

Outline

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Introduction

We previously saw that the Fourier transform is useful for decomposing a time series signal or image into its constituent temporal or spatial frequencies.

The discrete Fourier transform is also extremely useful for performing convolution.

Convolution via the discrete Fourier transform in frequency space is much faster than convolution in image space.

The Convolution Theorem

In the theory of Fourier transforms, there is a theorem that states that:

Performing convolution of a time series with a kernel in the time domain, is equivalent to pointwise multiplying the Fourier transforms of the time series and the kernel together then inverse Fourier transforming.

Performing convolution of an image with a kernel in the image domain, is equivalent to pointwise multiplying the Fourier transforms of the image and the kernel together then inverse Fourier transforming.

Let's see why and how this is true.

