# DIGITAL IMAGE PROCESSING

Image Enhancement in Frequency Domain: Session 4

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# Today's Lecture

- **Image Enhancement in Spatial Domain**
  - **Smoothing Filters**
  - **Sharpening Filters**

# Image Enhancement in Frequency Domai

## Smoothing Filters

- Edges and other sharp transitions (such as noise) contribute significantly to the high frequency content of Fourier transform.
- Smoothing (blurring) is achieved in frequency domain by attenuating a specified range of high frequency components.
- Three types of lowpass filters: Ideal, Butterworth and Gaussian filters
- These filters cover the range from very sharp (ideal) to very smooth (Gaussian) filter functions.

# Image Enhancement in Frequency Domai

## Smoothing Filters: **Ideal Lowpass Filters (ILPF)**

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## Smoothing Filters: **ILPF**

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## Smoothing Filters: **ILPF**

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## Smoothing Filters: **Spatial Representation of ILPF**

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## Smoothing Filters: **Butterworth Lowpass Filters (BLPF)**

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## Smoothing Filters: **Spatial Representation of BLPF**

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## Smoothing Filters: **Gaussian Lowpass Filters (GLPF)**

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## Smoothing Filters: **GLPF**

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## Smoothing Filters: **Example of smoothing by GLPF**

# Image Enhancement in Frequency Domai

## Smoothing Filters: **Example of smoothing by GLPF**

# Image Enhancement in Frequency Domai

## Smoothing Filters: **Example of smoothing by GLPF**

# Image Enhancement in Frequency Domai

## Sharpening Filters

- Image sharpening can be achieved in the frequency domain by highpass filtering.
- It attenuates low-frequency components without disturbing high-frequency information in the Fourier transform.

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## Sharpening Filters

A highpass filter is obtained from a given lowpass filter using

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## Sharpening Filters

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## Sharpening Filters: **Spatial Representation**

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## Sharpening Filters: **Result of IHPF**

# Image Enhancement in Frequency Domai

## Sharpening Filters: **Result of BHPF**

# Image Enhancement in Frequency Domai

## Sharpening Filters: **Result of GHPF**

# Image Enhancement in Frequency Domai

## Laplacian in Frequency Domain

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## Laplacian in Frequency Domain

# Next Class

- **Image Restoration**

**Thank you:**
**Question?**