March 26, 2008

LAB 6- Feature Extraction Using the Radon Transform -
Chapter 7- MATLAB for Image Processing

Lab Report Due: - April 2, 2006.

In this Lab. we do experiments in Chapter 7, pages 7-6 to 7-11. There is one copy of the notes in the Lab.

Radon transforms are a set of of 1-D projections of a given function \( f(x, y) \). In image processing, the given function is an image, a 2-D function and the projections are a set of line integrals (see \( R_\theta(x') \) in equation 1 and Figure 1).

The *radon* function in MATLAB computes the line integrals or projections from multiple sources along *parallel paths or beams* in a given direction. Projections that are line integrals along paths that radiate from a *single* source are called *fan beam projections*. MATLAB has a function for this. Go to HELP and type “fan beam projection”. We will not be doing fan-beam projections in this Lab.

\[
R_\theta(x') = \int_{-\infty}^{+\infty} f(x' \cos \theta - y' \sin \theta, x' \sin \theta + y' \cos \theta) dy'
\]  

where,

\[
\begin{bmatrix}
    x' \\
    y'
\end{bmatrix} = \begin{bmatrix}
    \cos \theta & \sin \theta \\
    -\sin \theta & \cos \theta
\end{bmatrix} \begin{bmatrix}
    x \\
    y
\end{bmatrix}
\]

**Question 1:** Give the transformation that converts \( f(x, y) \) to \( f(x', y') \).

**Simulation 1** In MATLAB, do the following:

```
>> edit radon_simple
```

Highlight the lines 4-6 of the code and do *Text → EvaluateSelection* and see the figure generated.

Highlight lines 9 - 13 and do the same.

**Question 2:** Explain the results.

Highlight lines 16-24 and evaluate.

**Question 3:** Explain the results.

Repeat the above simulation with the following image:

```
>> I=zeros(100,100);
I(25:75, 25:75) = 1;
I(30:70, 30:70) = 0;
imshow(I)
```

**Question 4:** Explain the results.

**Simulation 2** In MATLAB do the following:
>> edit radon_line_detection

Highlight the lines 1-9 of the code and do Text → EvaluateSelection and see the figure generated.
Highlight lines 11-15 and do the same. Observe the results.
Highlight lines 17-22 and evaluate. Observe the results.
Highlight lines 24-30 and evaluate.
**Question 5:** Explain the results.

Also do the following:

>>plot (theta, max(r))

**Question 6:** Explain the results.

**Question 7:** Given that you have an image and are computing its projection along a certain line (say a specific angle 45°), explain simply, in terms of the given discretized image, how the values of the projection $R_{45°}(y')$ are determined for each discrete value of $y'$.

Reference: Feature Extraction using Segmentation and Edge Detection, Chapter 7 from MATLAB for Image Processing.

*Class notes: mirchand/ee276*
Figure 1.

Figure 2.

Figure 3.