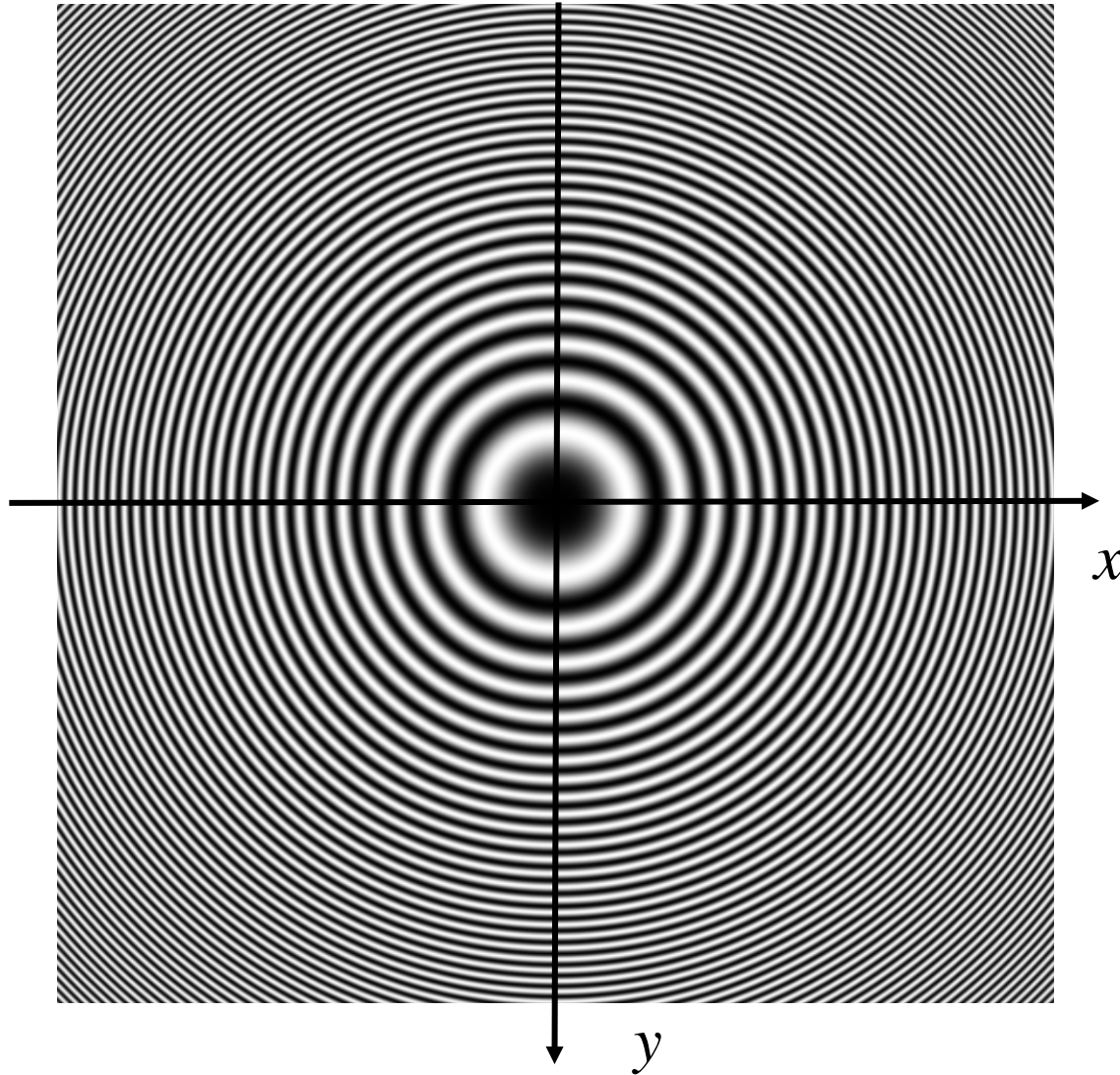


Zoneplate pattern to visualize frequency plane



Equation to generate pattern:

$$s(x, y) = \hat{s} \cos(a_x x^2 + a_y y^2) + s_0$$

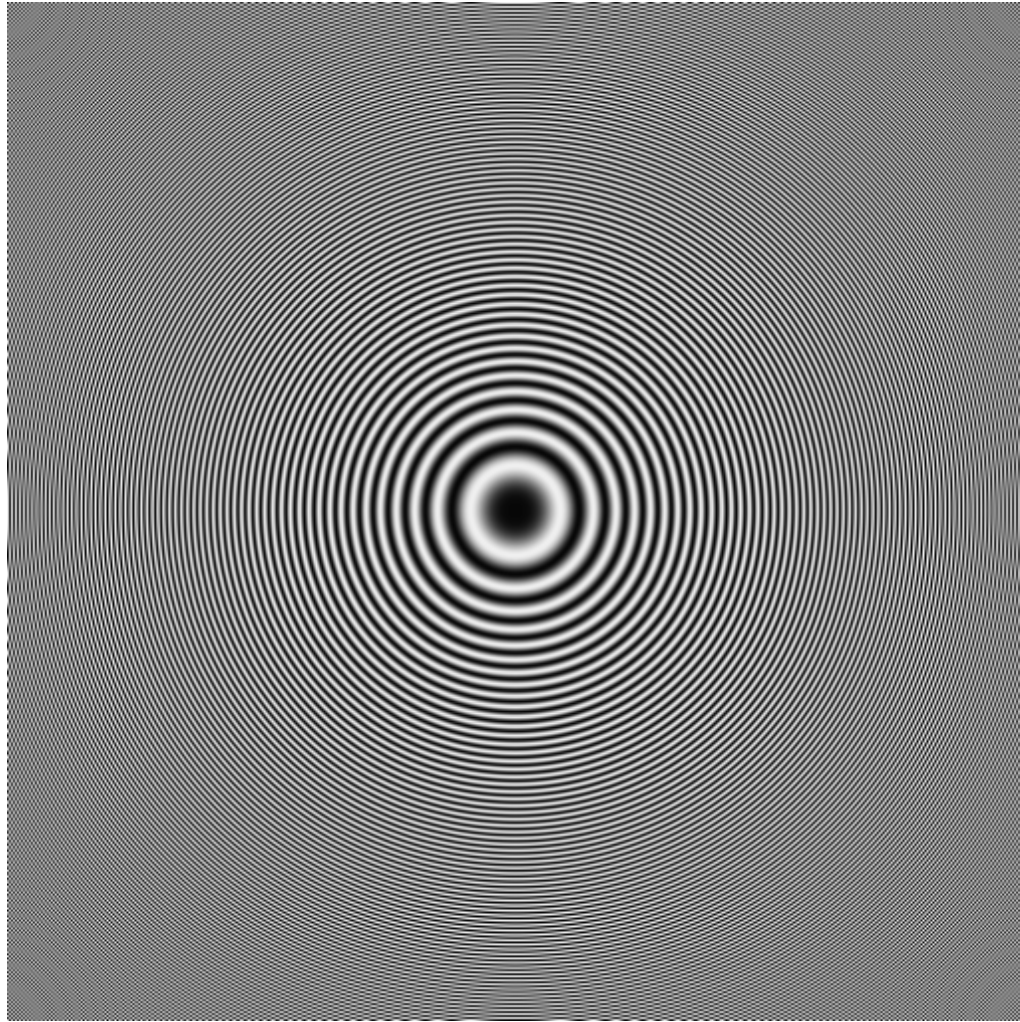
Local frequency at (x, y)

$$\frac{\partial}{\partial x} (a_x x^2 + a_y y^2) = 2a_x x$$

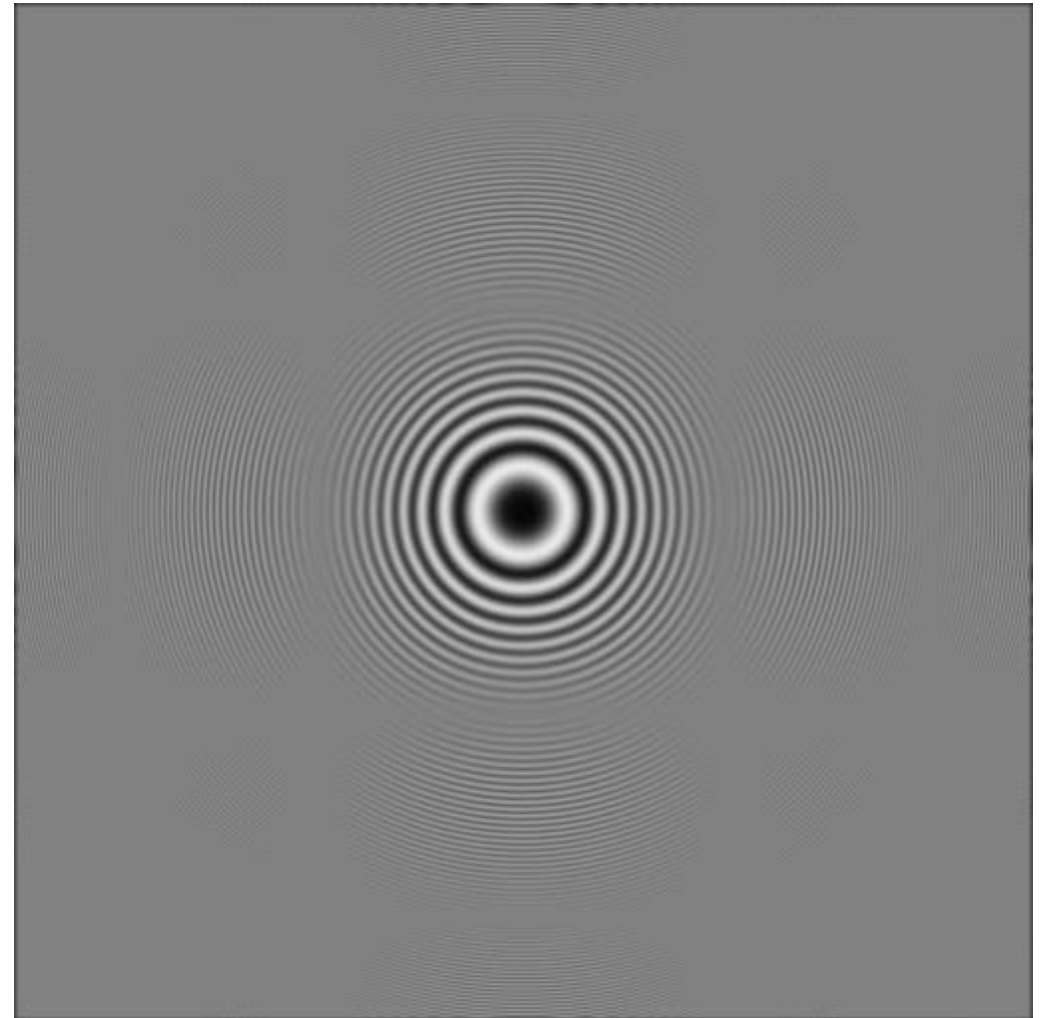
$$\frac{\partial}{\partial y} (a_x x^2 + a_y y^2) = 2a_y y$$

$$s[x, y] \begin{array}{c} \xrightarrow{\text{interpolation}} \\ \xleftarrow{\text{sampling}} \end{array} s(x, y)$$

Lowpass filtering

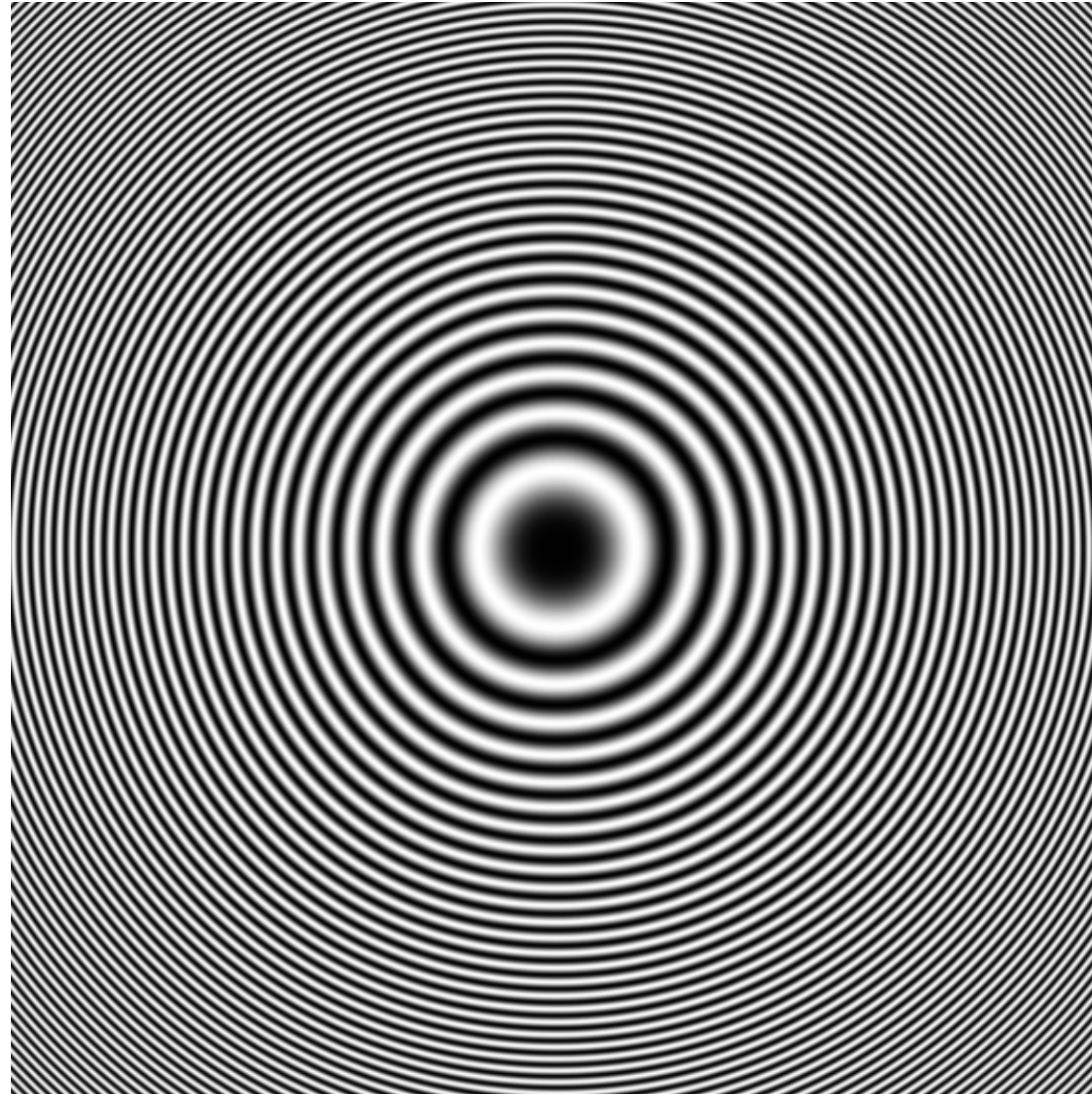


Original *Zoneplate* (512x512)

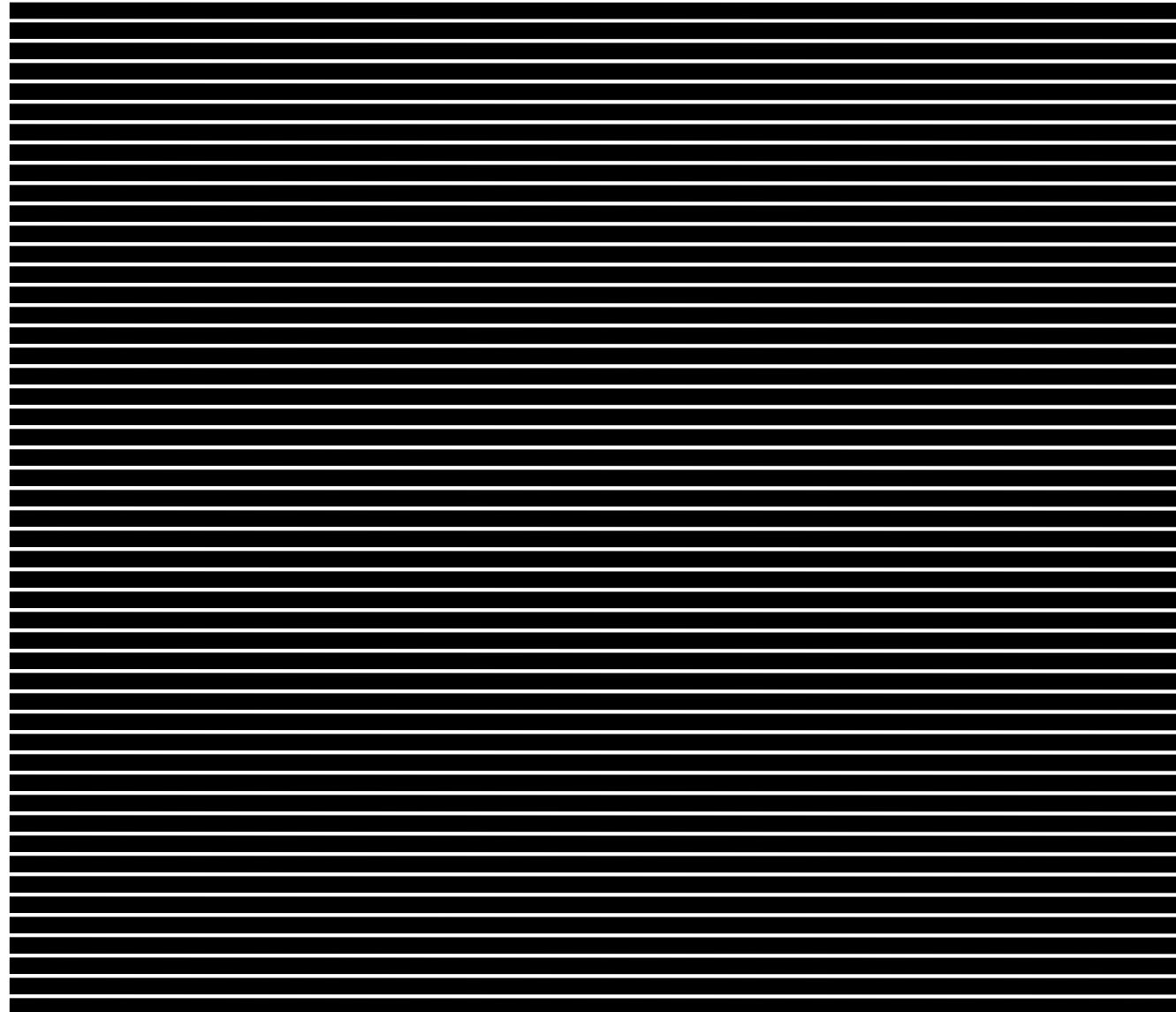


Lowpass filtered with 5x5 box filter

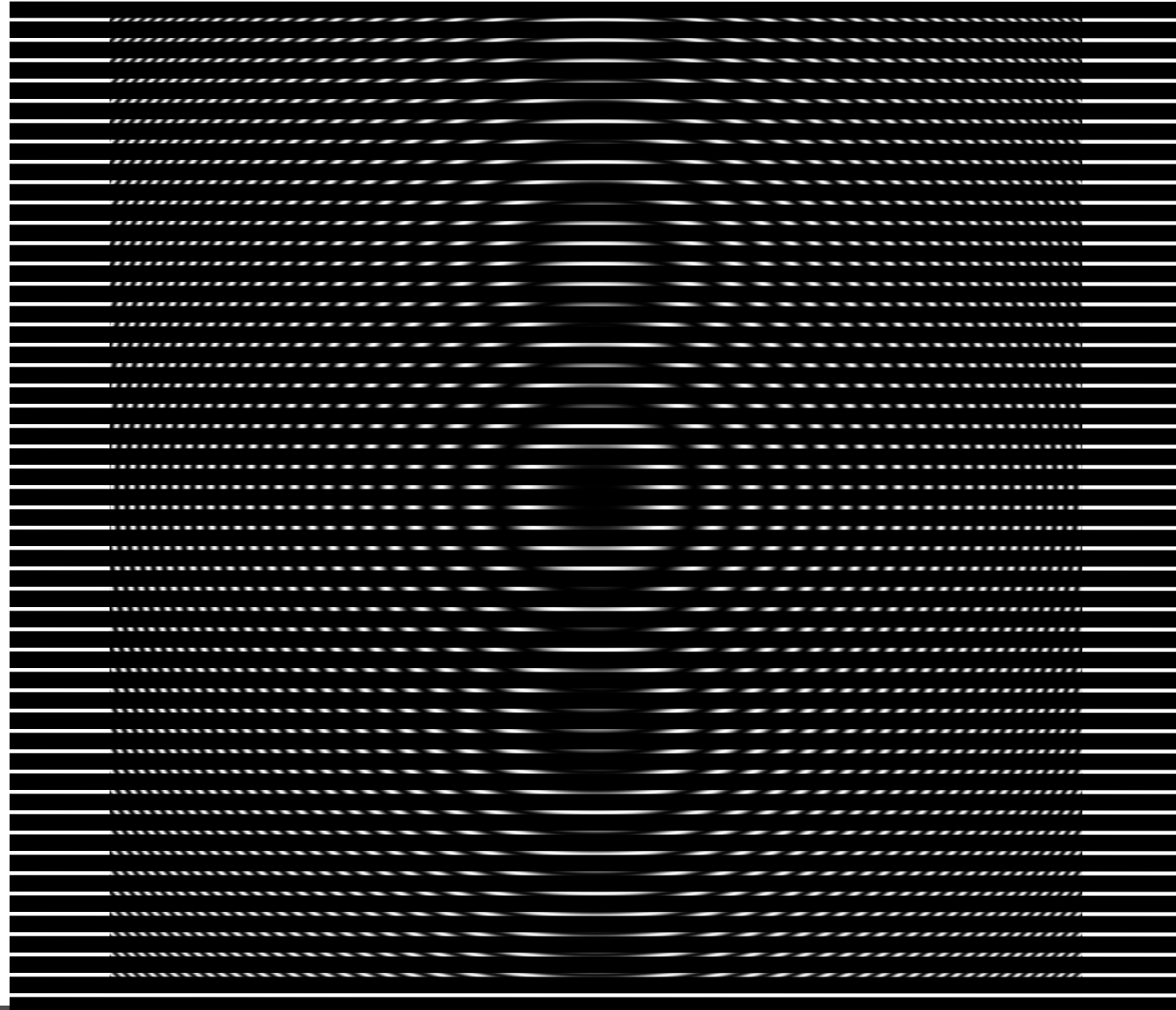
Zoneplate demonstration: 1-d sampling of 2-d signals



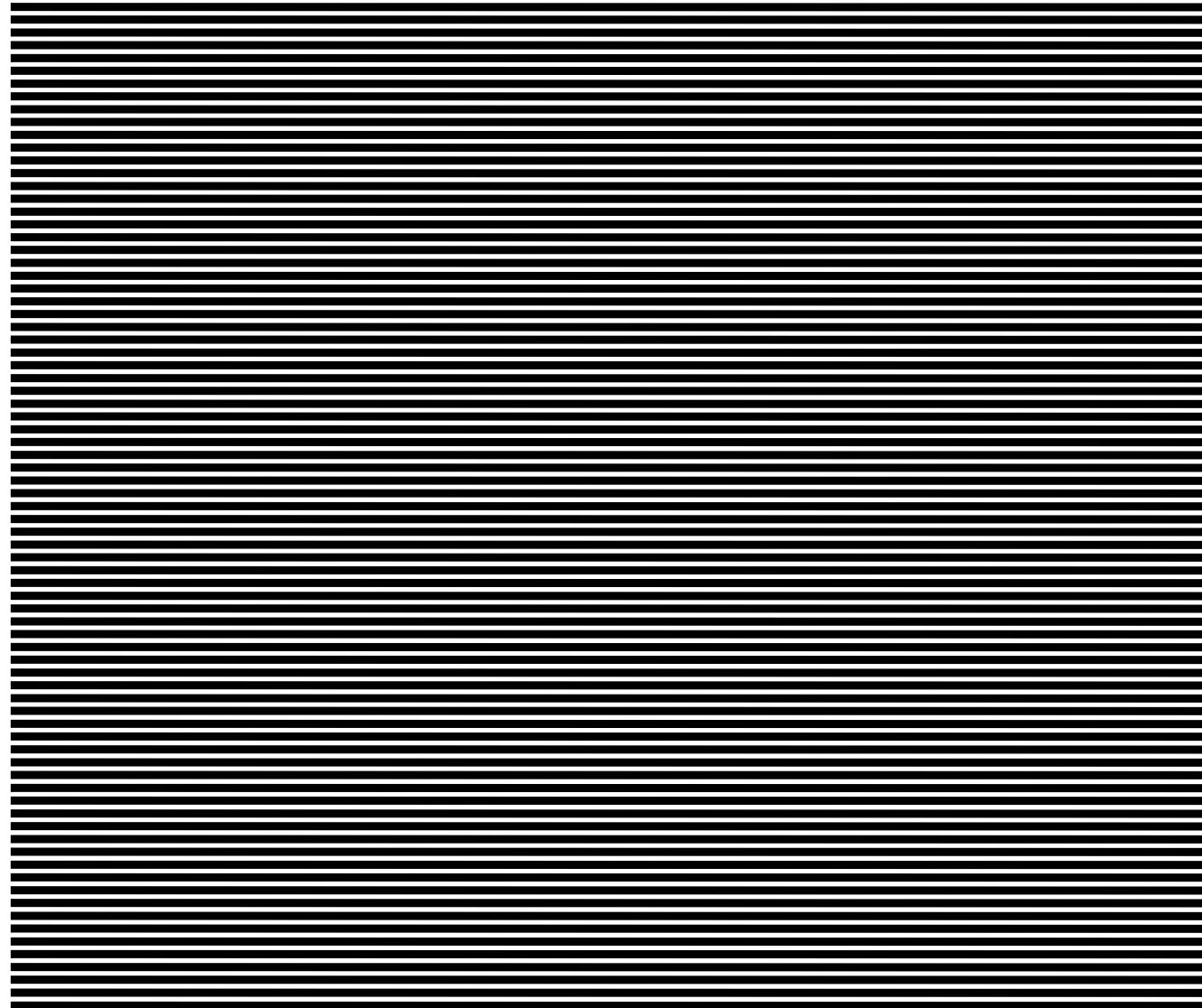
Zoneplate demonstration: 1-d sampling of 2-d signals



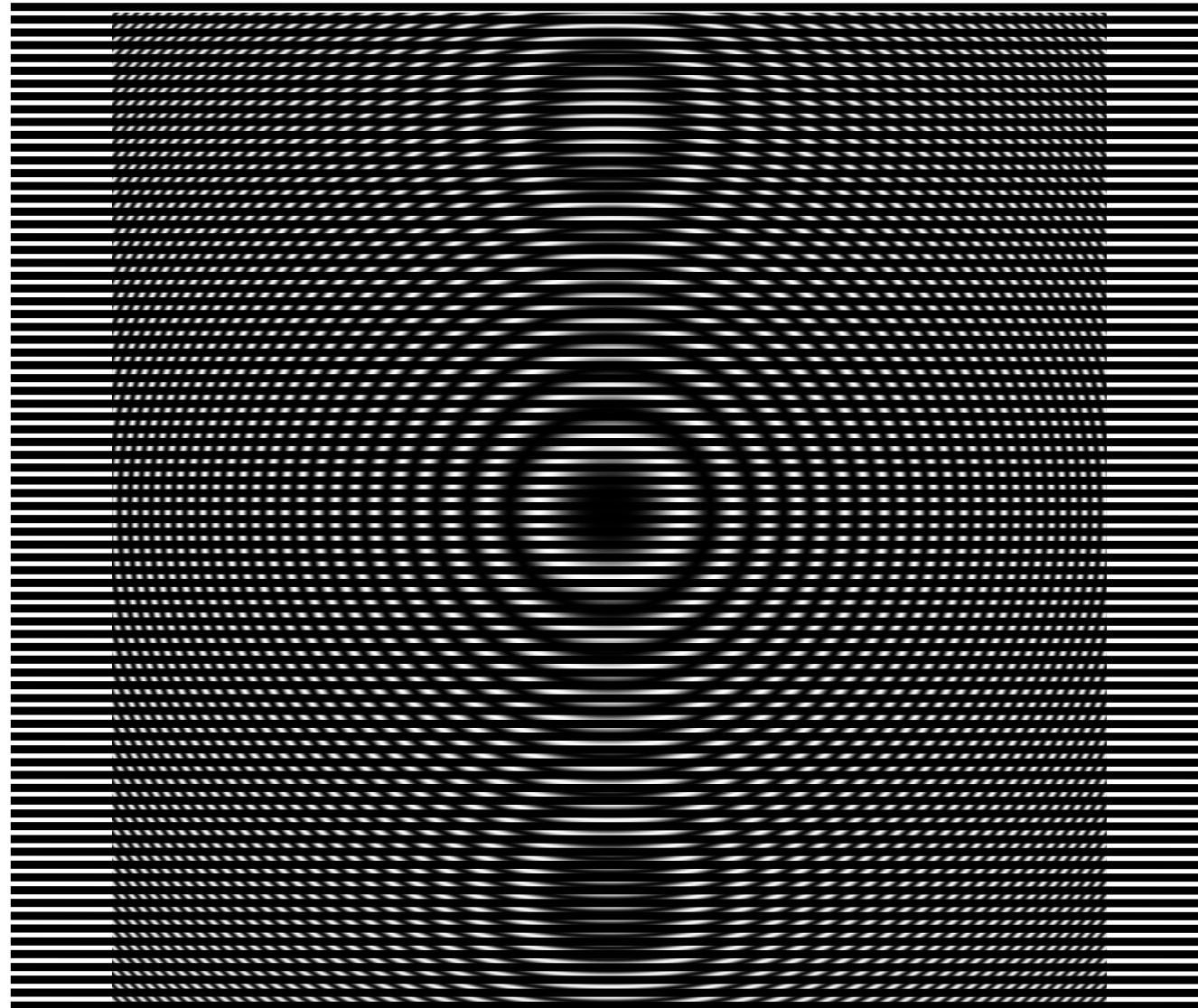
Zoneplate demonstration: 1-d sampling of 2-d signals



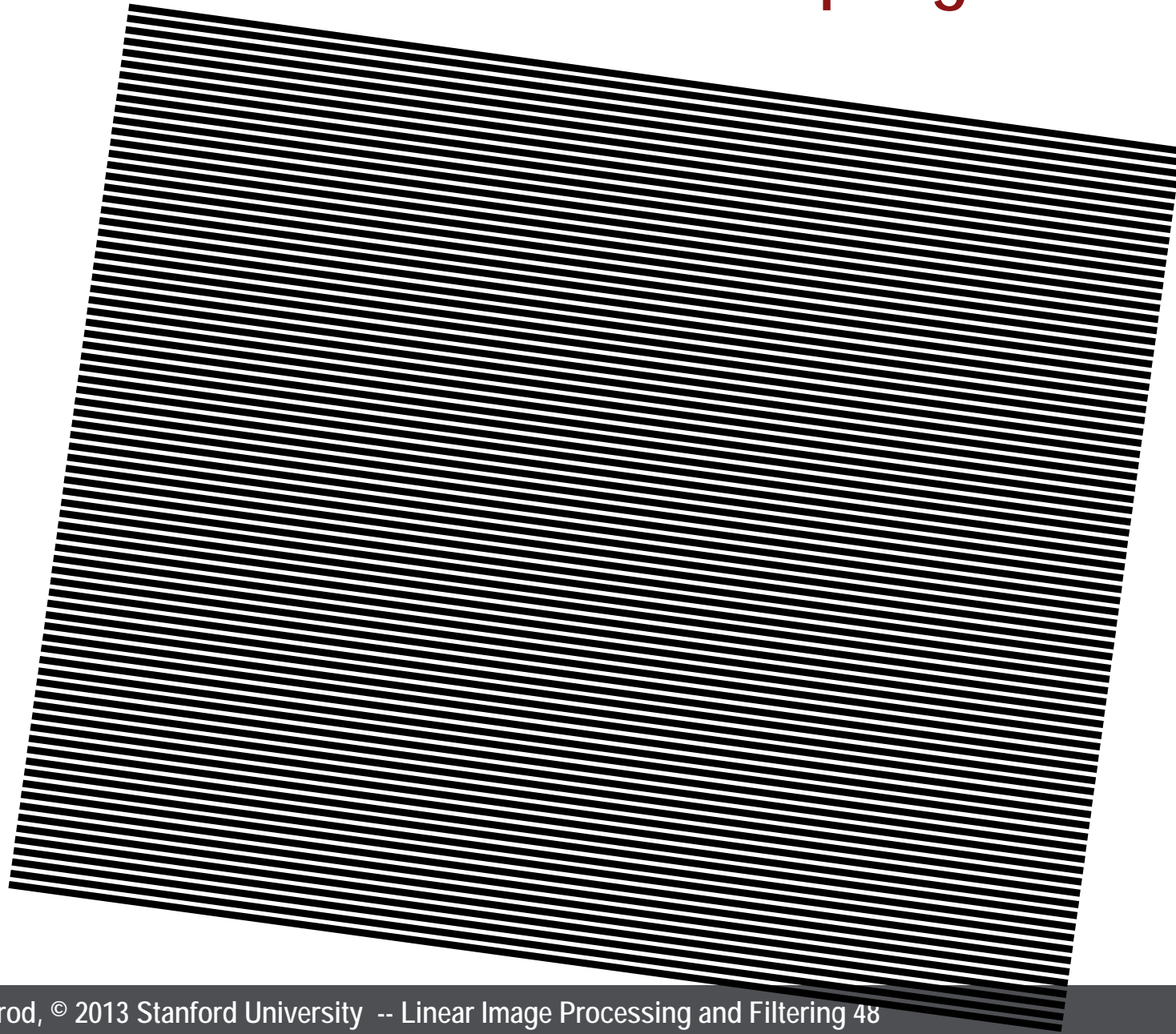
Zoneplate demonstration: 1-d sampling of 2-d signals



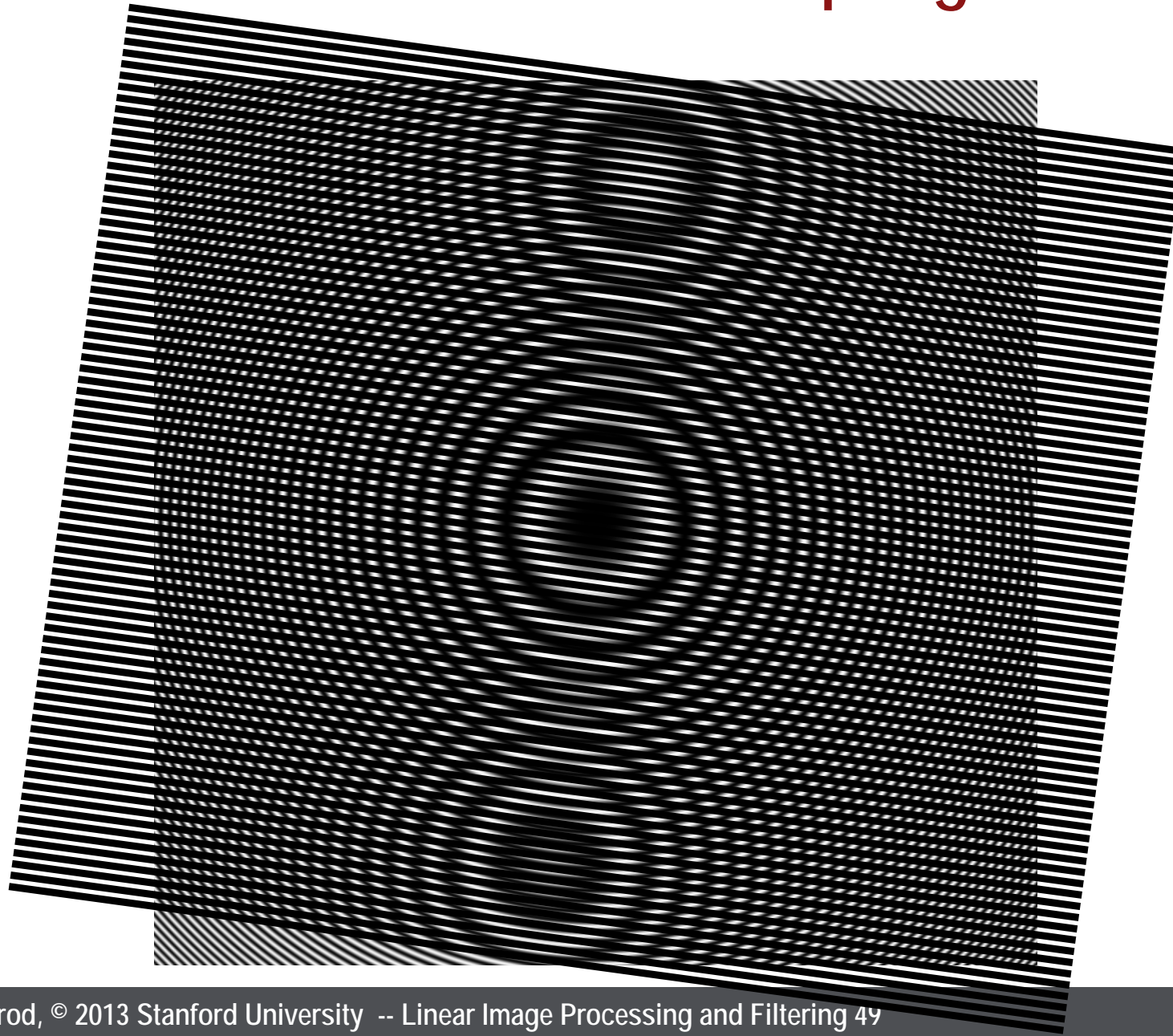
Zoneplate demonstration: 1-d sampling of 2-d signals



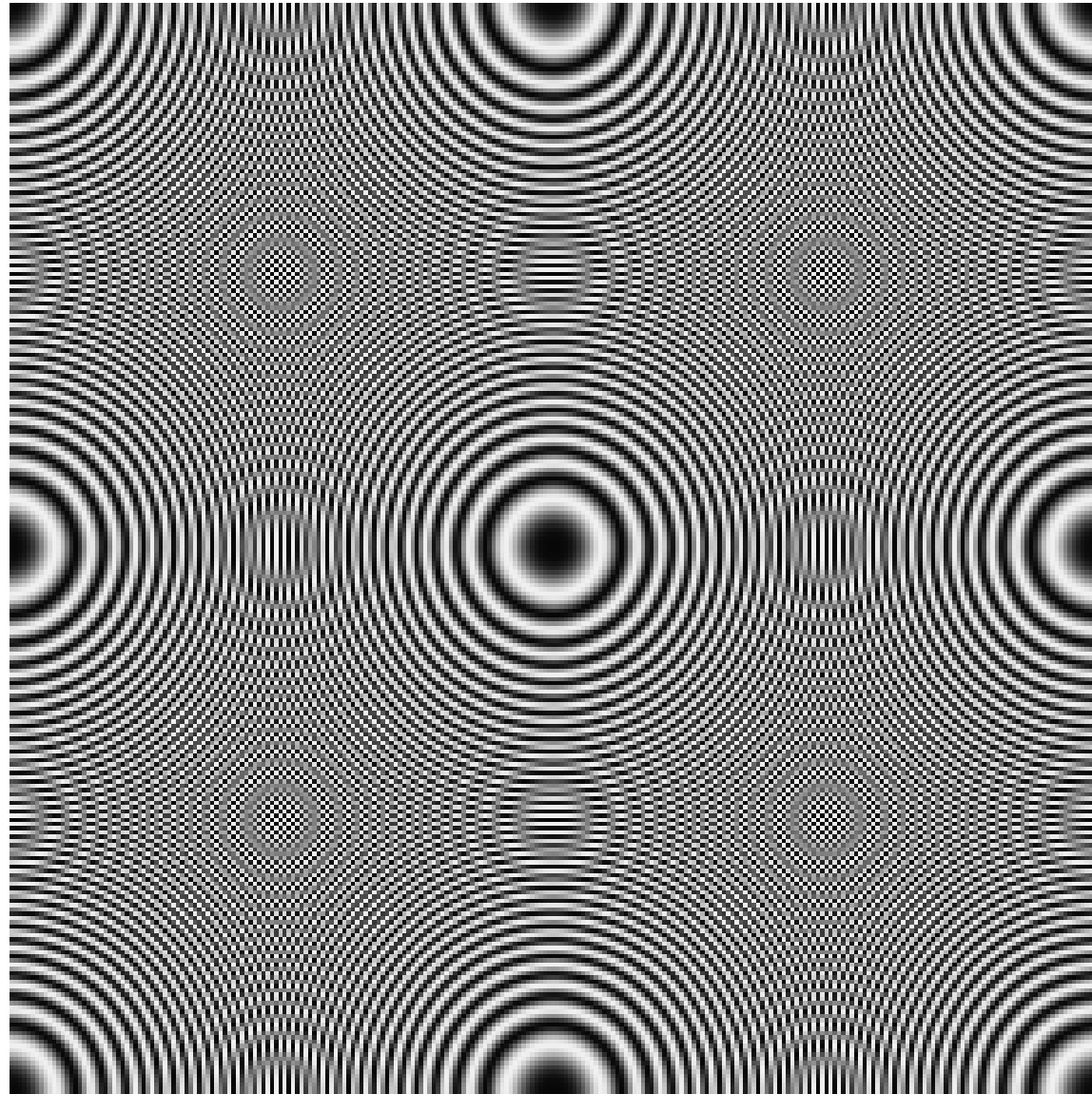
Zoneplate demonstration: 1-d sampling of 2-d signals



Zoneplate demonstration: 1-d sampling of 2-d signals



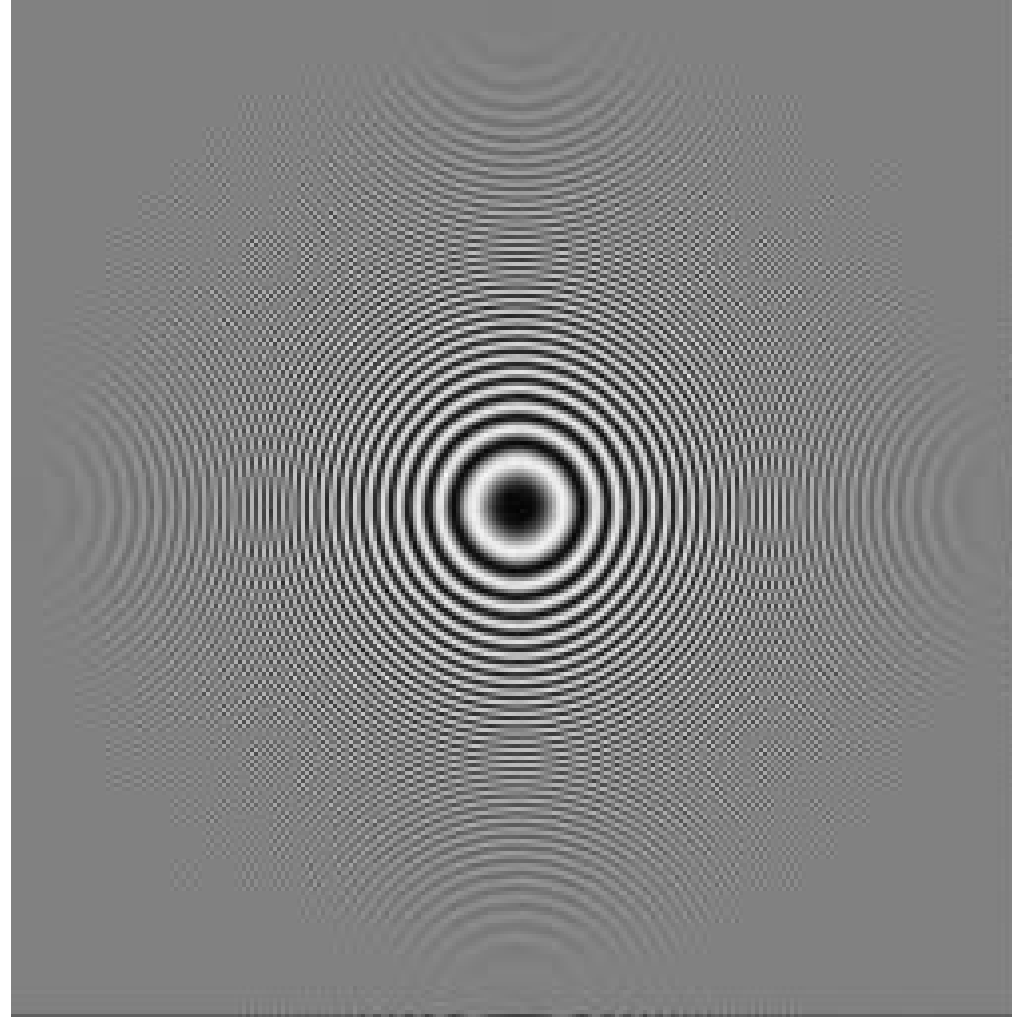
Horizontal/vertical 2:1 subsampling without prefiltering



Horizontal/vertical 2:1 subsampling with prefiltering

2d impulse response

$$\begin{pmatrix} 1 & 1 & 1 \\ 16 & 8 & 16 \\ 1 & 1 & 1 \\ 8 & 4 & 8 \\ 1 & 1 & 1 \\ 16 & 8 & 16 \end{pmatrix}$$



Frequency response

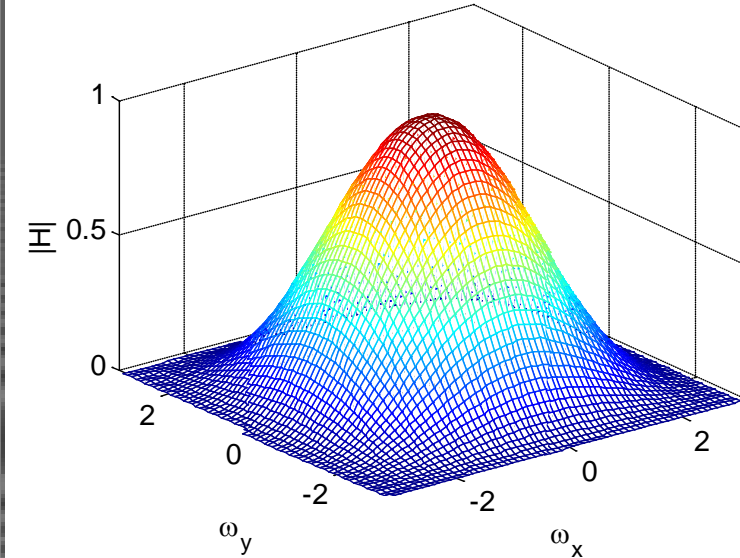
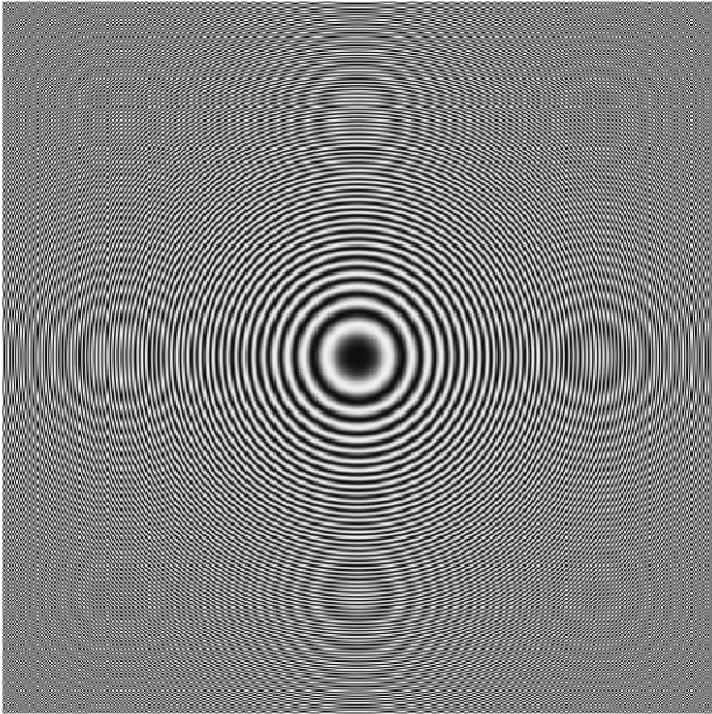
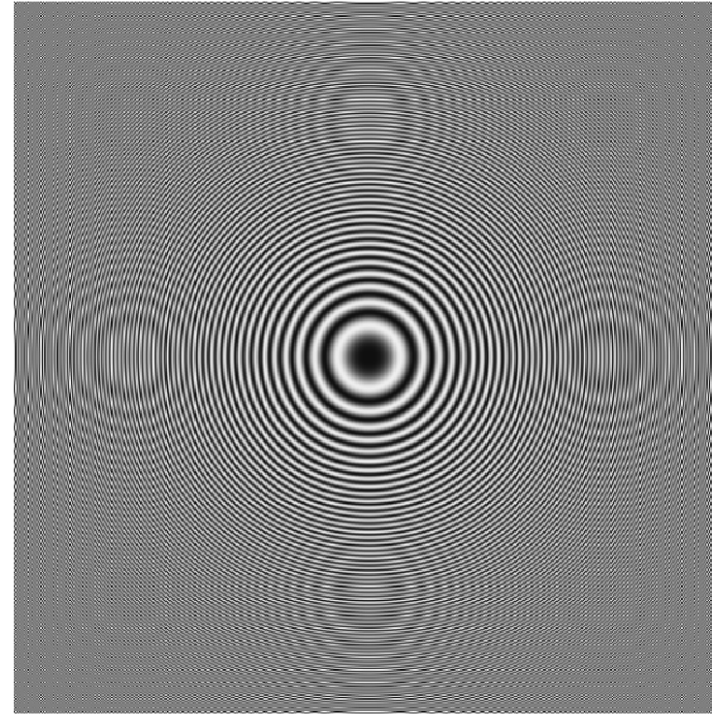


Image magnification (10%)



Nearest neighbor interpolation



Bilinear interpolation