

# Discrete Cosine Analysis

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A Maple notebook to load in an audio signal (stored in an Excel workbook) and perform a discrete cosine analysis of the frequency content.

```
> restart;
```

Load in various useful packages.

```
> with(SignalProcessing) : with(plots) : with(ArrayTools) : with(ExcelTools) :
```

## Load and Plot Audio Signal:

First switch to the directory with the file we want (change this to wherever you stored the .xlsx file).

```
> currentdir("C:/Users/bryan/Documents/texstuff/simiode_ODE_book/chapter8/figure_code/")
```

Read in the audio file, here stored as column 1 in an Excel worksheet. Here "n" is the number of data points.

```
> Q0 := Import("gong.xlsx") :  
n := Size(Q0)[1]; #Number of data points
```

Store in an array suitable for Maple's DCT command.

```
> fs := Array([seq(Q0[k][1], k = 1 .. n)]) :
```

Compute the duration "T" of the signal, and set the sampling rate (16000 Hz).

```
> samprate := 16000;  
T := evalf( $\frac{n}{\text{samprate}}$ );
```

Here's a plot of the entire signal versus time.

```
> fsize = 12 : #fontsize for plot  
dataplt := [seq( $\left[ \frac{k - 0.5}{\text{samprate}}, fs[k] \right]$ , k = 1 .. n)] :  
plot(dataplt, thickness = 1, labels = ["Time (seconds)", "Signal Intensity"], labeldirections  
= [horizontal, vertical], axes = boxed, color = red, font = [TimesRoman, fsize], labelfont  
= [TimesRoman, fsize])
```

For time t = 1 to t = 1.01 seconds plot from k = 16000 to k = 16161, roughly

```
> dataplt := [seq( $\left[ \frac{k - 0.5}{\text{samprate}}, fs[k] \right]$ , k = 16000 .. 16161)] :  
> plot(dataplt, thickness = 1, labels = ["Time (seconds)", "Signal Intensity"], labeldirections  
= [horizontal, vertical], axes = boxed, color = red, font = [TimesRoman, fsize], labelfont  
= [TimesRoman, fsize])
```

## Compute the DCT of the Signal Vector and Plot

```
> C := DCT(fs) :
```

Display the DCT versus frequency (C[k] is frequency (k-1)/(2\*T)).

Select data for plotting, plot.

```
> Cplot := [seq( $\left[ \frac{k - 1}{2 \cdot T}, \text{abs}(C[k]) \right]$ , k = 1 .. n)] :  
> plot(Cplot, thickness = 1, labels = ["Frequency (hz)", "DCT Magnitude"], labeldirections
```

```
| = [horizontal, vertical], axes = boxed, color = red, font = [TimesRoman, fsize], labelfont  
| = [TimesRoman, fsize])  
|>
```