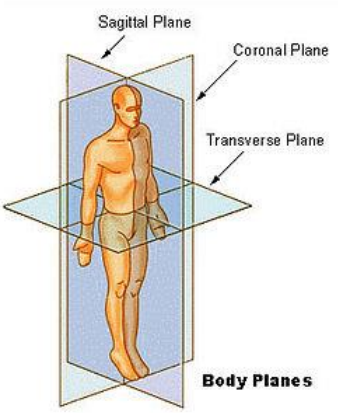
Medical Image Analysis (EE61008)

Assignment 4

Due: 19 Jan 2015, 3:30 - 4:00 PM, N232 Dept. of Electrical Engineering
Type: Solve in class.
Spring 2014-15

1. You are provided with a section of the T1 weighted MRI of the Brain (f) and a shape template for the Medulla oblongata (t).

$$f = \begin{bmatrix} 50 & 20 & 30 & 44 & 53 & 10 \\ 30 & 20 & 10 & 1 & 72 & 65 \\ 54 & 0 & 1 & 4 & 0 & 10 \\ 32 & 1 & 0 & 1 & 0 & 12 \\ 20 & 43 & 45 & 0 & 91 & 32 \\ 5 & 89 & 56 & 72 & 79 & 30 \end{bmatrix} \quad t = \begin{bmatrix} 1 & 1 & 0 & 1 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 1 & 1 & 0 & 1 \end{bmatrix}$$



   (a) Identify the plane of imaging of *f* with respect to the conventions for anatomical body planes used for medical imaging, as described in the adjacent figure.

   (b) Compute the quality-of-fit measure (QoF) over the complete domain of *f* for the pair (*f*,*t*) using the following metrics
      i. Mean square deviation
      ii. Correlation coefficient
      iii. Covariance in Fourier domain
   (c) Indicate the coordinate location where *t* matches *f* best?
   (d) Which of the earlier computed QoF measures offers the maximum dynamic range in the computed metric? Substantiate with respect to this numerical problem.
   (e) Which of the QoF measures is robust to intensity shifts of the image? Substantiate with respect to this numerical problem.
   (f) Compute the QoF measures with respect to (f,t_1) where t_1=50×*t* ?
   (g) Verify if you have obtained the same best match location is in (c)?
   (h) Comment on your answers for (d) and (e)?
   (i) Compute the QoF measures with respect to (f,t_2) where t_2 = -23×*t* + 1?
   (j) Re-evaluate your responses for (g) and (h)?

2. Consider the following image of blood vascular network in a section of the retina

$$f = \begin{bmatrix} 67 & 72 & 1 & 0 & 10 & 11 \\ 5 & 32 & 1 & 1 & 9 & 57 \\ 15 & 23 & 0 & 2 & 11 & 20 \\ 10 & 10 & 1 & 0 & 1 & 23 \\ 10 & 3 & 1 & 1 & 2 & 22 \\ 10 & 10 & 1 & 1 & 2 & 29 \end{bmatrix}$$

(a) Suggest an average image intensity invariant method of segmenting the blood vessels? Implement the method and obtain the result of segmentation.
(b) Suggest a local intensity invariant method of vessel segmentation? Implement the method and obtain the result of segmentation. Mention the output of each of the steps involved in the process.
(c) Compute the medial axis of the segmented blood vessel?
(d) Compute the thickness of the vessel in pixel units along each point on the medial axis?
(e) What is the mean and variance of the vessel thickness?