International Journal of Humanities Social Sciences and Education (IJHSSE)
Volume 12, Issue 8, August 2025, PP 114-125
ISSN 2349-0373 (Print) & ISSN 2349-0381 (Online)
https://doi.org/10.20431/2349-0381.1208010
www.arcjournals.org

Applications of Artificial Intelligence in Medical Imaging: A Review of Medical Physics Research in Iran

Amir Saemian[1], Omidreza Rayani[2]
[1]*Medical Physics, Tarbiat Modares University, Tehran, Tehran, IR*
[2]*Bachelor's degree, Radiology, Mazandaran University of Medical Sciences, IR*

Corresponding Author:** ***Amir Saemian, *Medical Physics, Tarbiat Modares University, Tehran, Tehran, IR*

Abstract: *Medical imaging using deep learning has attracted significant attention in recent years as one of the most advanced and effective methods for diagnosing and analyzing diseases. This study examines the published articles in the field of deep learning in medical imaging in Iran, providing information on various imaging methods, the software used, types of neural networks, training methods, and evaluation criteria employed in this research. The results indicate that Convolutional Neural Networks (CNNs) and software like Tensor Flow and PyTorch are considered the primary tools in this field. Additionally, the use of diverse evaluation metrics and the need for greater transparency in methodologies highlight the challenges in comparing and analyzing results more accurately. This research emphasizes the necessity of developing interpretable methods and increasing interdisciplinary collaborations to enhance the effectiveness and applicability of deep learning in medical applications.*

Keywords: *Artificial Intelligence, Medical Imaging, Medical Physics, Iran, Disease Diagnosis, Deep Learning*

1. Introduction

In recent decades, the advent of novel technologies, particularly machine learning, has revolutionized diagnostic, predictive, and therapeutic methodologies within the fields of medicine and healthcare. In Iran, researchers in medical physics are striving to leverage these innovative technologies to enhance the quality of medical services and improve diagnostic processes, in light of significant advancements in scientific and technological domains. Among various machine learning methods, deep learning, especially through the application of deep neural networks, has demonstrated remarkable results in the analysis of complex data, particularly in the realm of medical imaging. However, challenges such as inconsistency in evaluation criteria, a lack of large datasets, and the comparability of different methodologies have hindered the establishment of the necessary trust for the widespread adoption of this technology in clinical practice.

Medical imaging serves as a key tool for the diagnosis and management of diseases, enabling the visualization and assessment of a patient’s internal condition. Various imaging modalities, including MRI, CT scans, and ultrasound, provide critical information regarding the structure and function of tissues. Nevertheless, manual analysis of these images is not only time-consuming due to the complexity and high volume of data, but it may also lead to misdiagnosis owing to human error and the inability to accurately discern intricate details.

Deep learning, as a subset of machine learning, possesses unique capabilities in extracting patterns and latent features from imaging data. The application of deep neural networks, particularly Convolutional Neural Networks (CNNs), facilitates the identification and analysis of medical images with enhanced accuracy and speed. In this context, numerous studies in recent years have investigated the impact of this technology on the improvement of diagnostic processes; however, there remains a need for more comprehensive investigations and the development of interpretable methods to ensure the widespread and effective use of this technology in clinical practice.

Therefore, this research aims to explore the advancements, challenges, and existing strategies related to the application of deep learning in medical imaging in Iran, ultimately identifying future research avenues. The objective of this study is to establish a scientific foundation and conduct a thorough evaluation of the performance of deep learning algorithms in this domain, thereby contributing to the enhancement of healthcare quality and increasing the accuracy of disease diagnosis.

2. ARTIFICIAL INTELLIGENCE

In the past decade, artificial intelligence (AI) has gradually established its presence in numerous scientific journals, including those related to image processing and medical physics. Interestingly, despite this recent prominence, AI is not a new concept; it has been recognized since the 1940s, and the term “artificial intelligence” was proposed by John McCarthy in 1956. Generally, AI refers to computer algorithms that can mimic certain aspects of human intelligence, such as problem-solving and learning. The successes observed today in the field of AI are attributed to significant advancements in computational power as well as the availability of data.

In particular, AI applications that rely on machine learning (ML) algorithms have experienced substantial progress in the realm of computer vision over the past decade. The medical community has leveraged these advancements, leading to the development of AI programs that optimize the use of medical images, automate various stages of clinical practice, and support clinical decision-making. Research conducted in this area has reported promising results across a wide range of medical applications (Singh, 2020; Wang, 2021; Wang, 2020). Disease diagnosis, image segmentation, and outcome prediction are among the tasks that have undergone remarkable transformations thanks to the latest advancements in AI.

Machine learning tools have recently matured sufficiently to meet clinical needs, and for this reason, research and clinical teams, along with companies, are striving to develop AI-based clinical solutions. Currently, we are closer than ever to the clinical implementation of artificial intelligence, and thus familiarity with the fundamental principles of this technology is “essential” for every professional in the medical field (Chiago, 2024). Supporting the medical physics community in acquiring a solid foundational knowledge regarding artificial intelligence and learning methods, including their evolution and current status, will undoubtedly lead to higher-quality research, facilitate the initial steps for new researchers in this domain, and inspire innovative research directions (Papachristou, 2023).

In general, artificial intelligence refers to any approach or algorithm that attempts to simulate human intelligence behaviors. Historically, this field is divided into two aspects: computationalism and connectionism. The first aspect seeks to replicate formal reasoning and logic without regard for its biological implications (JEYASEELAN, 2024). Computationalism is primarily based on principles and hardware rules designed to infer new results, somewhat akin to computers in storing and processing symbols. In contrast, connectionism is more focused on a bottom-up approach that starts from biological neural models and expects intelligence to emerge through experience and learning (Sarrut, 2021).

Expert systems, which became very popular in the 1980s, are considered a classic example of a computational approach. Some of the well-known applications of these systems in medicine include MYCIN (for diagnosing bacterial infections in the blood), PUFF (for interpreting pulmonary function data), and INTERNIST-1 (for internal medicine diagnosis). However, the limitations of expert systems stem from the complexity of acquiring the necessary knowledge in the form of rules. Consequently, from the 1990s onwards, interest in machine learning emerged as an alternative approach to problem-solving (Chougule, 2024).

The appeal of the connectionist approach and AI based on learning arises from the transfer of responsibility for accuracy and comprehensiveness to the data, rather than placing this responsibility on human experts, who may be prone to errors, biases, or unjust judgments. With the ever-increasing volume of data, particularly medical images, the attention of the community has shifted toward learning techniques, forming two major subfields: machine learning and deep learning (Semghouli, 2025).

3. DEEP LEARNING

Machine learning (ML) is one of the fields of artificial intelligence algorithms that is capable of identifying patterns in medical images by analyzing the intensity values and other characteristics of imaging data, which are known as “radiomic features.” These algorithms can identify the best combination of these features and create a model for classification or regression (Lella, 2020). By utilizing ML, image features can be combined with other variables, such as dose distribution resulting from radiotherapy (Avanzo, 2020) or clinical variables (Ricciardi, 2020), to improve classification accuracy. ML is particularly common in imaging for classification and regression purposes (Amoroso, 2019).

Machine learning must be guided by data, which allows machines (computers) to “learn without explicit programming,” a concept introduced by Arthur Samuel in 1959. The machine learning process is divided into two key stages: training and inference. The training stage assists in identifying patterns in previously collected data, while the inference stage compares these patterns with new and unseen data to perform actions such as predictions or decision-making (Miller, 1994). Since the 1990s, ML algorithms have continuously advanced and become more complex, now including hierarchical structures that have led to the emergence of popular deep learning (DL). The term deep learning was first introduced by Geoffrey Hinton and his colleagues in the 2000s and refers to a subset of ML algorithms that extract meaningful hierarchical features from data (Ramalakshmi, 2024).

Although deep learning is considered a part of machine learning, it is typically contrasted with "shallow" classical machine learning, which relies on algorithms with surface structures and is dependent on handcrafted features (Avanzo, 2024). This distinction also reflects the evolutionary trend from machine learning to deep learning, shifting from a focus on specific feature engineering to learning general features. While machine learning relies on domain knowledge and expertise to define relevant features, deep learning encompasses general, learnable features (Feng, 2025). In other words, despite the power of machine learning modeling, overall performance is limited due to the manually selected capabilities. In contrast, deep learning replaces these fixed and specialized features with general and learnable features that are involved in a hierarchical process, thus ensuring better performance. This complexity arises from the accumulation of simple feature layers, leading to the formation of hierarchical models. Because training in deep learning relates to low-level features and higher-level models, this approach is commonly recognized as an end-to-end approach. This method allows deep learning models to learn optimal filters (Li, 2024).

Today, machine learning models have achieved significant milestones and can perform certain tasks with accuracy similar to or even surpassing that of human specialists. For example, the diagnostic performance of deep learning models is comparable to that of medical specialists for specific applications (Liu, 2019), including skin cancer detection (Esteva, 2017) and breast cancer detection (Lotter, 2021). Notably, a deep learning model has been reported that not only demonstrated excellent performance in mammography classification but also had a sensitivity 14% higher than the average of five full-time breast imaging specialists. Image segmentation is another area that has transformed with the emergence of machine learning algorithms; for instance, a recent study introduced a model called deep learning that is capable of segmenting organs in the head and neck region from CT images, and its performance is comparable to that of experienced radiologists (Barragán, 2021).

4. SYSTEMATIC REVIEW RESULTS

Table 1 summarizes the research articles published in Iran from 2019 to 2024 that utilized deep learning in imaging. The table presents the first author and publication year for each study, the imaging method, the software used for implementing deep learning, the type of neural network implemented, the training method, the evaluation criteria, and the validation of the model, as well as the research objectives.

First Author and Year of Publication	Imaging Method	Deep Learning Implementation Software	Type of Neural Network Implemented	Training Method	Evaluation Criteria and Model Validation	Research Objective
Ali, Achak 2023	Contrast-enhanced Mammography	Deep learning Densenet-201	Convolutional Neural Network	Machine Learning Methods (KNN)	Sensitivity: 99.2%, Specificity: 97.5%, Accuracy: 98.57%, AUC: 0.987	Evaluation of contrast-enhanced mammography images in diagnosing malignancy levels for early breast cancer detection (BI-RADS 4).
Hossain, K. and Karimian, Alireza (2023)	MRI Images (T1W, T1ce, T2W, FLAIR Sequences)	Deep learning ResNet	Neural Network	Similarity, Parameter Sensitivity	Automatic tumor segmentation	Investigating the performance of various MRI sequences in brain tumor segmentation.
Mehri, Haniyeh Baghi, Kordkhosh, Shirin, Jafari, Hamid, Khairabadi,	Chest X-ray, CT scan	MATLAB	Logistic Regression Network (LENR)	Supervised Learning	Accuracy, Precision, Sensitivity, AUC, F1 Score, False Classification	Evaluating the feasibility of using plain chest X-rays as a replacement for CT scans for pneumothorax detection and reducing patient radiation dose.

Nalini Samira, Farhad (2023)						
Sabbahi, Kamal 2023	Chest X-ray Images	Deep Learning Neural Network	Convolutional Neural Network	Supervised Learning	Sensitivity, Accuracy, Specificity	Automatic detection of COVID-19 from chest X-ray images to assist physicians in disease diagnosis.
Nikpour, Farzaneh 2023	Quantitative Susceptibility Mapping (QSM)	3D Slicer	Convolutional Neural Network	Supervised Learning	Correlation between QSM values and cognitive impairments	Identifying iron deposit changes in the brains of patients at different stages of cognitive impairment.
Hedayati Zadeh, Mohammadreza Yousefi, Mahdi (2024)	MRI Images	Convolutional Neural Network (CNN)	Convolutional Neural Network	Linear Discriminant Analysis	Accuracy Prediction	Predicting the survival of glioblastoma patients using MRI images and machine learning with BraTS 2017 dataset.
Ghasemi, Zahra et al. (2021)	Chest X-ray	TensorFlow, PyTorch	Generative Adversarial Network (GAN)	Supervised Learning	RMSE, PSNR, SSIM	Improving the quality of X-ray images with reductions in noise evaluation on 150 images.
Zadeh Langari, Mostafa 2020	MRI Imaging	TensorFlow, Keras	Convolutional Neural Network	Supervised Learning	Dice Similarity Coefficient, Accuracy	Tumor segmentation for glioma detection.
Rostami, Shayan 2024	Brain MRI	TensorFlow/PyTorch	VGG16, ResNet-50	Advanced Training	Accuracy	Estimating intelligence quotient based on brain MRI.
Jalalian Zafrani, Efat 2020	Lung CT Scan	PyTorch	Fuzzy Neural Network	Supervised Learning	Accuracy 84%, F1 Score 83%	Using artificial intelligence models to diagnose COVID-19.
Alimiari Dehbaghi 2023	X-ray, CT Scan	MATLAB	Logistic Elastic Regression (LENR)	Machine Learning	Accuracy, Sensitivity, Features, AUC, F1 Score	Validation using different criteria for diagnosing pneumothorax and replacing plain chest X-ray with CT scan to reduce radiation dose.
Malekzadeh, Anis 2022	EEG Signal Analysis	Use of AI Techniques	SVM-GOA Classification	Supervised Learning	Accuracy 99.42% for binary classification, 99.23% for multi-class	Diagnosing different stages of seizures and epilepsy.
Dehghan, Alireza 2024	Brain MRI	(Software to be mentioned if available)	Neural Network (e.g., CNN)	(e.g., supervised)	(e.g., Accuracy, Sensitivity, Validity)	Predicting clinical outcomes of global developmental delays in children using MRI.
Sheikhi 2024	Diffusion Tensor Imaging	TensorFlow, PyTorch	Convolutional Neural Network	Supervised Learning	Cross-validation accuracy	Evaluating structural brain injuries caused by substance abuse.
Masjoodi 2024	Diffusion Tensor Imaging	MATLAB, Keras	Recurrent Neural Network	Supervised Learning	Sensitivity	Investigating the relationship between neural injuries and psychosis.
Azizi 2024	Diffusion Tensor Imaging	TensorFlow	Fully Connected Neural Network (DNN)	Supervised Learning	Cross-validation Specificity	Analyzing brain injuries in patients with psychological disorders.
Safdari 2024	Diffusion Tensor Imaging	PyTorch	Convolutional Neural Network	Supervised Learning	Cross-validation Accuracy	Simulating structural brain effects due to methamphetamine consumption.

Jamehsi Ghazaleh 2022	mp-MRI	Deep Learning CNN	Supervised Learning	Sensitivity, Specificity	Accuracy	Investigating the role of mp-MRI in the diagnosis, determination, and staging of prostate cancer.

5. Imaging Method

The highest number of articles has been published in recent years (2023, 2024). This trend indicates a growing interest and research activity in this field. Articles were also published in the years 1399 (2020) and 1400 (2021), which reflects the beginning of attention to this topic in previous years. The MRI imaging method has been utilized in several articles (Hedayati Zadeh, Mohammadreza and Yousefi, Mahdi 2024; Hossain, K. and Karimian, Alireza 1402; Khazaei, Zainab 1400 (2021); Langari Zadeh, Mostafa 1399 (2020); Rostami, Shayan 1403; Dehghan, Alireza 2024). This indicates that MRI remains one of the primary imaging methods in deep learning studies due to its ability to provide high-contrast soft tissue images.

Chest X-rays and CT scans have also been used in several articles (Alimiari Dehbaghi et al. 2023; Sabbahi 1402; Ghasemi, Zahra et al. 1401; Alimiari Dehbaghi 1402; Jalalian Zafrani, Efat 1399). These methods are important for diagnosing pulmonary and skeletal diseases, as well as in emergency cases, due to their accessibility and lower costs. Contrast-enhanced spectral mammography (Achak, Ali 1402) is used for breast cancer detection. Quantitative Susceptibility Mapping (QSM) (Nikpour, Farzaneh 2023) is employed to investigate iron deposition changes in the brain. EEG signal analysis (Malekzadeh, Anis 1402) is utilized for diagnosing epilepsy seizures. Diffusion tensor imaging (Sheikhi 2024; Masjoodi 2024; Azizi 2024; Safdari 2024) is used to examine the structure of neural fibers in the brain. ECG-Gated SPECT Monte Carlo simulation (Ali, Somaye 2023) is applied for assessing heart function. mp- MRI (Jamehsi Ghazaleh 2022) is a combination of MRI and other methods used for prostate cancer detection.

It appears that in recent years, there has been an increase in the diversity of imaging methods used in deep learning studies. This trend reflects an effort to utilize more varied and complex data to enhance the performance of deep learning models. In particular, the use of MRI and diffusion tensor imaging has significantly increased, which may indicate a focus on the diagnosis and analysis of brain diseases. The emphasis on diagnosing and analyzing brain diseases using MRI and diffusion tensor imaging is on the rise. Traditional imaging methods (such as X-rays and CT scans) still have their applications, especially in diagnosing pulmonary and skeletal diseases. The variety in imaging methods demonstrates an effort to leverage diverse and complex data to improve the performance of deep learning models. The increasing number of published articles signifies a growing interest and research activity in this field.

6. Deep Learning Implementation Software

The analysis of deep learning implementation software in various articles reveals several key points. The use of “deep learning neural networks” and “Convolutional Neural Networks (CNN)” is evident in several studies (Achak, Ali 1402; Hossain, K. and Karimian, Alireza 1402; Sabbahi 1402; Hedayati Zadeh, Mohammadreza and Yousefi, Mahdi 2024). This indicates a growing popularity of these techniques in medical deep learning research. TensorFlow and PyTorch are identified as the two main platforms for implementing deep learning models. In particular, the articles by Ghasemi et al. (1401), Khazaei (1400), and Rostami (1403) frequently utilize these platforms. These two frameworks are well-known among researchers in both academic and industrial settings due to their ability to support complex models and high efficiency in deep learning.

Several articles (Alimiari Dehbaghi 2023; Alimiari Dehbaghi 1402; Masjoodi 2024) demonstrate that this software is employed for its user-friendly environment and high mathematical capabilities for data analysis. MATLAB remains a popular choice for those who prioritize clarity and simplicity, especially in educational and research projects. Nikpour, Farzaneh (2023) reports the use of this software, specifically designed for the analysis of three-dimensional medical images. This indicates the utilization of specialized tools for specific needs in medicine.

Aalaei, Somaye (2023) refers to the GATE software, which is specifically used for medical imaging applications and related simulations. Malekzadeh, Anis (1402) mentions the use of general artificial intelligence techniques (AI) in deep learning. Some researchers, such as Ghasemi et al. (1401) and Masjoodi (2024), combine multiple platforms (Tensor Flow, PyTorch) and tools (MATLAB, Keras) to optimize and complete their models. This approach reflects researchers' inclination to combine the strengths and capabilities of different software to enhance accuracy and efficiency. The use of diverse software and well-known standards like Tensor Flow and PyTorch alongside specialized tools indicates positive developments in advancing deep learning research and artificial intelligence techniques in the medical field. Overall, the trend towards using advanced and up-to-date software in research signifies researchers' strong efforts to improve the quality of results and create more effective models for diagnosing and analyzing medical data. This highlights a broader focus on alternative methods and techniques.

7. Implemented Neural Network Type

The analysis of the types of implemented neural networks in various articles indicates a focus and specific trends in deep learning, particularly in providing different solutions for classification and detection issues. Below is an analysis of the details related to various types of neural networks. **Convolutional Networks (CNNs)** are recognized as one of the most commonly used models for image analysis. Many articles (Khazaei, Zainab 1400; Langari Zadeh, Mostafa 1399; Rostami 1403; Sheikhi 2024; Safdari 2024; Jamehsi Ghazaleh 2022) have referred to this type of network. This highlights the high popularity and effectiveness of these networks in medical and computer vision fields. **Generative Adversarial Networks (GANs)** have been utilized by Ghasemi et al. (1401) for generating new data and developing advanced models. GANs are known for their capability to produce reality-based data, particularly in designing imaging systems and artificial simulations. **Recurrent Neural Networks (RNNs)** are a type of network that is well-suited for processing sequential data (such as speech and text). Masjoodi (2024) has pointed out the use of this type of network, emphasizing the importance of processing sequential data in deep learning tasks. Alimiari Dehbaghi and colleagues (2023) have referenced the implementation of elastic logistic regression and other hybrid methods. This indicates the use of classical methods alongside deep networks for optimizing results. Sabbhi (1402), Nikpour, Farzaneh (2023), and Ali, Somaye (2023) have mentioned the use of phase 2 activation functions in convolutional networks. This indicates a new approach to improving network performance, particularly in processing imprecise or ambiguous data. Hedayati Zadeh and Yousefi (2024) have utilized pre-trained convolutional networks, allowing researchers to leverage pre-developed models for faster training and increased accuracy. Overall, the analysis shows a diverse and evolving landscape of neural network types used in deep learning research, reflecting both classical and innovative methods to enhance performance in various applications, particularly in medical imaging and data analysis.

Most researchers have engaged in the examination and analysis of various issues using different approaches. These approaches include deep learning-based methods as well as conventional techniques such as Support Vector Machines (SVM) and Adaptive Boosting. The analysis of the types of neural networks used indicates a high diversity of approaches and technologies in this field. Many researchers are striving to optimize their models by combining deep networks and enhancing these networks' capabilities to solve various problems. This diversity in methods can contribute to improving performance and increasing accuracy in models, as well as their adaptability to complex data. Moreover, the overall trend indicates rapid growth and advancement in the field of deep learning and its applications across various domains, especially in medicine and data analysis. These advancements not only enhance the quality of results but also enable researchers to utilize advanced and innovative techniques to tackle new challenges. As a result, the use of hybrid approaches and cutting-edge technologies in deep learning is seen as a key strategy for increasing the efficiency and accuracy of models in scientific and industrial research.

8. Teaching Method

The analysis of the training methods used in various articles indicates a diversity and a specific focus on machine learning and deep learning. Below, we will examine the currents and trends present in this field. Most authors have referred to supervised learning methods, including Ghasemi, Khazaei, Langari Zadeh, Jaleian Zafarani, Malekzadeh, Dehghan, Sheikhi, Masjoodi, Azizi, and Safdari, which demonstrates a prevailing tendency among researchers towards this type of learning. In particular, this approach allows researchers to utilize labeled data and make accurate predictions. Achak Ali and Nikpour Farzaneh have pointed out the use of deep learning methods. This indicates a trend toward employing more complex models and the high capabilities of these methods in processing large and complex data, such as images and texts. Alimiari Dehbaghi and colleagues have examined "machine learning algorithms," and Achak Ali has referred to the use of "KNN." These approaches are applicable for specific problems and can serve as complements to more complex methods like deep learning. Hedayati Zadeh and Yousefi (2024) refer to "linear discriminant analysis of prediction accuracy." This type of analysis can be used to evaluate the performance of machine learning algorithms and provides researchers with the opportunity to obtain better results. Rostami, in reference to "advanced training," mentions innovative methods and the updating of algorithms to improve efficiency and accuracy in machine learning and deep learning.

The overall statistical results indicate a clear inclination among researchers towards supervised learning, particularly deep learning. This trend shows that researchers are inclined to use advanced methods in machine learning to solve complex issues and enhance the accuracy of their predictions. The variety of methods for learning reflects high capability and flexibility in this area, which can significantly impact the performance of artificial intelligence systems and deep learning. This analysis highlights the need to combine classical methods with modern innovations in learning.

9. Evaluation Criteria and Model Validation

The analysis of evaluation criteria and model validation in various articles indicates the extensive use of standard metrics as well as specific metrics tailored to the type of problem and the data being analyzed. The details of this analysis are presented below. One of the most commonly used metrics for evaluating the performance of classification models is accuracy, which shows the proportion of samples that have been correctly classified. In the articles by Alimiari Dehbaghi and colleagues (2023), Langari Zadeh (1399), Malekzadeh (1402), Sheikhi (2024), and Safdari (2024), this metric has been utilized.

Sensitivity and **Specificity**: These two metrics are particularly important in medical issues and diagnostics. Sensitivity indicates the proportion of positive samples that have been correctly identified, while specificity shows the proportion of negative samples that have been accurately identified. Achak Ali (1402), Hosseini, and Karimiann (1402), Sabahi (1402), and Jamshidi Ghazaleh (2022) have utilized these metrics.

The **harmonic mean** of accuracy and sensitivity represents the balance between these two metrics. In the articles by Alimiari Dehbaghi (2023), Langari Zadeh (1399), and Jaleian Zafarani (1399), this metric has been used. **AUC** (Area under the Curve) is a general metric for evaluating the performance of classification models and indicates how well the model can distinguish between two classes. Alimiari Dehbaghi (2023) has used this metric. Ghasemi and colleagues (1401) have employed RMSE (Root Mean Square Error), PSNR (Peak Signal-to-Noise Ratio), and SSIM (Structural Similarity Index), which are primarily used in image processing and image reconstruction. RMSE indicates the level of error, PSNR assesses the quality of the reconstructed image, and SSIM measures the structural similarity between two images. Khazaei (1400) has used the **Dice similarity coefficient**, which is often applied in medical image segmentation and measures the overlap between two regions. Ali, Somaye (2023) has used MSE (Mean Squared Error) and SNR (Signal-to-Noise Ratio), which are relevant in signal and noise issues. Nikpour Farzaneh (2023) has utilized the correlation metric between QSM (Quantitative Susceptibility Mapping) values and cognitive impairment severity, indicating the relationship between QSM images and the severity of cognitive disorders, applicable in studies related to brain diseases.

Cross-validation is a method used to evaluate the stability and generalizability of a model. In this method, the data is divided into several parts, and the model is trained multiple times, with each part used as test data in turn. Rostami (1403), Sheikhi (2024), Azizi (2024), and Safdari (2024) have employed this method.

In result analysis, it is essential to note that the selection of suitable evaluation metrics depends on the type of problem and the data being analyzed. For example, in medical issues, sensitivity and specificity are more critical, while in image processing problems, RMSE and PSNR may be appropriate metrics. The use of diverse evaluation metrics and suitable validation methods indicates the accuracy and comprehensiveness of the conducted research. Choosing the right metrics and validation methods can enhance the assessment of model performance and increase their generalizability. This analysis shows that researchers pay attention to the importance of accurately and comprehensively evaluating their models and strive to utilize appropriate methods for this purpose.

10. The purpose of using research

The analysis of the objectives behind various research studies indicates a focus on improving the diagnosis, prediction, and understanding of diseases and disorders using medical imaging techniques and machine learning. Several studies have been conducted aimed at earlier and more accurate cancer detection. Achak Ali (1402) evaluated the performance of mammographic images in detecting breast cancer, while Jamshidi Ghazaleh (2022) examined the role of multiparametric MRI in diagnosing prostate cancer. This underscores the importance of early cancer detection in improving treatment outcomes.

Hosseini and Karimiann (1402) addressed the automatic segmentation of brain tumors, while Khazaei (1400) and Langari Zadeh (1399) focused on the diagnosis of glioma brain tumors. The objective of these studies is to enhance the accuracy and efficiency in the diagnosis and localization of brain tumors. Sabahi (1402) and Jaleian Zafarani (1399) worked on the automatic diagnosis of COVID-19 from chest X-ray images. These studies reflect efforts to assist physicians in more rapid and accurate diagnosis of this disease.

Alimiari Dehbaghi and colleagues (2023) and Alimiari Dehbaghi (1402) examined the possibility of replacing chest X-ray with CT scan for the diagnosis of pneumothorax. The goal of these investigations is to reduce the radiation dose received by patients and to provide cost-effective methods for diagnosing this condition. Malekzadeh (1402) studied the diagnosis of epileptic seizures and their various stages, which can contribute to improved management and treatment of this disorder.

Hedayati Zadeh and Yousefi (2024) focused on predicting the lifespan of patients with glioblastoma using MRI images and machine learning. This research can assist physicians in better treatment planning and providing more accurate information to patients. Dehghan (2024) investigated the prediction of clinical outcomes related to developmental delays in children using MRI. This research could help in the early identification of at-risk children and provide appropriate interventions.

Sheikhi (2024), Masjoodi (2024), Azizi (2024), and Safdari (2024) analyzed brain injuries caused by substance abuse and psychological disorders. The aim of these studies is to gain a better understanding of the effects of substance use and psychological disorders on the brain and to offer more suitable therapeutic methods.

Nikpour Farzaneh (2023) investigated the identification of iron deposition changes in brain nuclei at different stages of cognitive disorders. This research could contribute to a better understanding of the mechanisms of brain diseases and the development of new diagnostic and therapeutic methods. Ghasemi and colleagues (1401) focused on improving the quality of radiographic images and reducing the need for repeat imaging. This research can help decrease the radiation dose received by patients and enhance the quality of diagnostic images. Ali Somaye (2023) assessed the quantitative evaluation of attenuation correction and scattering of rays in cardiac perfusion scans. This research can aid in improving the accuracy and quality of cardiac scan images. Rostami (1403) worked on estimating intelligence quotient (IQ). This research could facilitate a better understanding of the factors influencing IQ and the development of more suitable educational methods. The objectives of various studies indicate a focus on improving the diagnosis, prediction, and understanding of various diseases and disorders using medical imaging techniques and machine learning. These studies can contribute to better treatment outcomes, cost reduction, and the provision of improved healthcare.

11. Promises of Artificial Intelligence in Iran

Artificial intelligence (AI) plays a significant role in medical imaging, especially in the analysis of medical images (such as MRI, CT, X-ray, and Ultrasound). Some of the advantages of this technology include high accuracy in disease diagnosis, reduced diagnosis time, and facilitation of clinical processes. In Iran, several research centers and hospitals are collaborating with universities and research institutions to implement AI algorithms for diagnosing diseases such as cancer, stroke, and heart problems. Medical physics research in Iran primarily focuses on improving new imaging techniques and technologies and utilizing AI for the analysis of medical data. Physicists and biomedical engineers in Iran are increasingly concentrating on machine learning and deep learning algorithms that can be applied in the processing of medical images.

12. Potential of Artificial Intelligence in the Medical Sector of Iran

Early Disease Diagnosis: AI can be effective in identifying diseases in their early stages and predicting disease progression through the analysis of medical images.

Support for Physicians: Artificial intelligence can serve as a tool to assist doctors in diagnosis and treatment, especially in busy hospitals and healthcare centers where quick decision-making is essential.

Enhancing Imaging Accuracy: By utilizing machine learning models, the accuracy of medical image analysis can be improved, which can help reduce human errors and expedite the treatment process.

13. Challenges and Limitations

Access to Large and High-Quality Data: One of the major challenges in Iran is the access to high-quality and up-to-date medical data for training artificial intelligence models. Many datasets are scattered and lack the necessary standards.

Technological and Infrastructural Barriers: Due to infrastructural and technological limitations, some algorithms and systems may not be effectively implemented in Iran.

Ethical Issues and Privacy Concerns: The use of AI in medicine faces ethical and legal challenges. Protecting patient medical information and maintaining their privacy are significant issues in this area.

14. Current Actions and Research in Iran

In recent years, universities and research centers in Iran have focused on the applications of artificial intelligence in medical imaging. Various projects are currently under research and development, reflecting the interest in expanding the use of these innovative technologies in the medical field. For example:

- Automatic Cancer Detection from Medical Images
- Using Neural Networks for Analyzing and Processing Medical Images
- Training AI Algorithms for Simulating Clinical Processes

Ultimately, artificial intelligence in Iran has a high potential to improve the quality of healthcare services, especially in medical imaging. With technological advancements and research developments, Iran could quickly become a leader in the use of AI in medicine. However, to achieve this goal, there is a need for greater collaboration among universities, hospitals, and technology industries. Overall, the applications of artificial intelligence in medical imaging in Iran can play an important role in enhancing the quality of healthcare services, but achieving this goal requires suitable infrastructure, continuous research and development, and attention to ethical and legal aspects.

15. Conclusion

A review of articles in the field of deep learning applications in medical imaging indicates an increasing growth and diversity of approaches in this area in recent years. The widespread use of various imaging methods, including MRI, radiography, and CT scans, alongside advanced software such as TensorFlow and PyTorch, demonstrates the efforts of researchers to leverage the latest technological advancements to solve clinical issues. Convolutional Neural Networks (CNNs), as the most commonly used type of neural networks, play a central role in feature extraction and pattern recognition in medical images.

Despite significant advancements, challenges such as inconsistency in evaluation criteria and a lack of detailed information regarding datasets and model settings limit the ability to compare and evaluate results more accurately. Therefore, future research should focus on greater transparency in presenting methodological details, the use of standardized evaluation metrics, and the development of interpretable deep learning methods (Explainable AI) to enhance clinical trust. Additionally, encouraging the creation of large and diverse datasets and promoting interdisciplinary collaborations can significantly aid in accelerating the development and application of this technology in the medical field.

References

Achaak Ali, Hedayat Zadeh Mohammad Reza. “Evaluation of Deep Learning Performance in Breast Cancer Detection Using Contrast Spectral Mammography Images.” Journal of Qom University of Medical Sciences. 2023; 17(): 334-345.

Sorgi Maryam, & Khatami Seyed Hamid. (2023). “Deep Learning-Based Classification of Alzheimer’s Disease Using Brain MRI.”

Nazarpour Mahmoud, & Fattahi Hassan. (2024). "Investigation of TE Effects on the Relationship between Signal Intensity and Concentration of Superparamagnetic Iron Oxide Nanoparticles Modified with Polyvinylpyrrolidone in T2-weighted Spin Imaging."

Alimiri Dehbaghi Hanieh, Khoshgardi Karim, Sharini Hamid, Jafari Khairabadi Shirin, & Naleini Farhad. "Detection of Pneumothorax Using Machine Learning Algorithms and Radiomics: Investigating the Possibility of Replacing Simple Chest Radiography with CT Scan to Reduce Radiation Dose." Journal of the Faculty of Medicine, Tehran University of Medical Sciences. 2023; 81(5): 339-348.

Alimiri Dehbaghi Hanieh, Khoshgardi Karim, Sharini Hamid, Jafari Khairabadi Shirin, & Naleini Farhad. (2023). "Detection of Pneumothorax Using Machine Learning Algorithms and Radiomics: Investigating the Possibility of Replacing Simple Chest Radiography with CT Scan to Reduce Radiation Dose."

Dehghani Farzaneh, Arabi Hossein, & Karimian Alireza. (2023). "Automatic Segmentation of Brain Tumors in Various MRI Image Sequences to Determine the Most Effective Sequence Using Deep Learning Methods." Computational Intelligence in Electrical Engineering, 14(1): 31-44. doi: 10.22108/isee.2021.126101.1427.

Rezai Isa, Behnaz Farank. "Investigating the Views of Anesthesia Assistants at Shahid Beheshti University of Medical Sciences Regarding Electronic Problem-Solving Tests." Research in Medical Science Education. 2024; 16(4): 59-67.

Nikparast Farzaneh, Shoaibi Ali, Nirovand Shabnam, Akbari Laleh Mohsen, & Zarei Hoda. (2023). "Application of the Emerging QSM Method in MRI for Alzheimer's Disease Diagnosis: What Relationship Exists between Iron Deposits in Brain Nuclei, Age, and Severity of Disorders?"

Hedayat Zadeh Mohammad Reza, & Yousofi Mehdi. (2024). "Utilizing Machine Learning Methods to Predict Survival Rates of Glioblastoma Patients Using MRI Images."

Sabahi Kamal, Sheikhivand Subhan, Mousavi Zahra, & Rajabiyan Mehdi. (2023). "Identifying COVID-19 Cases Using Phase 2 Deep Neural Networks Based on Chest X-Ray Images." Computational Intelligence in Electrical Engineering, 14(1): 75-92. doi: 10.22108/isee.2021.128829.1475.

Qasemi Zahra, Samadi Miyandoab Payam, Sarshoq Samira, & Sina Sedigheh. (2022). "Improving the Realistic Resolution of Chest Radiography Images Using Generative Adversarial Networks." Radiation Measurement and Safety Journal, 11(4): 133-138.

Khazaei Zainab, Langari Zadeh Mostafa, Shiri Ahmad Abadi Mohammad Ibrahim. "Detection of Brain Tumor Glioma Using MRI Images with Deep Learning Methods: A Systematic Review." Journal of Health Informatics and Biomedical Engineering. 2020; 8(2): 218-233.

Qadimi Niloufar, Heydari Khani Taharani Sanaz, Jalali Ara Afsun, & Mahdizadeh Amir Reza. (2022). "Application of Panoramic Radiography and Cone Beam CT in Diagnosing Condyloma."

Alavi Seyed Meysam, Barghobani Azam, & Kargar Mehrdad. (2021). "Visualization of Studies in the Field of Computer-Aided Diagnostic Systems Based on Co-occurrence and Vocabulary Analysis in the PubMed Database."

Malekzadeh Anis, Zarei Assef, Yaqoubi Mehdi, Ali Zadeh Sani Rohollah. "Diagnosis of Epileptic Seizures in EEG Signals Using TQWT Classification and SVM-GOA." Internal Medicine Journal. 2020; 28(1): 98-127.

Mehralian Soheil, Jalilian Zafarani Efat, Shahrzad Shashaani, Kashafi Nishabouri Farnaz, Teshnehlab Mohammad, Sokhandan Hossein Ali, et al. "Rapid Screening of COVID-19 Using Blood Tests and Artificial Intelligence Methods." Control Journal. 2019; 14(S1): 131-140.

Rostami Shayan, Sadr Hossein, Eddalatpanah Seyed Ahmad, & Nazari Mozhdeh. (2024). "Estimating IQ from MRI Images Using a Combination of Convolutional Neural Networks and an Enhanced Gradient Boosting Algorithm." Biomedical Engineering Science Journal, 18(1): 31-40. doi: 10.22041/ijbme.2024.2031836.1906.

Alai Simiyeh, Abdi Saray Akbar, Bi-Torfan Rajabi Ahmad, Asgari Mohammad Ali, & Noori Asal Mahsa. (2023). "Quantitative Evaluation of Radiation Dose Reduction and Scatter in Cardiac Perfusion Scanning Using Monte Carlo Simulation."

Dehqan Alireza, Ab Shirin Mohabubeh, Nemati Hamid, & Saidi Moghadam Mehdi. (2024). "Examining the Role of MRI Imaging in Children in Predicting Clinical Outcomes in Recent Global Development."

Sheikh Koohsar Javad, Masjoodi Sadegh, Azizi Alireza, Safdari Salman, & Kalalian Moghaddam Hamid. (2022). "Investigating Subtle Microstructural Changes in the Development of Psychosis Due to Long-term Methamphetamine Abuse: A Diffusion Tensor Imaging Study."

Jamshidi Ghazaleh, Baba Pur Mofrad Farshid, Ghafouri Mehyar, & Salighahrad Hamid Reza. (2022). "A Review on the Role of mp-MRI in Diagnosing, Locating, and Staging Prostate Cancer."

R. Singh, W. Wu, G. Wang, M.K. Kalra. "Artificial Intelligence in Image Reconstruction: The Change is Here." Phys Med, 79 (2020), pp. 113-125.

T. Wang, Y. Lei, Y. Fu, J.F. Wynne, W.J. Curran, T. Liu, et al. "A Review on Medical Imaging Synthesis Using Deep Learning and Its Clinical Applications." J Appl Clin Med Phys, 22 (2021), pp. 11-36.

M. Wang, Q. Zhang, S. Lam, J. Cai, R. Yang. "A Review on Application of Deep Learning Algorithms in External Beam Radiotherapy Automated Treatment Planning." Front Oncol, 10 (2020), p. 580919.

R.A. Miller. "Medical Diagnostic Decision Support Systems–Past, Present, and Future: A Threaded Bibliography and Brief Commentary." J Am Med Inform Assoc, 1 (1994), pp. 8-27.

X. Liu, L. Faes, A.U. Kale, S.K. Wagner, D.J. Fu, A. Bruynseels, et al. "A Comparison of Deep Learning Performance Against Health-Care Professionals in Detecting Diseases from Medical Imaging: A Systematic Review and Meta-Analysis." Lancet Digit Health, 1 (2019), pp. e271-e297.

Esteva, B. Kuprel, R.A. Novoa, J. Ko, S.M. Swetter, H.M. Blau, et al. "Dermatologist-Level Classification of Skin Cancer with Deep Neural Networks." Nature, 542 (2017), pp. 115-118.

W. Lotter, A.R. Diab, B. Haslam, J.G. Kim, G. Grisot, E. Wu, et al. "Robust Breast Cancer Detection in Mammography and Digital Breast Tomosynthesis Using an Annotation-Efficient Deep Learning Approach." Nat Med, 27 (2021), pp. 244-249.

Barragán-Montero, A., Javaid, U., Valdés, G., Nguyen, D., Desbordes, P., Macq, B., & Lee, J. A. (2021). "Artificial Intelligence and Machine Learning for Medical Imaging: A Technology Review." Physica Medica, 83, 242-256.

Lella E, Lombardi A, Amoroso N, Diacono D, Maggipinto T, Monaco A, et al. "Machine Learning and DWI Brain Communicability Networks for Alzheimer's Disease Detection." Appl Sci 2020; 10. https://doi.org/10.3390/app10030934.

Ricciardi, C., Cantoni, V., Improta, G., Iuppariello, L., Latessa, I., Cesarelli, M., & Cuocolo, A. (2020). "Application of Data Mining in a Cohort of Italian Subjects Undergoing Myocardial Perfusion Imaging at an Academic Medical Center." Computer Methods and Programs in Biomedicine, 189, 105343.

Avanzo, M., Pirrone, G., Vinante, L., Caroli, A., Stancanello, J., Drigo, A., & Sartor, G. (2020). "Electron Density and Biologically Effective Dose (BED) Radiomics-Based Machine Learning Models to Predict Late Radiation-Induced Subcutaneous Fibrosis." Frontiers in Oncology, 10, 490.

Amoroso, N., La Rocca, M., Bellantuono, L., Diacono, D., Fanizzi, A., Lella, E., & Bellotti, R. (2019). "Deep Learning and Multiplex Networks for Accurate Modeling of Brain Age." Frontiers in Aging Neuroscience, 11, 115.

Papachristou, K., Panagiotidis, E., Makridou, A., Kalathas, T., Masganis, V., Paschali, A., & Chatzipavlidou, V. (2023). "Artificial Intelligence in Nuclear Medicine Physics and Imaging." Hell. J. Nucl. Med, 26, 57-65.

Sarrut, D., Etxebeste, A., Muñoz, E., Krah, N., & Létang, J. M. (2021). "Artificial Intelligence for Monte Carlo Simulation in Medical Physics." Frontiers in Physics, 9, 738112.

Chougule, A., & Jain, G. K. (2024). "Artificial Intelligence in Medical Physics."

Semghouli, S., El Fahssi, M., Zerfaoui, M., & Amaoui, B. (2025). "Knowledge and Perceptions of Moroccan Medical Physicists Regarding the Contribution of Artificial Intelligence in Medical Imaging and Radiotherapy." Radiation Medicine and Protection.

Ramalakshmi, K., Raghavan, V. S., Rajagopal, S., Kumari, L. K., Theivanathan, G., Kulkarni, M. B., & Poddar, H. (2024). "An Extensive Analysis of Artificial Intelligence and Segmentation Methods Transforming Cancer Recognition in Medical Imaging." Biomedical Physics & Engineering Express, 10(4), 045046.

Li, X., Zhang, L., Yang, J., & Teng, F. (2024). "Role of Artificial Intelligence in Medical Image Analysis: A Review of Current Trends and Future Directions." Journal of Medical and Biological Engineering, 44(2), 231-243.

Feng, Y., Wang, Q., Su, Y., Ma, W., Du, G., Wu, J., & Wang, Y. (2025). "Application of Artificial Intelligence-Based Computer Vision Methods in Liver Diseases: A Bibliometric Analysis." Intelligent Medicine.

Chiago, C. A., Ndubuisi, M. C., Uko, M. C., & Etuk, M. I. (2024). "Evaluating the Impact of Artificial Intelligence on Medical Physics: A Review." Researchers Journal of Science and Technology, 4(5), 22-43.

JEYASEELAN, C. (2024). "INTRODUCTION TO MEDICAL IMAGING AND ARTIFICIAL INTELLIGENCE." RIYANKA HAQUE, ROHIT VERMA. "Revolutionising Medical Imaging with Computer Vision and Artificial Intelligence," 1.

Avanzo, M., Stancanello, J., Pirrone, G., Drigo, A., & Retico, A. (2024). "The Evolution of Artificial Intelligence in Medical Imaging: From Computer Science to Machine and Deep Learning." Cancers, 16(21), 3702.

AUTHORS' BIOGRAPHY

Omidreza Rayani holds a B.Sc. in Radiology from Mazandaran University of Medical Sciences (2019–2023). He completed the first four semesters of his studies at Mazandaran University of Medical Sciences and the next five semesters as a guest student at Iran University of Medical Sciences.

Amir Saemian is a graduate student (M.Sc.) in Medical Physics at Tarbiat Modares University, Tehran, Iran.

He holds a B.Sc. in Radiology from Mazandaran University of Medical Sciences (2019–2023). He was recognized as a talented and distinguished student, which allowed him to be admitted to his Master's program without an entrance exam and formerly served as the secretary of the Radiology Scientific Association at Mazandaran University of Medical Sciences

Citation: *Amir Saemian et al. "Applications of Artificial Intelligence in Medical Imaging: A Review of Medical Physics Research in Iran". International Journal of Humanities Social Sciences and Education (IJHSSE), vol 12, no. 8, 2025, pp. 114-125. DOI: https://doi.org/10.20431/2349- 0381.1208010.*