

# Generating Images with Waves

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## 1 Introduction

This report presents a method for generating images by combining different waves. Each image is a combination of waves with varying wavelengths, frequencies, and amplitudes.

## 2 Concept

The process of generating images using waves involves the following steps:

1. **Get the Grayscale Image:** Convert the original image to grayscale.
2. **Fourier Transform:** Find the Fourier Transform of the image to analyze its frequency components. The Fourier Transform  $F(k, l)$  of a 2D image

$$F(k, l) = \sum_{m=0}^{M-1} \sum_{n=0}^{N-1} f(m, n) \cdot e^{-j2\pi(\frac{km}{M} + \frac{ln}{N})}$$

3. **Wave Partitioning:** Partition the Fourier-transformed waves into  $n$  portions and visualize the result by computing the Inverse Fourier Transform of the waves in that portion. The Inverse Fourier Transform  $f(x, y)$  is given by:

$$f(m, n) = \frac{1}{MN} \sum_{k=0}^{M-1} \sum_{l=0}^{N-1} F(k, l) \cdot e^{j2\pi(\frac{km}{M} + \frac{ln}{N})}$$

## 3 Code

```
1 % 1. LOADING THE IMAGE
2 originalImage = imread('image3.jpg');
3 grayImage = rgb2gray(originalImage);
4
5 %%
```

```

6 % 2. APPLYING FOURIER TRANSFORM TO CONVERT THE SPACE DOMAIN
  TO FREQUENCY DOMAIN
7 ft = fft2(double(grayImage));
8
9 % 3. Shift the zero frequency component to the center
10 ft_shifted = fftshift(ft);
11
12 %%
13 % 4. Initialize a reconstructed image
14 [rows, cols] = size(ft_shifted); % Size of image same as
  previous
15
16 reconstruction = zeros(rows, cols); % Empty reconstruction
  image
17
18 %%
19 % 5. Loop to add frequency components
20
21 % num_portions: # steps to divide the process into
22
23 num_portion = 20; % the ft_shifted will be converted to
  num_portion portions for reconstruction
24
25 for step = 1:num_portion
26     % For step value, add a portion of waves from the
  shifted fourier transform to the final image
27     no_coefficients = round(step * (rows * cols) /
  num_portion); % #coefficients to add to reconstructed
  image
28     reconstruction(1:no_coefficients) = ft_shifted(1:
  no_coefficients); % Add portion of image on top of
  the reconstructed image
29
30     % Inverse Fourier Transform to reconstruct image
31     reconstructed_image = abs(ifft2(ifftshift(reconstruction
  )));
32
33     % Saving step wise image to device
34     filename = sprintf('E:/codes/image-through-waves/images3
  /reconstructed_step_%d.png', step);
35     imwrite(uint8(reconstructed_image), filename);
36
37 end
38
39 % Display the final reconstructed image
40 figure;
41 imshow(reconstructed_image, []), title('Final Reconstructed
  Image');

```

## 4 Result

The result is a sequence of images generated by the addition of waves.

## 5 Reconstructed Images

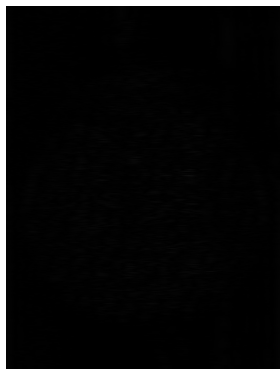


Figure 1: Image 1



Figure 2: Image 2



Figure 3: Image 3



Figure 4: Image 4



Figure 5: Image 5



Figure 6: Final Image

Figure 7: Series of Reconstructed Images by gradually increasing the number of waves