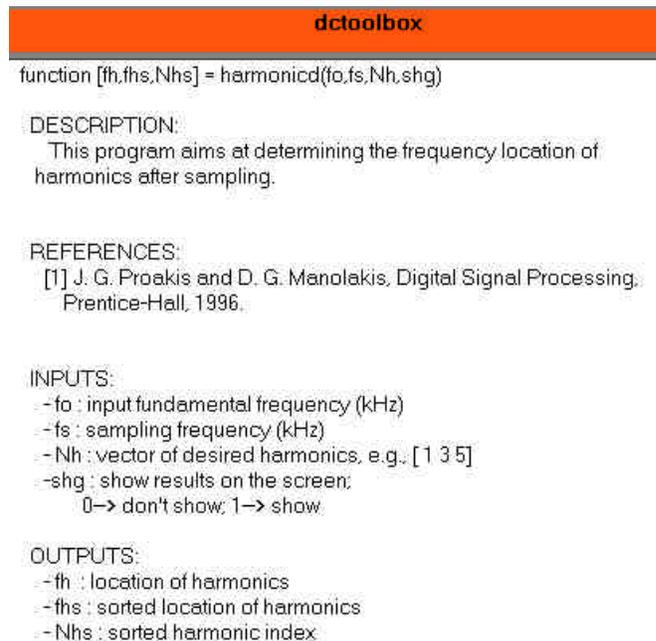
Objectives

- To explore the various effects of converting signals between analogue and digital forms.

Lab Exercises

In this lab you will use Matlab to investigate aliasing of harmonic components, quantization noise in A/D converters, signal-to-noise ratio, interpolation filter and quantization noise in D/A converters. The exercises are based on the Data Conversion Toolbox for Matlab provided with the book “DSP System Design using the TMS320C6000” by N. Kehtarnavaz and M. Keramat. You are strongly advised to keep a logbook and take copies of the plots from this exercise for references.

1. To run the lab, first download a copy of the toolbox from http://www.ee.ic.ac.uk/pcheung/teaching/ee3_study_project/dctoolbox.zip.
2. Unzip this in your home directory so that you can make changes as necessary. You should find two new directories full of .m files: dctoolbox and helptext.
3. Add these two directories to the Matlab search path using either the set path pulldown menu or the addpath command.
4. Invoke Matlab and enter command helptool. Click on the **Toolbox** button and navigate to your dctoolbox directory, and select the file harmonicd.m. You should see a description of this function. You can also browse the descriptions for all the functions in this toolbox.
5. Read the description here and/or in the header part of the .m file. Explore this with various parameters. Do not spend time on the .m file itself for this function.
6. Now explore the a2d.m utility with the default parameters. Spend some time understanding the source code of this utility. Then explore it with parameters other than the defaults.



dctoolbox

```
function [fh,fhs,Nhs] = harmonicd(fo,fs,Nh,shg)
```

DESCRIPTION:
This program aims at determining the frequency location of harmonics after sampling.

REFERENCES:
[1] J. G. Proakis and D. G. Manolakis, Digital Signal Processing, Prentice-Hall, 1996.

INPUTS:
- fo : input fundamental frequency (kHz)
- fs : sampling frequency (kHz)
- Nh : vector of desired harmonics, e.g., [1 3 5]
- shg : show results on the screen;
 0 -> don't show; 1 -> show

OUTPUTS:
- fh : location of harmonics
- fhs : sorted location of harmonics
- Nhs : sorted harmonic index

7. Try the function `sinfft.m` which demonstrates the effect of quantization noise on the spectrum of the sinusoidal signal. Again explore with various parameters, e.g. 8kHz sample frequency, 14 bit resolution and signal frequency of 550Hz.
8. Try the `snr.m` and `snr2vi.m` utilities to explore the effects of quantization to signal-to-noise ratios. Again use your own parameters in addition to the default values.
9. Try `interpolsinc.m` to explore how interpolation could be used to reconstruct an analogue output from the digital signal.
10. Explore the `d2a.m` utilities to see how the D/A output quantization error is affected by input signal to noise ratio and resolution.

Deliverables

As with ALL lab exercises, you are not required to write formal report. However, you are required to provide program listings and evidence (e.g. hardcopies of graphs) that you have done the exercises.