

**ECEn 563**  
**Numerical Methods**

Homework #22  
Due Apr. 8, 2026

1. Set up a vertical line of  $N$  points  $\mathbf{r}_{1,n}$  at  $x = 0$  and another vertical line of  $M$  points  $\mathbf{r}_{2,m}$  at  $x = r$ . Fill an  $M \times N$  matrix with elements

$$A_{mn} = e^{-jk|r_{2,m}-r_{1,n}|}$$

- (a) Along the second line of points, create a desired radiated field distribution, such as a narrow rect function. Solve  $Ax = b$ , where  $b$  is the field distribution and  $x$  is a vector of currents at the first set of points. Overlay the desired and realized radiated fields. Explain what you see.
  - (b) Experiment with different ways of solving  $Ax = b$  (Gaussian elimination, pseudoinverse, regularized normal equation, etc.) and compare results.
  - (c) Change the separation distance  $r$  and the number of source points on the first line. How does this affect the results?
  - (d) Visualize the matrix  $AA^+$  where  $A^+$  is the pseudoinverse. How does the form of this matrix relate to your results?
2. 10.3 [HBT]