ECE 643: Introduction to Biocomputing

Project # 7: Model-Based Segmentation

(Issued Thursday 04/16/2009 – Due Thursday 04/23/2009)

1. For each of the following images
   I. “Lung.pgm”    II. “Kidney.pgm”
      a. Compute the gray levels histogram,
      b. Using the EM that you implemented in a previous project, fit \( N \) Gaussians on this histogram,
      c. From the \( N \) Gaussians, estimate the marginal density of each class \( P(I_p|f_p) \), and compute the threshold between these densities,
      d. Obtain an initial segmentation using this threshold,
      e. If we fit a MGRF on the desired image \( f \) with the assumption that the Gibbs energy is identified by the 2nd order neighborhood system, the Pairwise interaction model is chosen and the potential function is selected to be:

\[
V(f_p) = \alpha f_p \\
V(f_p, f_q) = \begin{cases} 
\beta & \text{if } f_p \neq f_q \\
0 & \text{otherwise} 
\end{cases}
\]

\[
\alpha = 0, \quad \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta
\]

For a proper value \( \beta \), obtain the final segmentation by computing the Maximum-A-Posteriori estimate of \( f \) using the ICM algorithm,

f. Study the effect of the value of \( \beta \) on the final segmentation,

\[ \text{g. (Extra credit) Repeat (e) using the simulated annealing algorithm.} \]

2. (Extra credit) Repeat 1 for the “rose.ppm” image.