The Mystery of the Shifting Coordinates: DFT to the Rescue!

CSE 220 Online on DFT

Section C

Time: 40 minutes

Scenario

You've always been passionate about DFT (Discrete Fourier Transform)—after all, who doesn't get excited about the power of frequency analysis? Imagine you're working for a top-secret Satellite Research and Funhouse project, tasked with analyzing satellite images of the Earth. Unfortunately, due to a small error in the satellite's positioning system, one of the images has shifted slightly both **horizontally** and **vertically**. Now it's your job to realign the two images using the most elegant solution known to science: the Discrete Fourier Transform (DFT).

As passionate as you are about DFT, you know that this isn't just a simple case of pixel-by-pixel comparison. In fact, DFT will give you a much more powerful way of detecting shifts than just comparing pixel values.

Your Mission

You've been provided with two images: one is the **original image** from the satellite, and the other is the **shifted image** of the original image. Your task is to detect the horizontal and vertical shifts of the shifted image compared to the original one using DFT-based **cross-correlation** and then reverse these shifts on the shifted image to re-align the images. You are recommended to use **FFT** & **IFFT** for cross-correlation calculation. For shifting, you can directly do that without using dft.

Hint

You need to calculate cross correlation only between the 2 rows of the 2 images to get the horizontal shift and 2 columns of the 2 images to get the vertical shift amounts. But for that, you have to select the row and column no wisely!

Expected outcome

The realigned image should match the original image perfectly after reversing the shifts.

Submission

Just submit a single python file after renaming it with your student ID: 2105XXX.py