

Title: An AI-Driven Multi-Medical Image Denoising Framework for Enhanced Image Quality and Diagnostic Precision

Abstract

Medical imaging modalities such as MRI, CT, ultrasound, and X-ray are indispensable in clinical diagnosis and treatment planning. However, these images are often degraded by various types of noise introduced during acquisition, transmission, or low-dose scanning protocols. Such noise can obscure fine anatomical details, reduce diagnostic confidence, and potentially lead to misinterpretation or delayed detection of disease. Addressing this challenge is crucial for maintaining diagnostic accuracy, particularly in resource-limited or radiation-sensitive environments where low-dose imaging is preferred. The main goal of this work is to develop an AI-driven multi-modal image denoising framework capable of adapting to different medical imaging modalities while preserving essential diagnostic information. Unlike conventional noise-removal methods that focus solely on pixel-level restoration, the proposed approach integrates data-driven deep learning with modality-specific priors and diagnostic task awareness. By combining physics-based understanding of image formation with intelligent learning mechanisms, the framework aims to suppress noise while maintaining texture, edge, and lesion integrity—key aspects for accurate medical interpretation. This technique emphasizes generalizability across imaging types, robustness to varying noise conditions, and preservation of clinically significant structures. The framework incorporates self-supervised and adaptive learning strategies, allowing it to operate even when clean reference images are unavailable. The expected outcome is a significant enhancement in image clarity and diagnostic precision, contributing to improved clinical decision-making and reducing the need for repeated imaging. Ultimately, this work seeks to bridge the gap between image quality enhancement and diagnostic reliability through a unified, intelligent, and efficient denoising solution.