EE3005.01 Homework 3

(Image Processing)

Objective: The objective of this homework assignment is to explore various image processing filters, including unsharp and sharp masking, Laplacian of Gaussian (LoG) and Difference of Gaussian (DoG) filters, mean filters (arithmetic, geometric, harmonic, and contraharmonic mean), and order statistic filters (median, minimum, maximum, midpoint, alpha-trimmed mean), as well as bilateral filters. Through this assignment, students will gain a deeper understanding of different filter types, their applications, and their performance characteristics.

Instructions:

1. **Unsharp and Sharp Masking:**
    - **Define unsharp and sharp masking filters.**
    - **Describe their differences in terms of their effects on image enhancement and edge detection.**
    - **Provide examples of biomedical images and their enhancements using both filters.**
    - **Discuss the advantages and limitations of each approach.**
2. **Laplacian of Gaussian (LoG) and Difference of Gaussian (DoG) Filters:**
    - **Explain the concepts behind LoG and DoG filters.**
    - **Compare and contrast the characteristics of LoG and DoG filters in terms of edge detection and noise suppression.**
    - **Provide visual examples demonstrating the effects of LoG and DoG filters on biomedical images.**
    - **Discuss scenarios where one filter might be preferred over the other.**
3. **Mean Filters:**
    - **Define arithmetic, geometric, harmonic, and contraharmonic mean filters.**
    - **Discuss the mathematical formulas and operations involved in each filter type.**

- **Provide examples of biomedical images filtered using each mean filter.**
- **Compare the performance of different mean filters in terms of noise reduction and preservation of image details.**

4. **Order Statistic Filters:**
    - **Define median, minimum, maximum, midpoint, alpha-trimmed mean filters, and bilateral filters.**
    - **Explain the concepts and operations involved in each filter type.**
    - **Provide visual examples illustrating the effects of each filter on biomedical images.**
    - **Discuss the advantages and limitations of each order statistic filter.**
5. **Comparison:**
    - **Compare and contrast the performance characteristics of different filter types discussed in this assignment.**
    - **Discuss the trade-offs between noise reduction, edge preservation, and computational complexity for each filter type.**
    - **Provide recommendations for selecting the appropriate filter based on specific image processing tasks.**

Submission Guidelines:

- The number of group members should be at most 3. One submission is enough per group.

- The entire report should be in a single Word document, including MATLAB code and images.

- Include the images and the source code for each steps with their explanations.

- Write a comprehensive report discussing your observations, insights, and any challenges faced during the implementation.

- Your reports will be checked by an AI detector. You will receive a grade of zero if AI is detected. Even if you use it only for grammar correction, the AI detector may detect AI. For your information.