ECE 278C **IMAGING SYSTEMS** **Winter 2024**

ASSIGNMENT 2: Backward Propagation Technique

Due: Tuesday, February 6

Objective: The main objective of this programming assignment is to experience image formation by backward propagation for a simplified 2D case, instead of the full-scale 3D model.

Part A: Preliminary test

Consider a single centered point source,

scatter	*scatter location*
(x_0, y_0)	$(0, 0)$

The *horizontal receiver aperture* is organized in the form of a centered linear receiver array with a span of 60λ (from $x = -30\lambda$ to $x = +30\lambda$). This horizontal linear receiver array is placed at

$$y = y_o = +60\lambda.$$

With quarter-wavelength spacing ($\lambda/4$) spacing, there are 241 complex wavefield data samples in total over the 60λ-long linear aperture.

(i) Perform image reconstruction of the (60λ x 60λ) 2D source region. The source region is a square area centered at $(0, 0)$ and bounded by $x = \pm 30\lambda$ and $y = \pm 30\lambda$. For consistency, use quarter-wavelength spacing as the sample spacing in both directions.

(ii) Obtain and show the *512* x *512 FFT spectrum* of the complex image. (Apply the same procedure you used for Assignment 1.)

(iii) Plot the magnitude distribution of your reconstructed image.

Part B: Multiple point sources

Repeat the exercise with 3 active point sources, located at (x_n, y_n), $n = 1, 2,.. 3$.

	scatters	*scatter locations*
1	(x_1, y_1)	$(0,\ +15\ \lambda)$
2	(x_2, y_2)	$(-12\ \lambda, -9\ \lambda)$
3	(x_3, y_3)	$(+12\ \lambda, -9\ \lambda)$

Report format:

1. Cover page.
2. Images.
3. Summary: (comments based on your observations)
4. Appendix: (computer code)