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The Fourier series and Fourier transform are mathematical tools used to represent and analyze functions, including images, in terms of their frequency components.

## Fourier Transform Interpretation in Images:

- Pixel Representation: In the context of image processing, when we apply the Fourier transform (or Fourier series for periodic images), we are decomposing the image into its frequency components.
- Spatial Frequencies: Each pixel in the Fourier spectrum represents the magnitude of a spatial frequency component. Spatial frequencies describe how rapidly intensity varies in different directions across the image.

## • Low vs High Frequencies:

- > Low Frequencies: Represent variations in intensity that change slowly across the image. These components correspond to large structures and smooth gradients in the image.
- High Frequencies: Represent rapid changes in intensity, such as edges, textures, and fine details.

## • Interpretation:

- The position of a pixel in the Fourier spectrum corresponds to a specific spatial frequency along the horizontal and vertical axes.
- The magnitude of that pixel indicates the strength (or amplitude) of that particular frequency component in the image.

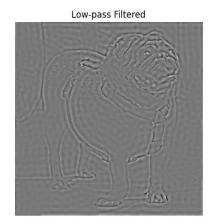
## Visualization:

- > When visualizing the Fourier spectrum of an image, typically the center of the spectrum represents low frequencies, while the edges represent high frequencies.
- > Brighter pixels in the spectrum indicate stronger contributions from those frequencies in the original image.

**2D Fourier Transform**: The 2D Fourier transform of an image f(x,y) is defined as:  $F(u,v) = \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} f(x,y) \exp(-i2\pi(ux+vy)) \, dx dy$ , here F(u,v) represents the frequency components in the spatial domain, where u and v are the spatial frequencies along the horizontal and vertical axes respectively.







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