

Chapter 8

AI in Neuroimaging and Brain Analysis

Aashish A. Gadgil

KLS Gogte Institute of Technology, Belagavi, India

P. Selvakumar

 <https://orcid.org/0000-0002-3650-4548>


Department of Science and Humanities, Nehru Institute of Technology, Coimbatore, India

G. Sabeena Gnanaselvi

 <https://orcid.org/0000-0003-1362-8123>

Sathyabama Institute of Science and Technology, India

G. Malathi

 <https://orcid.org/0000-0002-1872-3501>

Sri Akilandeswari Women's College, India

ABSTRACT

The integration of AI in neuroimaging offers unprecedented opportunities to enhance our understanding of the brain, improve diagnostic accuracy, and personalize treatment strategies for neurological disorders. This capability is particularly significant given the increasing volume and complexity of neuroimaging data generated by modalities such as MRI, CT, PET, and EEG. As AI algorithms evolve, they are not only enhancing image quality and acquisition processes but also aiding in the development of biomarkers for various neurological conditions. This capability can lead to earlier diagnosis and intervention, which is crucial in managing progressive conditions. Moreover, AI-driven approaches can streamline workflow processes in clinical settings, reducing the burden on radiologists and enabling more efficient patient management. Despite these opportunities, the incorporation of AI in

DOI: 10.4018/979-8-3693-9341-3.ch008

neuroimaging also presents significant challenges. Data privacy and security are paramount concerns, especially when dealing with sensitive patient information.

INTRODUCTION TO AI IN NEUROIMAGING: OPPORTUNITIES AND CHALLENGES

The integration of AI in neuroimaging offers unprecedented opportunities to enhance our understanding of the brain, improve diagnostic accuracy, and personalize treatment strategies for neurological disorders. This capability is particularly significant given the increasing volume and complexity of neuroimaging data generated by modalities such as MRI, CT, PET, and EEG. As AI algorithms evolve, they are not only enhancing image quality and acquisition processes but also aiding in the development of biomarkers for various neurological conditions. This capability can lead to earlier diagnosis and intervention, which is crucial in managing progressive conditions. Moreover, AI-driven approaches can streamline workflow processes in clinical settings, reducing the burden on radiologists and enabling more efficient patient management. Despite these opportunities, the incorporation of AI in neuroimaging also presents significant challenges. Data privacy and security are paramount concerns, especially when dealing with sensitive patient information. The risk of data breaches or misuse must be carefully managed through robust ethical frameworks and compliance with regulations like HIPAA. Furthermore, the use of AI models often requires large, well-curated datasets for training, which can be difficult to obtain. Variability in imaging protocols, patient demographics, and clinical contexts can lead to biases in AI algorithms, potentially affecting their generalizability and clinical utility. Another critical challenge is the interpretability of AI models. While algorithms may excel in classification tasks, understanding the underlying decision-making process can be complex. Clinicians need to trust and comprehend AI outputs to integrate them effectively into their practice. This demand for transparency necessitates the development of explainable AI techniques that elucidate how models derive their predictions. Without this transparency, the adoption of AI in clinical settings may be hindered, as healthcare professionals may be reluctant to rely on “black box” models that do not provide insight into their reasoning.

Furthermore, the interdisciplinary nature of neuroimaging and AI necessitates collaboration between neurologists, radiologists, computer scientists, and ethicists. Effective collaboration is essential for translating AI research into clinical practice, ensuring that models are not only technically sound but also clinically relevant. As we look toward the future, the potential for AI in neuroimaging is immense. Emerging technologies, such as federated learning, promise to enhance model training while

26 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/ai-in-neuroimaging-and-brain-analysis/367709

Related Content

Inclusive Pedagogy and Artificial Intelligence in the Teaching of Physical Education and Sports

Imane Belmaadadiaand Mohamed Meliani (2026). *Transforming Humanities and Social Sciences Through AI* (pp. 345-366).

www.irma-international.org/chapter/inclusive-pedagogy-and-artificial-intelligence-in-the-teaching-of-physical-education-and-sports/402272

Multi-Agent Negotiation in B2C E-Commerce Based on Data Mining Methods

Bireshwar Dass Mazumdarand R. B. Mishra (2010). *International Journal of Intelligent Information Technologies* (pp. 46-70).

www.irma-international.org/article/multi-agent-negotiation-b2c-commerce/46963

Script-Independent Text Segmentation from Document Images

Parul Sahare, Jitendra V. Tembhurne, Mayur R. Parate, Tausif Diwanand Sanjay B. Dhok (2022). *International Journal of Ambient Computing and Intelligence* (pp. 1-21).

www.irma-international.org/article/script-independent-text-segmentation-from-document-images/313967

User Relevance Feedback in Semantic Information Retrieval

Antonio Picarielloand Antonio M. Rinaldi (2007). *International Journal of Intelligent Information Technologies* (pp. 36-50).

www.irma-international.org/article/user-relevance-feedback-semantic-information/2417

Threats and Security Issues in Smart City Devices

Jayapandian N. (2021). *Research Anthology on Artificial Intelligence Applications in Security* (pp. 1230-1251).

www.irma-international.org/chapter/threats-and-security-issues-in-smart-city-devices/270646