

Problem 3

Nithin S
201 ITO 85

1) Signal Processing

- $$f(t) = a_0 + \sum_{n=1}^{\infty} (a_n \cos(2\pi n f_0 t) + b_n \sin(2\pi n f_0 t))$$
- In Filtering, Analysis, Sound Synthesis of Audio Signals
- Image Compression
- The ~~2D~~ Fourier transform is applied to the image data to convert it to frequency domain
- The high frequency components that represent the fine details in the image are quantized more aggressively or even discarded to achieve compression
- After compression, the image can be reconstructed by applying the inverse Fourier transform

2) Cyber Security

Role \rightarrow {

- Frequency Domain Analysis:
- Signal Decomposition
- Feature Extraction

- Identifying unexpected frequency for traffic detection
- Pattern Recognition
- Behavioral Profiling
- Real time Detection

3) Data Analysis

Relevance

- 1) Frequency Component Identification
- 2) Signal Decomposition
- 3) Noise Reduction
- 4) Feature Extraction

Finance

Ex: Analysing Stock Prices to understand market dynamics.

IoT

Ex: Sensor Data Analysis for Environmental monitoring.
Ex: Signal Processing in IoT devices

4) IT Engineering

- Algorithm Analysis & Complexity Evaluation
- Optimizing of Algorithms
- Data Compression & Decompression
- Signal Processing & Filtering
- Cryptography and Security
- Network Analysis & Optimization

5) Image Processing

$$F(u, v) = \iint f(x, y) \cdot e^{-i 2\pi (ux + vy)} dx dy$$

$$f(x, y) = \iint F(u, v) \cdot e^{i 2\pi (ux + vy)} du dv$$

$F(u, v) \rightarrow$ complex valued frequency component.

$f(x, y) \rightarrow$ pixel intensity at spatial coordinates.

$u, v \rightarrow$ spatial frequencies in horizontal & vertical directions.

Significance

- Frequency Analysis
- Filtering
- Compression
- Noise Removal
- Transformation.

6) Data Science

- Feature Extraction
- Data Pre processing.

ML

- Signal Processing in ML
- NLP (Natural Language Processing)
- CNN (Convolutional Neural Network)

7) Cyber-Security & Encryption

- FT used in encryption to convert data from time to frequency domain
- Frequency domain encryption involving manipulating data in frequency domain making it harder for hackers to decipher.
- enhances security by adding more complexity to encryption algo
- obscures the original data's pattern.

8) Big Data analytics

- decompose complex data to simpler frequent component.
- identify underlying patterns & trends in large data sets
- anomaly detection & signal processing
- accurate insights from massive data sets
- efficient extraction of relevant info from noisy & unstructured data.