**LAPORAN PRAKTIKUM PENGOLAHAN CITRA DIGITAL**

**12. 2D FOURIER TRANSFORM**



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**2024**

**TUTORIAL : 2D FOURIER TRANSFORM**

**Goal**

The goals of this tutorial are to learn how to compute and display the FT of an image

and how to develop filters to be used in the frequency domain.

**Objectives**

* Learn how to use the fft2 function to compute the FT of a monochrome image.
* Learn how to visualize the FT results.
* Learn how to generate filters to be used in the frequency domain.

**What You Will Need**

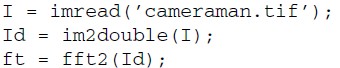
* distmatrix.m

**Procedure**

To generate the FT of an image (a 2D function), we use the IPT function fft2, which

implements the FFT algorithm.

1. Load the cameraman image, convert it to double (one of the data classes accepted as an input to fft2), and generate its FT.



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**Question 1** What are the minimum and maximum values of the resulting discrete Fourier transform coefficients for the cameraman image?

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To view the spectrum of the image, that is, the amplitude component of the FT results, we must shift the zero-frequency (DC) component to the center of the image using the fftshift function.

1. Shift the FT array of results.



From your answer to Question 1, you should by now know that the range of values in the FT array of results (ft) extends well beyond the typical values of a grayscale image ([0, 255]). Consequently, we will try to display the resulting spectrum as an image using the “scaling for display purposes” option of function imshow.

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1. Display the FT results, remapped to a grayscale range.



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**Question 2** Why are we required to use the abs function when displaying the ft\_shift image?

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| Pakai abs karena hasil transformasi Fourier berupa bilangan kompleks. |

**Question 3** Howdid we remap the image to a different (narrower) grayscale range?

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| Menggunakan fungsi log(1 + abs(...)) dan parameter [] |

As you may have noticed, directly remapping the image to the grayscale range does not give us any useful information (only a white pixel at the center of the image the DC component of the FT results with all other pixels displayed as black). This suggests that there might be a significant amount of detail in other frequencies that we just cannot see.

We can perform the log transformation within the imshow function call and then remap the adjusted values to the grayscale range by specifying ’[]’ in the second parameter.

1. Display the log of the shifted FT image.



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**Question 4** How does the log remap compare to the direct remap?

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| Log remap membuat detail spektrum lebih terlihat. Sedangkan direct remap sering membuat gambar terlalu kontras. |

**Distance Matrices**

In the second part of this tutorial, we will look at distance matrices. To specify and implement frequency-domain filters, we must first generate a matrix that represents the distance of each pixel from the center of the image. We can create such matrix using the distmatrix function. The function takes two parameters, M and N, and will return the distance matrix of size M × N.

1. Close any open figures.
2. Generate a distance matrix that is the same size as the image I.



We can visualize the distance matrix in a 3D mesh plot, but we must first shift the image similar to the way we shifted the frequency spectrum earlier.

1. Create a 3D mesh plot of the distance matrix.



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**Question 5** Explain the shape of the 3D plot.

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| Bentuk 3D plot dari distance matrix adalah seperti mangkuk atau gunung simetris yang puncaknya berada di Tengah. |

After obtaining the distance matrix, we can generate the filter of our choice. From that point, filtering in the frequency domain is as simple as multiplying the filter by the FT image and converting back to the spatial domain. These processes will be examined in the remaining tutorials of this chapter.