

# Chapter 10

## Feature Extraction and Feature Selection Procedures for Medical Image Analysis

**Soumya Gupta**

*University School of Automation and Robotics, Guru Gobind Singh Indraprastha  
University, India*

**Sia Gupta**

*University School of Automation and Robotics, Guru Gobind Singh Indraprastha  
University, India*

### **ABSTRACT**

*This chapter delves into the critical processes of feature extraction and selection in medical image analysis, essential for transforming raw data into actionable insights. It begins with preprocessing techniques, including noise reduction using linear and nonlinear filters, to enhance image quality. Intensity-based methods utilize pixel statistics, while texture analysis techniques like Local Binary Patterns, co-occurrence matrices, wavelets, Fourier transforms, and orientation histograms capture intricate patterns. Deep learning-based features, especially autoencoders, automatically learn hierarchical data representations. For feature selection, filter methods evaluate relevance independently, wrapper methods iteratively train models to identify optimal subsets, and embedded methods integrate selection within training, promoting sparsity. Dimensionality reduction techniques like Principal Component Analysis (PCA) condense feature spaces, retaining essential information.*

DOI: 10.4018/979-8-3693-5226-7.ch010

Copyright © 2025, IGI Global. Copying or distributing in print or electronic forms without written permission of IGI Global is prohibited.

## FEATURE EXTRACTION PROCEDURES

### Noise Reduction

#### Model

Given an image  $g$ , it is viewed as the combination of a noise-free ideal image  $f$  and zero-mean noise  $n$ , which constitutes an additive noise model. This noise is uniformly distributed, making it stationary additive noise. (Cadena et al.,2017)

To remove noise through linear filtering, we estimate the expected value  $E(g)$ . This estimation assumes that  $f$  is locally constant or smooth, which justifies using neighborhood averaging in linear filtering. For median filtering, provided the neighborhood is sufficiently large, the assumption is that the pixel values follow a Gaussian distribution. Additionally, it is assumed that  $f$  is locally constant except at straight edges.

$$g = f+n$$

$$E(g) = E(f) + E(n)$$

$$\text{As, } E(n) = 0$$

$$E(g) = E(f) = f$$

We have two kinds of filtering: namely linear and non-linear filtering.

#### Linear Filtering

To estimate  $E(g)$  for noise reduction in an image, a common approach is box car filtering. This technique involves averaging the pixel values within a small patch and replacing the central pixel with this average (see in *Figure 1*, the central pixel highlighted as yellow was 37 which is then replaced by 31 i.e. the average of neighboring pixels), assuming uniformity among the pixels in the patch. While this method effectively smooths the image and diminishes noise, it may also blur edges and reduce sharpness.

Alternatively, Gaussian weighting accounts for the decreasing similarity of pixels as they move away from the center pixel. By applying a 2D Gaussian distribution to weight the pixels based on their distance from the center, edges are better preserved. Since Gaussian distributions have infinite support, they are truncated in practical applications using low pass filters such as Butterworth, Hamming, and Hanning windows. (Cadena et al.,2017)

58 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage: [www.igi-global.com/chapter/feature-extraction-and-feature-selection-procedures-for-medical-image-analysis/361027](http://www.igi-global.com/chapter/feature-extraction-and-feature-selection-procedures-for-medical-image-analysis/361027)

## Related Content

---

### Advanced Object Detection in Bio-Medical X-Ray Images for Anomaly Detection and Recognition

Garv Modwel, Anu Mehra, Nitin Rakeshand K. K. Mishra (2023). *Research Anthology on Improving Medical Imaging Techniques for Analysis and Intervention* (pp. 1180-1198).

[www.irma-international.org/chapter/advanced-object-detection-in-bio-medical-x-ray-images-for-anomaly-detection-and-recognition/315099](http://www.irma-international.org/chapter/advanced-object-detection-in-bio-medical-x-ray-images-for-anomaly-detection-and-recognition/315099)

### Advancements and Emerging Trends in Deep Learning-Based Transformers for Medical Image Processing

Uzair Aslam Bhatti, Muhammad Aamir, Zia Ur Rehman, Jameel Ahmed Bhutto, Mughair Aslam Bhatti, Ahsan Ahmad Nizamani and Abdul Haseeb Nizamani (2025). *Deep Learning in Medical Signal and Image Processing* (pp. 63-86).

[www.irma-international.org/chapter/advancements-and-emerging-trends-in-deep-learning-based-transformers-for-medical-image-processing/381151](http://www.irma-international.org/chapter/advancements-and-emerging-trends-in-deep-learning-based-transformers-for-medical-image-processing/381151)

### An Overview of Biomedical Image Analysis From the Deep Learning Perspective

Shouvik Chakraborty and Kalyani Mali (2023). *Research Anthology on Improving Medical Imaging Techniques for Analysis and Intervention* (pp. 43-59).

[www.irma-international.org/chapter/an-overview-of-biomedical-image-analysis-from-the-deep-learning-perspective/315037](http://www.irma-international.org/chapter/an-overview-of-biomedical-image-analysis-from-the-deep-learning-perspective/315037)

### Histopathological Image Analysis in Medical Decision Making: Classification of Histopathological Images Based on Deep Learning Model

R. Meena Prakash and Shantha Selva Kumari R. (2023). *Research Anthology on Improving Medical Imaging Techniques for Analysis and Intervention* (pp. 935-947).

[www.irma-international.org/chapter/histopathological-image-analysis-in-medical-decision-making/315084](http://www.irma-international.org/chapter/histopathological-image-analysis-in-medical-decision-making/315084)

## Bioinspired Inference System for MR Image Segmentation and Multiple Sclerosis Detection

Hakima Zouaoui and Abdelouahab Moussaoui (2023). *Research Anthology on Improving Medical Imaging Techniques for Analysis and Intervention* (pp. 649-670).

[www.irma-international.org/chapter/bioinspired-inference-system-for-mr-image-segmentation-and-multiple-sclerosis-detection/315068](http://www.irma-international.org/chapter/bioinspired-inference-system-for-mr-image-segmentation-and-multiple-sclerosis-detection/315068)