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Anomaly Detection in Medical Imaging

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Abstract: *Anomaly detection in medical imaging refers to the identification of unusual patterns or structures in medical scans that deviate from what is considered normal anatomy or physiology. This process plays a critical role in the early diagnosis and treatment of various diseases, including cancer, neurological disorders, and cardiovascular conditions. With the advent of advanced imaging technologies such as MRI, CT, X-rays, and ultrasound, vast amounts of visual data are now available for analysis, creating opportunities to enhance clinical decision-making through automated tools.*

Traditional anomaly detection has relied heavily on radiologists' expertise, which can be time-consuming, subjective, and prone to error, especially in complex or subtle cases. To address these challenges, artificial intelligence (AI) and machine learning (ML) techniques—particularly deep learning—have emerged as powerful tools for detecting anomalies in medical images. These methods can learn patterns from large datasets and identify deviations with high accuracy, often surpassing human-level performance in specific tasks. Key applications of anomaly detection in medical imaging include tumor detection, lesion segmentation, fracture identification, and organ deformation monitoring. Unsupervised and semi- supervised learning approaches are especially valuable in this field, as they can detect abnormalities without requiring extensive labeled datasets, which are often scarce in healthcare. In summary, anomaly detection using medical images is transforming the field of diagnostic medicine by improving accuracy, reducing workload for healthcare professionals, and enabling earlier intervention. As research and technology evolve, this domain holds great promise for enhancing patient outcomes and supporting precision medicine.

Keywords: Anomaly Detection, Medical Imaging, Deep Learning, ,Convolutional Neural Networks (CNNs), Autoencoders, Unsupervised Learning, Supervised Learning, Semi-supervised Learning, Feature Extraction, Image Segmentation, Radiology, MRI (Magnetic Resonance Imaging),CT (Computed Tomography),X-ray, Ultrasound Imaging, Medical Image Analysis

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