BE 3600 BIOMEDICAL INSTRUMENTATION (LAB) -

Experiment 11:

Imaging Systems: Computer Tomography

OBJECTIVE: Learn the basic principles of non-invasive imaging

BACKGROUND ON COMPUTER TOMOGRAPHY

Read Chapter 13 of "Biomedical Instruments: Theory and Design" by Welkowitz, Deutsch and Akay. A handout will be provided in advance.

EXPERIMENT AND REPORT

1. Create a hypothetical 3x3 object using your MTU student I.D. as shown in the example below:

    Assume the student I.D. is 234 - 56 - 7890. Then the 3x3 object ($Actual_{i,j}$)would be as follows:

    $Actual_{i,j}$

2	3	4
5	6	7
8	9	0

2. Calculate the horizontal and vertical projections, by simply adding the entries of the individual columns and rows. This will give you the "z_i" values that you would normally have received from the imaging device.

3. Assume all initial pixel values to be zero, i.e., start with the initial guess shown below:

$Estimated_{i,j}$

0	0	0
0	0	0
0	0	0

4. Calculate the projections from the rows and the columns of the estimated matrix shown in item 3 above. This will give you the "Z_i" values.

5. Calculate the error in estimation as follows:

$$Error = \sum_{i,j=1}^{3} \left| Actual_{i,j} - Estimated_{i,j} \right|$$

6. Iterate for at least three times using the Algebraic Reconstruction Technique as it is outlined on pages 351-3 of "Biomedical Instruments: Theory and Design" by Welkowitz et al. You can do this either manually, or write your own code. If you carry out the calculations by hand, you must include them with your report. If you write your own code to carry out the calculations, then include the program listing as well as the program output.

REPORT:

1. For each step of the iterative solution, show the estimated value matrix, horizontal and vertical projection values, as well as the error value.

2. Did the estimated values approach to the actual values? Why or why not?

3. Compare the various methods listed in the reading assignment. Which one is the easier one? Which one is the most accurate one? Which one is more suitable for large images (e.g. 512 x 512 pixels)?