

Image Processing Workshop: From Spatial to Frequency Domain and Back

Student Worksheet

October 28, 2024

Exercise 1: Understanding Basic Patterns

Part A: Simple Pattern Analysis

Consider these 5×5 grayscale images. Draw their likely frequency domain representations in the empty grids.
(Key: \blacksquare = strong component, \square = medium component, \cdot = weak component)

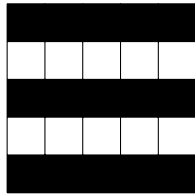
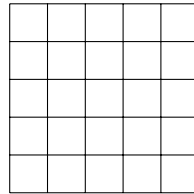


Image 1



Frequency Domain 1

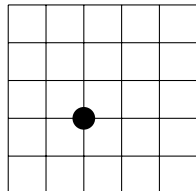
Your observations:

1. What pattern do you see in the image? _____
2. Where would you place the main frequency components? _____
3. Why did you place them there? _____

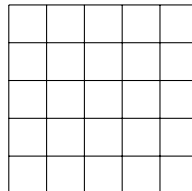
Exercise 2: Image Reconstruction

Part A: Building from Components

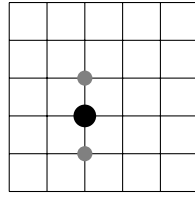
Given these frequency domain patterns, sketch the corresponding image patterns:



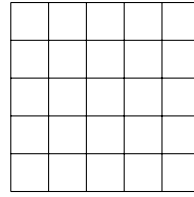
Pattern 1



Your Image 1



Pattern 2



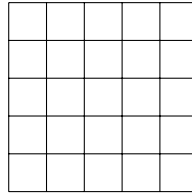
Your Image 2

Exercise 3: Synthesis Challenge

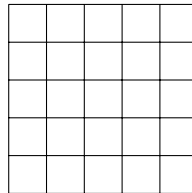
Try to create an image with these characteristics:

- Strong vertical edge in the middle
- Smooth gradient from left to right

1. First, draw your image here:



2. Then, draw what you think its frequency components would look like:

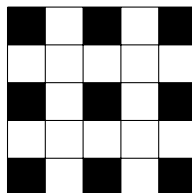


3. Explain your reasoning: _____

Exercise 4: Filtering Effects

Part A: Prediction

Given this original image:

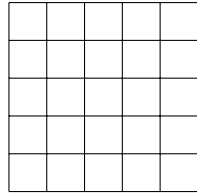


Predict what happens when we:

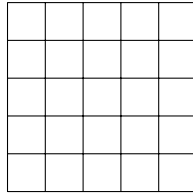
1. Remove all high frequencies (keep only center and adjacent points)
2. Remove all horizontal frequencies

3. Keep only diagonal frequencies

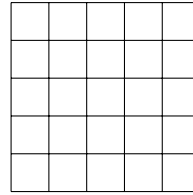
Draw your predictions:



No high freq.



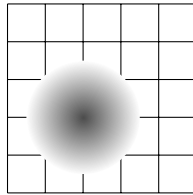
No horizontal



Only diagonal

Exercise 5: Real World Connection

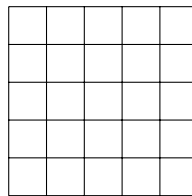
Look at this blurry image:



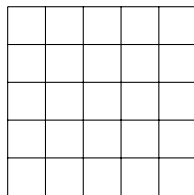
1. What frequencies are missing? _____

2. How would you make it sharper? _____

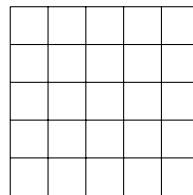
3. Draw its frequency domain representation:



Bonus Challenge: Create your own pattern and its frequency representation!



Your Pattern



Frequency Domain

Explain why you think they match: _____