

Fourier Transforms

a very brief intro

Basis of Fourier's ideas.

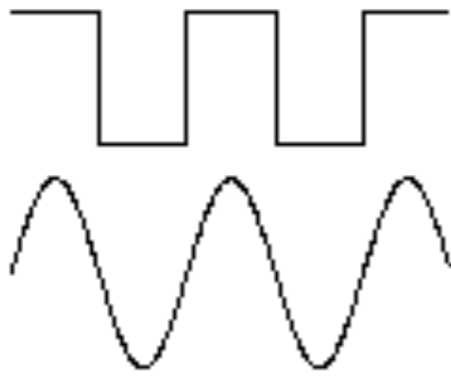
- Any function can be composed of a sum of simple sine waves.
- Each sine wave then has a frequency and phase.
- Summing all these sine wave together creates the final function.
- Summing a limited number will create an imperfect representation of the function.

Simple 1 dimensional example



- a square wave can be made by adding...

Simple 1 dimensional example



- a square wave can be made by adding...

- the fundamental...



Simple 1 dimensional example



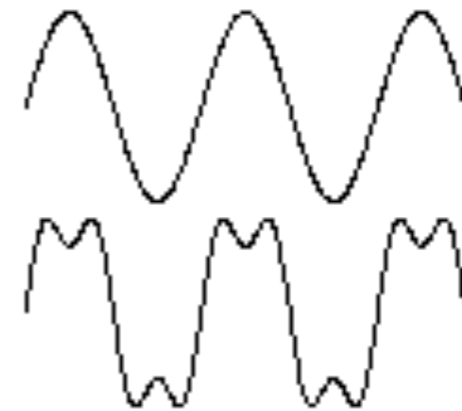
- a square wave can be made by adding...



- the fundamental...



- minus $1/3$ of the third harmonic



Simple 1 dimensional example



- a square wave can be made by adding...



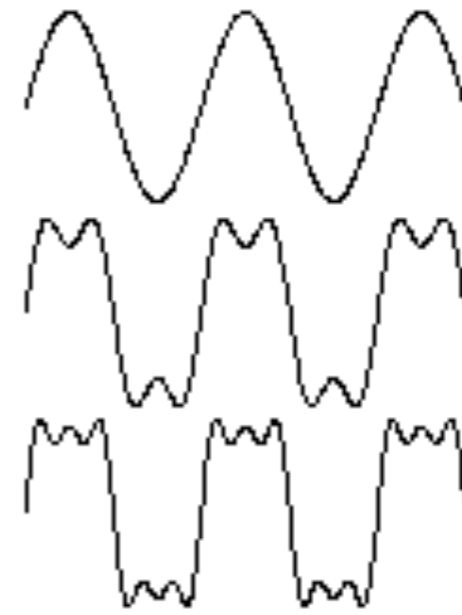
- the fundamental...



- minus 1/3 of the third harmonic



- plus 1/5 of the fifth harmonic...



Simple 1 dimensional example



- a square wave can be made by adding...



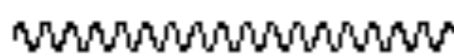
- the fundamental...



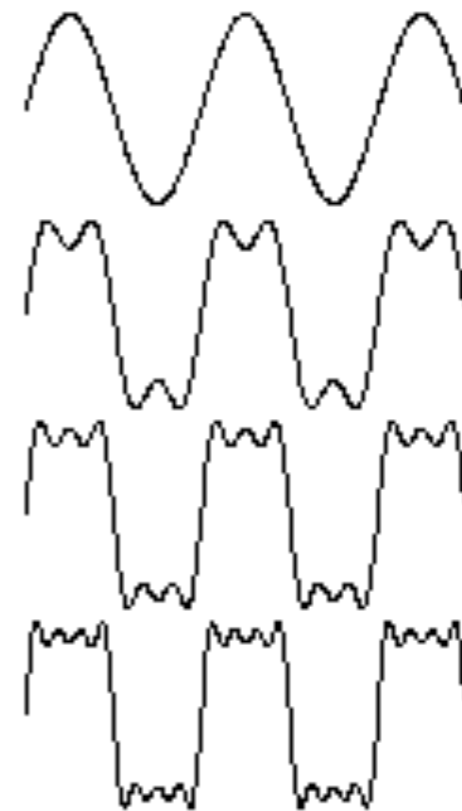
- minus 1/3 of the third harmonic



- plus 1/5 of the fifth harmonic...



- minus 1/7th of the 7th harmonic...



Fourier transforms of images.

Image with
1 Fourier
component
in each
direction



Fourier transforms of images.

Image with
1 Fourier
component
in each
direction



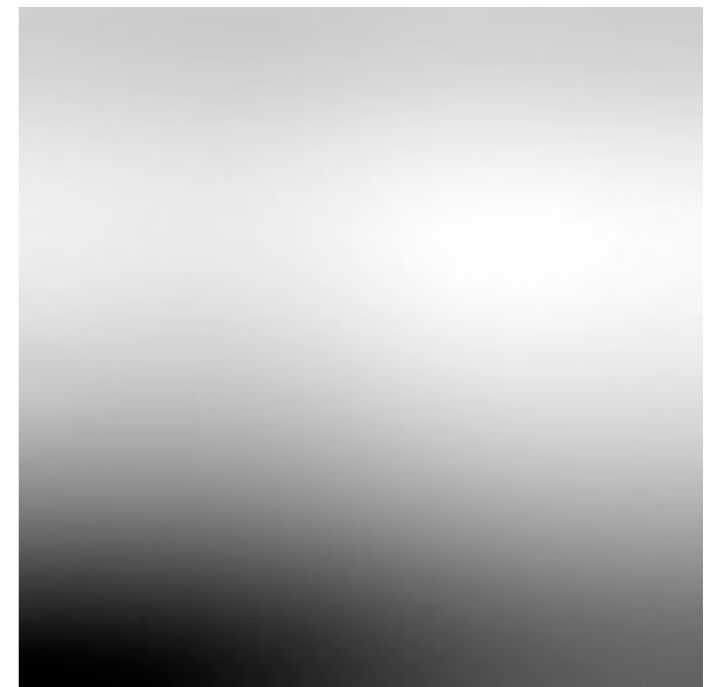
+

Fourier transforms of images.

Image with
1 Fourier
component
in each
direction



+



Fourier transforms of images.

Image with
2 Fourier
components
in each
direction



Fourier transforms of images.

Image with
2 Fourier
components
in each
direction



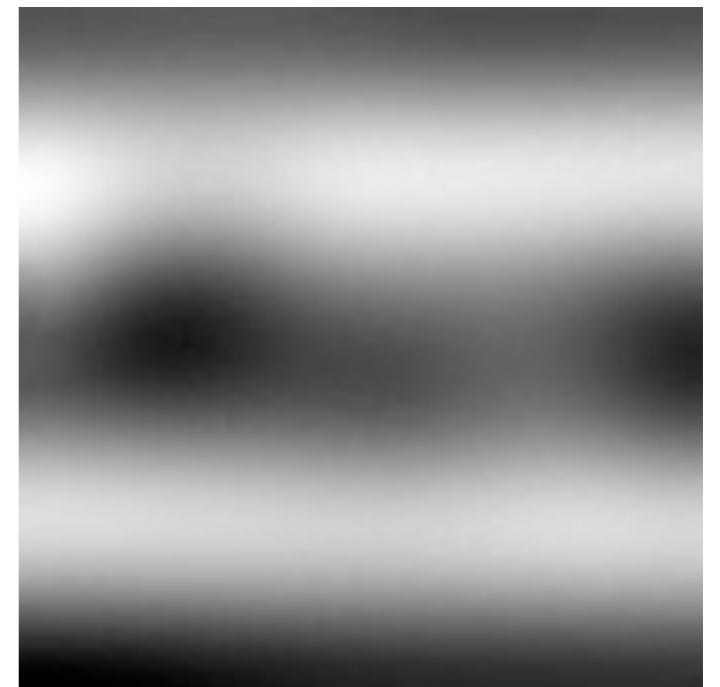
+

Fourier transforms of images.

Image with
2 Fourier
components
in each
direction



+



Fourier transforms of images.

Image with
3 Fourier
components
in each
direction



Fourier transforms of images.



Fourier transforms of images.



Fourier transforms of images.



Fourier transforms of images.



Fourier transforms of images.



Fourier transforms of images.



Fourier transforms of images.



The full Fourier Transforms

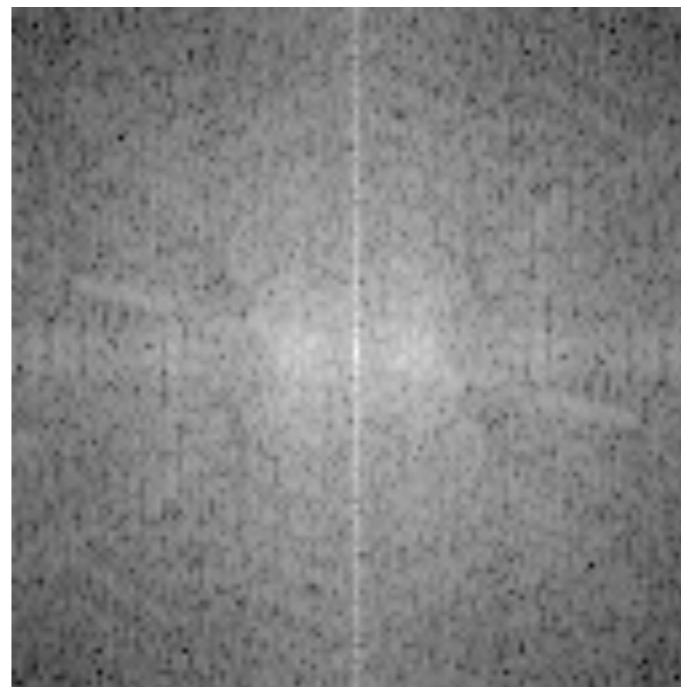


Fourier
→
Transform

The full Fourier Transforms



Fourier
→
Transform

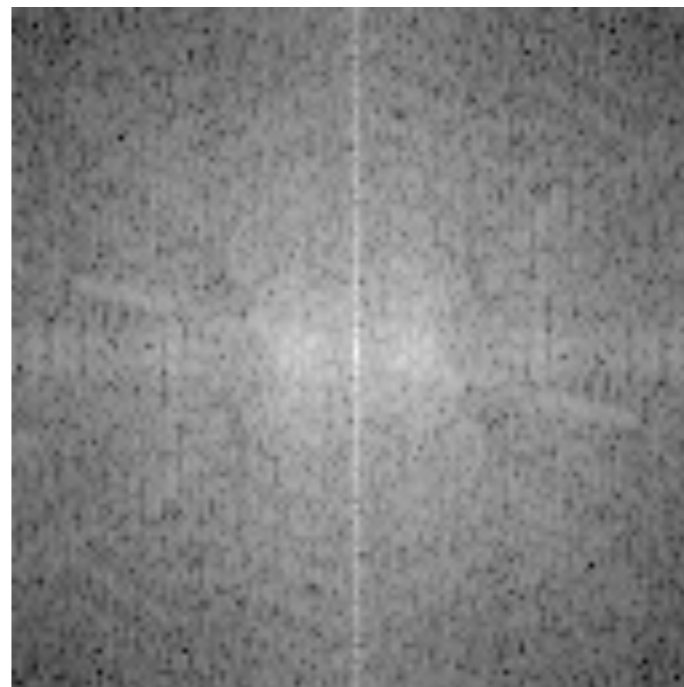


Intensity
Image

The full Fourier Transforms

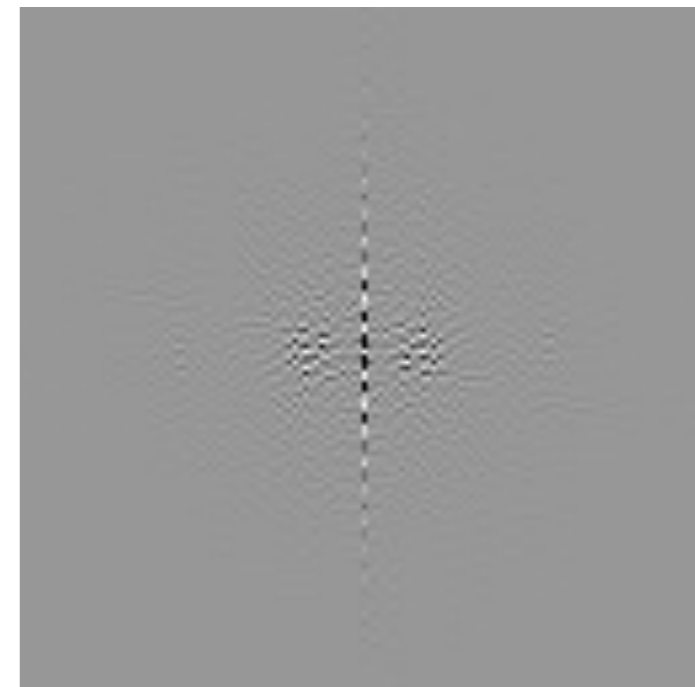


Fourier
→
Transform



Intensity
Image

+



Phase
Image

A few technical points.

- As the image has discrete pixels, this is a Discrete Fourier Transform (DFT) and you DON'T need an infinite series
- Every point in the image contributes to every point in the transform and vice-versa.
- BUT certain features in the transform contribute to certain features of the image.