PGM - Homework 5

Image Segmentation Using Graph cuts

March 8, 2017

You need to perform a binary image segmentation task using graph cuts, segmenting a foreground object from the background. You only need to get your program working on a single image, namely the image of a maple leaf in the water (the leaf is the foreground, the water is background). The image can be obtained from here:

http://www.1wallpaperhd.com/2014/06/maple-leaf-on-the-water-wallpapers-hd.html

You may use an MRF with a 4-neighbourhood graph structure with the following energy function

$$E(\mathbf{x}) = \sum_{i \in \mathcal{V}} E_i(x_i) + \sum_{(i,j) \in \mathcal{E}} E_{i,j}(x_i, x_j) \tag{1}$$

Where $\mathcal{V}$ is the set of nodes and $\mathcal{E}$ is the set of edges of the graph. As a very simple energy function you can have

$$E_{i,j}(x_i, x_j) = \begin{cases} 0 & x_i = x_j, \\ 1 & x_i \neq x_j, \end{cases} \tag{2}$$

and

$$E_i(0) = \beta \left\| I_i - \bar{I}_B \right\| \tag{3}$$
$$E_i(1) = \beta \left\| I_i - \bar{I}_F \right\| \tag{4}$$

where $I_i \in \mathbb{R}^3$ is the color (red, green, blue) of the pixel i, and $\bar{I}_B$ and $\bar{I}_F$ are the average colors of foreground and background respectively. You can obtain $\bar{I}_B$

and $\bar{I}_F$ by averaging over small rectangular areas of foreground and background. Play with the parameter β until you get a reasonable segmentation.

You can use any software solving the min-cut/max-flow problem. But, your are not allowed to use software specially designed for image segmentation. This means that you need to programmatically read the image and build the corresponding MRF graph (build the nodes and edges, and assign the edge weights).

You can find graph cut packages for common programming languages in the following links:

- http://vision.csd.uwo.ca/code/

- http://cmp.felk.cvut.cz/ smidm/python-packages-for-graph-cuts-on-images.html

* Writing an interactive segmentation software will give you extra points.