SNS COLLEGE OF ENGINEERING

Kurumbapalayam (Po), Coimbatore – 641 107

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE NAME : 19EC513 – IMAGE PROCESSING AND COMPUTER VISION

III YEAR / V SEMESTER

Unit V- Computer vision

Topic : FOURIER TRANSFORMS IN COMPUTER VISION

INTRODUCTION

Fourier transforms are essential tools in image processing and computer vision. They convert an image from the spatial domain to the frequency domain, making it easier to analyze, filter, and compress image data based on frequency characteristics.

The Fourier transform decomposes an image into sine and cosine components, revealing the frequency (rate of change) and phase (position) information of the image's structures.

Key Concepts in Fourier Transforms for Images

Spatial Domain: This is the original image where pixel values represent spatial information.

Frequency Domain: After applying the Fourier transform, the image is represented by its frequency components. Lower frequencies represent the general shapes and structures, while higher frequencies capture fine details and noise.

Applications of Fourier Transforms in Computer Vision and Image Processing

Image Filtering

•**Low-pass Filtering**: A low-pass filter removes high-frequency components, which smoothens or blurs the image, often used to reduce noise.

•**High-pass Filtering**: A high-pass filter removes low-frequency components, emphasizing edges and fine details. This is useful for edge detection and sharpening.

•**Band-pass Filtering**: By isolating a specific frequency range, band-pass filters allow detection of textures or specific details that lie within that range.

Edge Detection

Fourier transforms can be used to enhance edges by applying high-pass filters in the frequency domain. Since edges contain high-frequency information, filtering out the low-frequency background allows the prominent edges to remain visible.

APPLICATIONS CONT.,

•Image Compression

•In compression, the Fourier transform identifies and reduces redundancies in an image. JPEG compression, for example, uses the Discrete Cosine Transform (DCT), a related technique, to separate image data into frequency components, allowing the image to be represented with fewer bits by discarding less visible high frequencies.

•This is effective for reducing storage needs, as the human eye is more sensitive to low-frequency information and less sensitive to high frequencies.

Pattern Recognition

Fourier descriptors, derived from the Fourier transform of an object's boundary, help in object recognition tasks. They represent shape information in the frequency domain, making it easier to compare and recognize objects regardless of rotation, translation, or scaling.

Applications include optical character recognition (OCR) and object matching.

APPLICATIONS CONT.,

•Image Reconstruction

•Fourier transforms are instrumental in reconstructing images in fields like medical imaging (MRI, CT scans) and astronomy. These methods collect data in the frequency domain and reconstruct the image in the spatial domain.

•Texture Analysis

•Textures have specific frequency characteristics, making Fourier analysis ideal for texture identification and classification. By analyzing the frequency spectrum, textures can be differentiated based on their unique frequency signatures, aiding in applications like defect detection, material classification, and remote sensing.

THANK YOU !!!