Due Never

ECE 438 Assignment No. 11 Summer 2004

1. Compute the CSFT, F(u,v), of the following functions:

   a) $f(x,y) = rep_{T_x,T_y}\{\ rect(x,y)\ \} = \sum_{m=-\infty}^{\infty}\sum_{n=-\infty}^{\infty} rect(x-mT_x, y-nT_y)$

   b) $f(x,y) = \sum_{m=-2}^{2}\sum_{n=-2}^{2} rect(x-mT_x, y-nT_y)$

   c) $f(x,y) = \begin{cases} 1 & , \quad (x/a)^2 + (y/b)^2 \le 1 \\ 0 & , \quad (x/a)^2 + (y/b)^2 > 1 \end{cases}$ (1 inside an ellipse)

2. Define the Radon Transform of f(x,y), denoted $\Re\{f(x,y)\}$, by the following:

$$\Re\{f(x,y)\} = \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} f(x,y)\delta(x\cos(\theta) + y\sin(\theta) - t)dxdy$$

   Let $p_\theta(t) = \Re\{f(x,y)\}$. Prove the following properties:

   a) shifting: $\Re\{f(x-x_o, y-y_o)\} = p_\theta(t - x_o\cos(\theta) - y_o\sin(\theta))$

   b) scaling: $\Re\{f(ax,ay)\} = \frac{1}{|a|}p_\theta(at)$ (remember $\delta(at) = \frac{1}{|a|}\delta(t)$)

3. For the following signals, compute the Radon Transform $p_\theta(t)$ and its Fourier transform $S_\theta(\rho) = CTFT\{p_\theta(t)\}$.

   a) $f(x,y) = \delta(x-x_o, y-y_o)$ (remember $\delta(x,y) = \delta(x)\delta(y)$)

   b) $f(x,y) = circ(x,y)$ (Hint: the Fourier-slice theorem is useful here)