Activity 2:
FOURIER TRANSFORM MODEL OF IMAGE FORMATION PART 1

Genesis Vertudez – 202003099

App Physics 157 - Computational Analysis and Modeling in Physics

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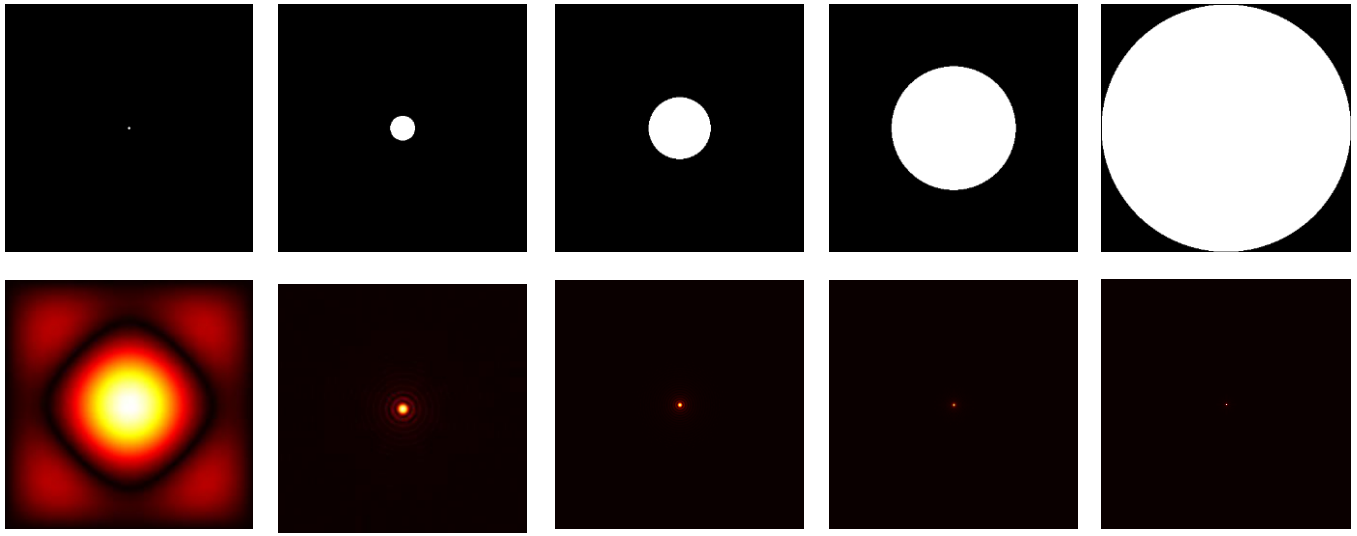
OBJECTIVES

- Use Fourier transform to manipulate images
- Convolve images with patterns to apply it to them
- Convolve images with filters to improve them
- Use Fourier transform to locate certain patterns in images

RESULTS & ANALYSIS

- Fourier transform of circles

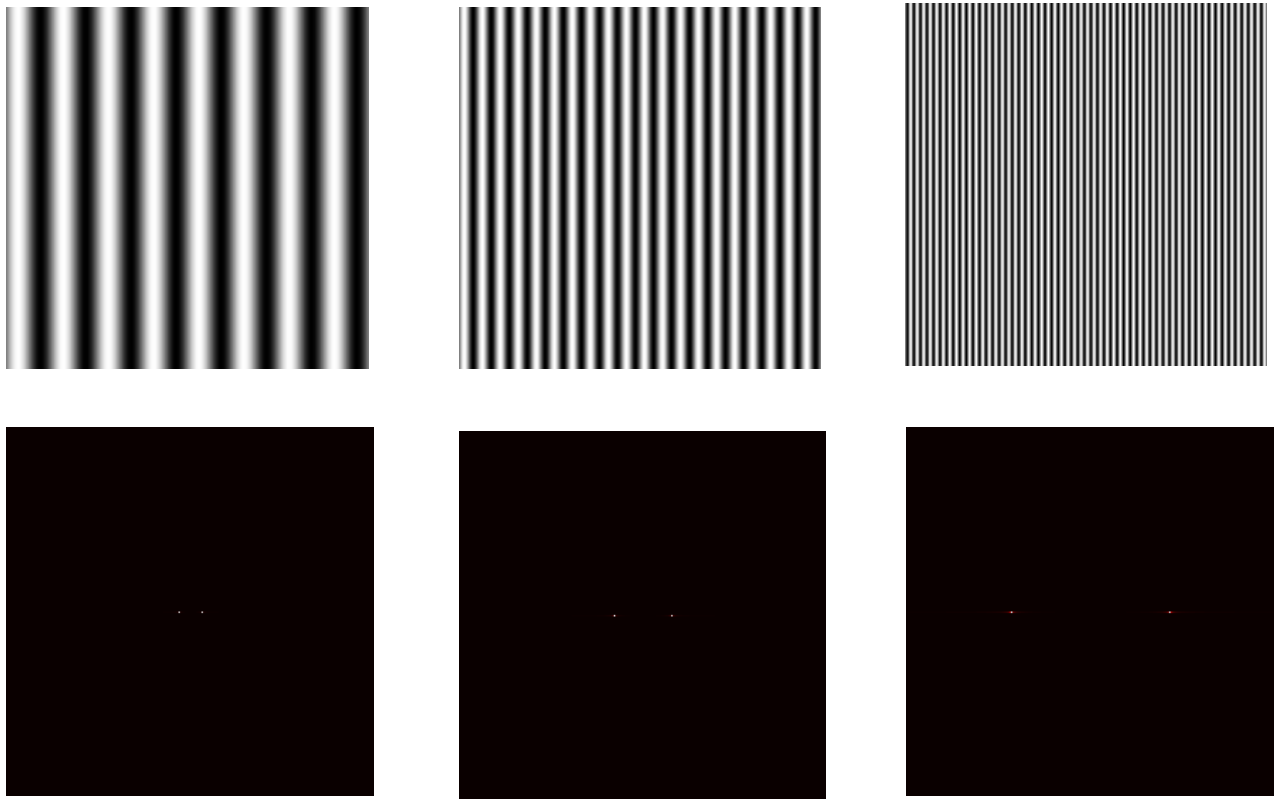


- The Fourier transform of a circle are concentric circles. The larger the radius of the circle, the smaller the Fourier transform.

Codes and files: https://github.com/genvert/AP_157_FX-2_Vertudez/tree/main/Activity%202

RESULTS & ANALYSIS

- Fourier transform of sinusoids



- The Fourier transform of a sinusoid are two points, which correspond to two Dirac deltas. The frequency is directly proportional to the separation distance of the points.

Codes and files: https://github.com/genvert/AP_157_FX-2_Vertudez/tree/main/Activity%202

RESULTS & ANALYSIS

- fft of fft VS. ifft of fft

Original image

fft of fft

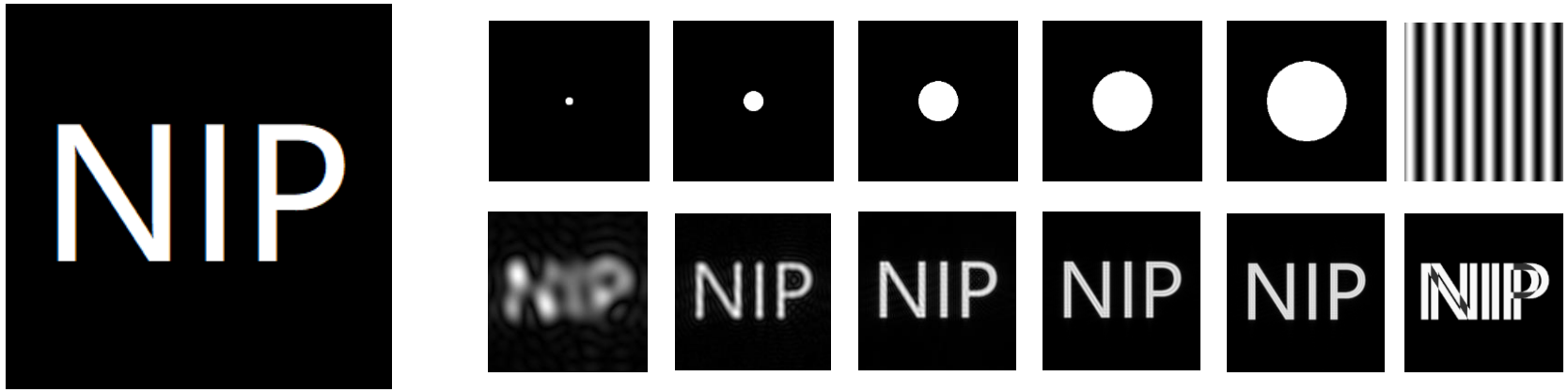
ifft of fft

- Taking the fft of fft of an image rotates it 180 degrees.
- Taking the ifft of fft returns the original image, which makes sense since they are inverse operator of each other.

Codes and files: https://github.com/genvert/AP_157_FX-2_Vertudez/tree/main/Activity%202

RESULTS & ANALYSIS

- Convolving an image with another



- Convolving two functions is equal to multiplying their Fourier transforms
- In this case, each pixel of the image acts as a Dirac delta function. Convolving it with different images (circles and sinusoid) essentially copies their the Fourier transform to each pixel.
- From previous results, smaller circle has larger diffraction pattern as Fourier transform, which makes the NIP image blurry. Sinusoids has two points spaced from the center as Fourier transform, which makes the NIP image duplicate with space from the center.

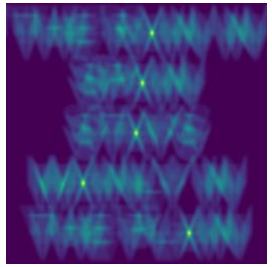
Codes and files: https://github.com/genvert/AP_157_FX-2_Vertudez/tree/main/Activity%202

RESULTS & ANALYSIS

- Correlating an image with another

THE RAIN IN
SPAIN
STAYS
MAINLY IN
THE PLAIN

A



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- Correlating two functions is equal to multiplying their Fourier transforms, but this time the other is complex conjugate.
- Correlation measures the degree of similarity of the functions
- The results make sense since when the phrase was correlated with a letter, the result show the points where the functions (in this case images) are similar

Codes and files: https://github.com/genvert/AP_157_FX-2_Vertudez/tree/main/Activity%202

REFLECTION

- This activity was straightforward so I was able to follow it easily.
- It is cool that the pixels can act as Dirac delta functions such that other images are copied to each pixel when convolved.
- I managed to do it on time this time.
- I give myself a 10/10.