MATLAB Exercise – VQ Cells

Program Directory: `matlab_gui\VQ\VQ_Cells`
Program Name: `VQ_Cells_GUI25.m`
GUI data file: `VQ_Cells.mat`
Callbacks file: `Callbacks_VQ_Cells_GUI25.m`

This MATLAB exercise illustrates the cell formation properties of Vector Quantizers based on minimum distance clustering of cepstral coefficient vectors.

VQ Cells – Theory of Operation

This code uses the VQ codebook vectors from a VQ analysis with $L_m = 2$, i.e., using just 2-element vectors, to design the set of VQ codebooks for the set of 11 TI Digits training files. The program then plots the Voronoi cells of the training set vectors by plotting the values of the second cepstral coefficient versus the first cepstral coefficient for each of the training vectors assigned to one of the codewords from the codebook for that vector. Color is used to distinguish the codewords that represent each of the training vectors in the VQ solution. Hence an 8-codeword codebook will use 8 colors to distinguish the training set vectors assigned to each codebook codeword. The location of each of the codebook centroids is also shown in the plot via the heavy round circle within each VQ cell.

VQ Cells – GUI Design

The GUI for this exercise consists of two panels, 1 graphics panel, 1 title box and 5 buttons. The functionality of the two panels is:

1. one panel for the graphics display,
2. one panel for parameters related to the VQ analysis, and for running the program.

The graphics panel is used to display the following:

1. for a given digit and for a given size codebook, the exercise plots the values of $c[2]$ versus $c[1]$ for each training set vector. The exercise uses a different color for each codeword that is used to represent the particular training vector.

The title box displays the information about the VQ codebook used in the graphics display. The functionality of the 5 buttons is:

1. an editable button that specifies the VQ codebook size, `vqsize`: (the default value is `vqsize=8`),
2. an editable button that specifies the specific digit, `idigit`, from which the training set vectors were derived; (the default is `idigit=1`),
3. an editable button that specifies the length of the cepstral vector, L_m; (the default is $L_m = 2$),
4. a pushbutton to run the code and display the results on the graphics panel display,
5. a pushbutton to close the GUI.

VQ Cells – Scripted Run

A scripted run of the program 'VQ_Cells_GUI25.m' is as follows:

1. run the program 'VQ_Cells_GUI25.m' from the directory:

`matlab_gui\VQ\VQ_Cells`

2. using the editable buttons, set initial values as `vqsize=8, idigit=1` and $L_m = 2$,
3. hit the 'Run VQ Cells' button to display the plots of $c[2]$ versus $c[1]$ for all training vectors in the idigit training set, using a different color for each vector assigned to a different codebook centroid; the exercise also plots the centroid locations of each of the codebook centroids,
4. experiment with different choices of `vqsize, idigits` and L_m,
5. hit the 'Close GUI' button to terminate the run.

An example of the graphical output obtained from this exercise using the TI digits training files of cepstral vectors is shown in Figure 1. The graphics panel shows values of $c[2]$ versus $c[1]$ for each vector in the TI digits training set for digit idigit=1 (from a codebook with 8 VQ cells), using a different color for each codeword to which the training set vector was assigned during the VQ design process.

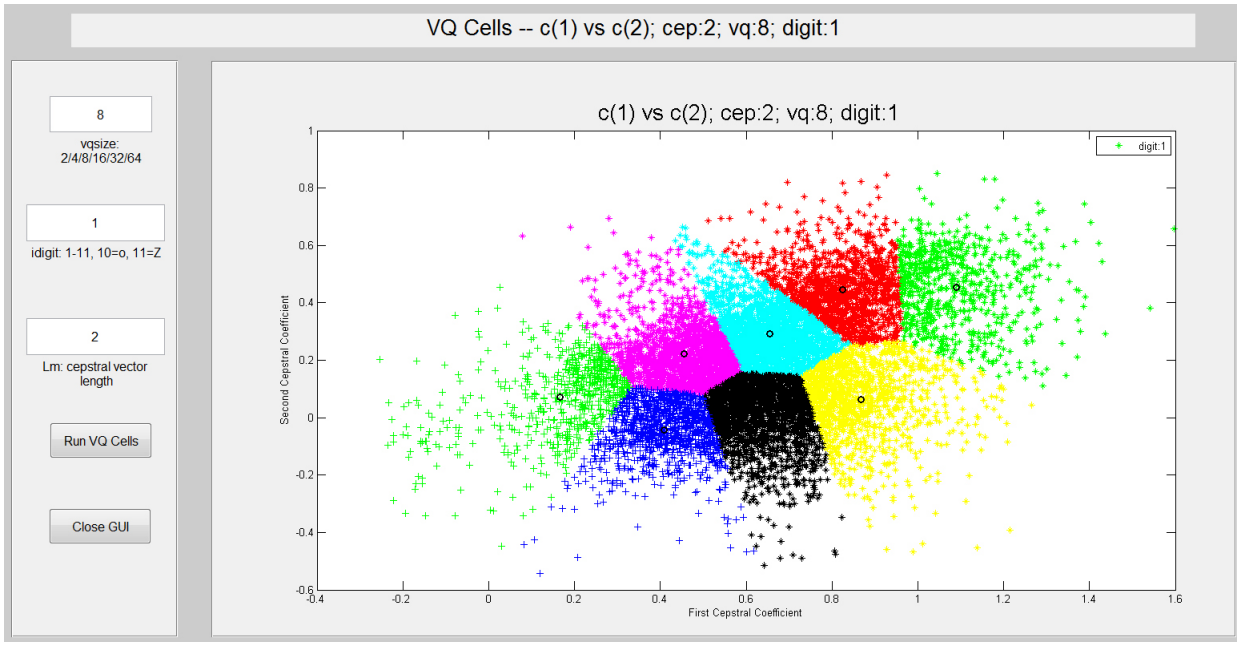

Figure 1: Graphical output from this exercise. The graphics panel shows values of $c[2]$ versus $c[1]$ for each vector in the TI digits training set for digit idigit, using a different color for each codeword to which the training set vector was assigned during the VQ design process.