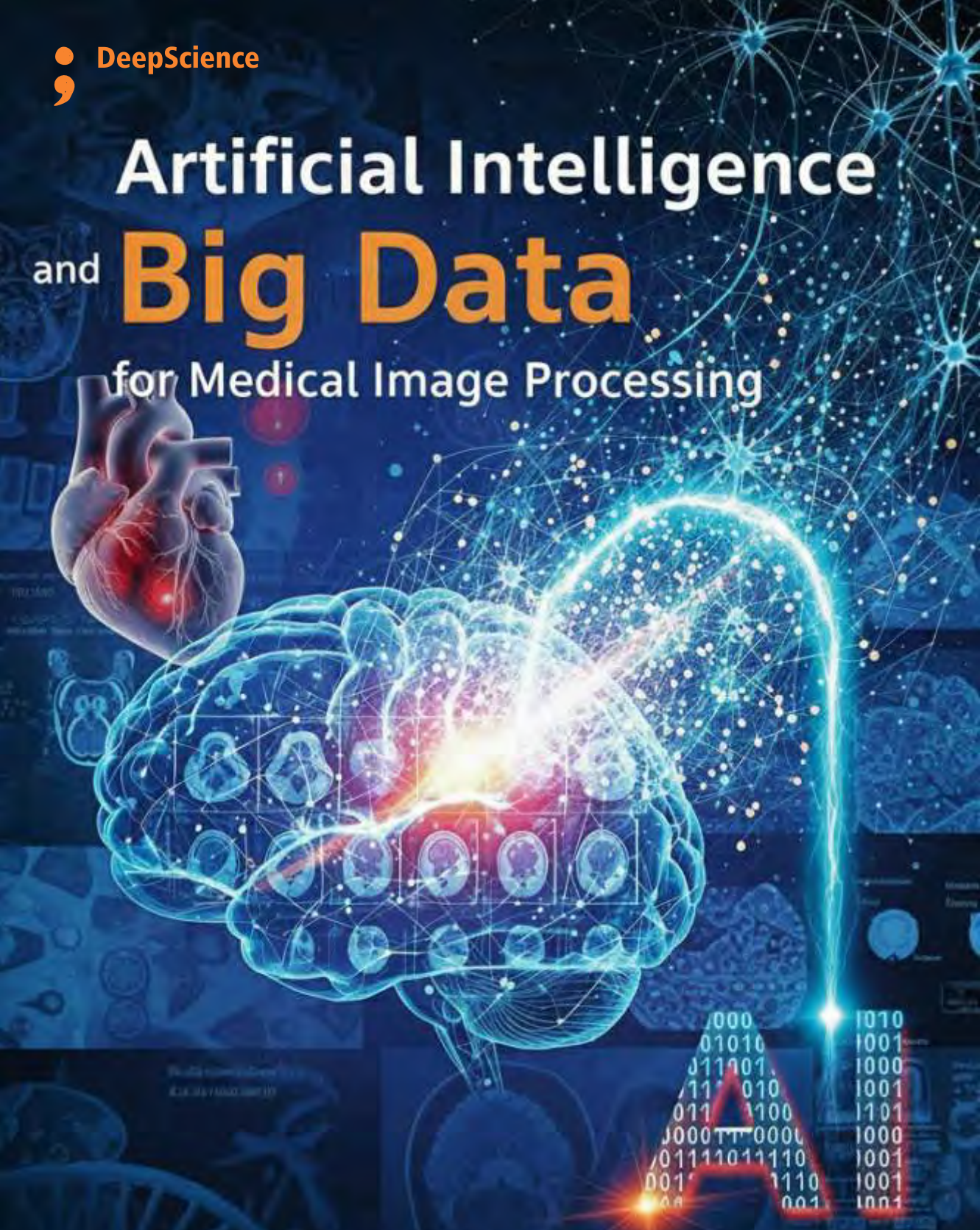
DeepScience

Artificial Intelligence and Big Data for Medical Image Processing



M. AKSHARA VIJAYAN, M.Tech(CSE)(Ph.D)
R. JAYASHREE, M.E(CSE)(Ph.D)

Artificial Intelligence and Big Data for Medical Image Processing

M Akshara Vijayan

Department of Computer Science and Engineering, St. Joseph's College of Engineering and Technology

R Jayashree

Department of Computer Science and Engineering, St. Joseph's College of Engineering and Technology

DeepScience

Published, marketed, and distributed by:

Deep Science Publishing, 2025
USA | UK | India | Turkey
Reg. No. MH-33-0523625
www.deepscienceresearch.com
editor@deepscienceresearch.com
WhatsApp: +91 7977171947

ISBN: 978-93-7185-784-0

E-ISBN: 978-93-7185-033-9

https://doi.org/10.70593/978-93-7185-033-9

Citation: Vijayan, M. A., & Jayashree, R. (2025). *Artificial Intelligence and Big Data for Medical Image Processing*. Deep Science Publishing. https://doi.org/10.70593/978-93-7185-033-9

Artificial Intelligence and Big Data for Medical Image Processing

---

Preface

Medical imaging has become an indispensable tool in modern healthcare, enabling clinicians to visualize internal structures of the human body and detect diseases at early stages. With the explosive growth of healthcare data and the advancements in artificial intelligence (AI), the integration of **big data technologies** with **medical image processing** has opened new horizons for research, clinical applications, and decision support systems.

This book aims to provide students, researchers, and professionals with a comprehensive yet concise understanding of how AI and big data are transforming the field of medical imaging. The chapters cover fundamental concepts, state-of-the-art techniques, real-world applications, and emerging challenges, making the book both an academic reference and a practical guide.

We have structured the book to gradually build knowledge — beginning with the basics of medical image processing, progressing through machine learning and deep learning techniques, and culminating with advanced applications and future directions. Each chapter is enriched with examples, case studies, and references to ensure readers gain both theoretical insight and practical exposure.

This work is intended for:

- Undergraduate and postgraduate students of computer science, biomedical engineering, and related fields
- Researchers working on artificial intelligence, big data, and healthcare applications
- Professionals seeking to understand the role of AI and big data in medical imaging systems

It is our hope that this book inspires readers to contribute to the next generation of intelligent healthcare solutions.

M AKSHARA VIJAYAN M. Tech, (Ph.D.)
Assistant Professor/ CSE, Researcher,
Department of Computer Science and Engineering,
St. Joseph's College of Engineering and Technology
Sep 2025

R JAYASHREE M.E, (Ph.D.)
Assistant Professor/ CSE, Researcher,
Department of Computer Science and Engineering,
St. Joseph's College of Engineering and Technology
Sep 2025

Dedication

To my grandmother, Jayalakshmi,

You were more than a grandmother—
you were my mother, my guardian, my everything.
From the moment I was born, you held my hand,
guiding me with your unconditional love, patience, and strength.
For 27 years, your arms were my home,
your words were my wisdom,
your prayers were my protection.
Losing you has left a silence in my heart that words cannot fill.
But through this book, a part of you lives on—
because everything I am is shaped by you.
I miss you every single day,
and this book is my way of saying:
Thank you for raising me, loving me, and never letting go.
I miss you deeply, and I carry you in every word I write.
This is for you, Paati. Forever and always.

Acknowledgments

This book, **Artificial Intelligence and Big Data for Medical Image Processing,** would not have been possible without the invaluable support, guidance, and inspiration of many individuals.

I would first like to express my deepest gratitude to my husband, **Mr Vijayan M**, for being my greatest source of strength and inspiration. His endless love, patience, and encouragement have carried me through every challenge of this journey. He has stood by me with unwavering belief, sacrificing his time and comfort so that I could dedicate myself to this work. Without his constant support, this book would never have been possible.

I extend my sincere thanks to my Ph.D. supervisor **Prof.Dr C Chellaswamy**, for the invaluable guidance, mentorship, and encouragement that have shaped my academic growth and strengthened my research journey. I also express my heartfelt appreciation to our respected Administrator **Rev.Sr.P. Maria Alangaram, DMI** and Principal **Prof.Dr. I. Neethi Manickam**, for their motivation, trust, and encouragement in all my academic endeavours.

A special note of gratitude goes to my Head of the Department **Mr.P. Muthamil Selvan**, more than just being my HoD, he has been like an elder brother to me always guiding, supporting, and encouraging me for his trust and constant motivational support have been instrumental in the successful completion of this work.

I am especially indebted to my beloved **Josi Ma**, whose unconditional love, blessings, and prayers have always been with me. Her words of wisdom, warmth, and constant encouragement have been a guiding light in both my personal and professional life.

My heartfelt thanks also go to my dear friend **Jayashree Ramalingam**, for her understanding, kindness, and the positivity she has always brought into my life. Her constant encouragement and companionship have made this journey smoother and more memorable.

Finally, I dedicate my gratitude to my students, whose curiosity, enthusiasm, and eagerness to learn continue to inspire me every single day. They are a true source of motivation that pushes me to grow as a teacher and a researcher.

Finally, I extend my appreciation to the academic community and publishers for providing platforms to share knowledge that advances both science and society.

Table of Contents

References

1. Razzak, M.I., Imran, M., & Xu, G. (2018). Big data analytics for preventive medicine. *Neural Computing and Applications*, 32(9), 4417–4451. https://doi.org/10.1007/s00521-017-3279-0
2. Litjens, G., Kooi, T., Bejnordi, B.E., et al. (2017). A survey on deep learning in medical image analysis. *Medical Image Analysis*, 42, 60–88. https://doi.org/10.1016/j.media.2017.07.005
3. Lundervold, A.S., & Lundervold, A. (2019). An overview of deep learning in medical imaging focusing on MRI. *Zeitschrift für Medizinische Physik*, 29(2), 102–127. https://doi.org/10.1016/j.zemedi.2018.11.002
4. Apache Software Foundation. (2023). *Apache Spark™ Programming Guide*. Retrieved from https://spark.apache.org/docs/latest/
5. Dean, J., & Ghemawat, S. (2008). MapReduce: Simplified data processing on large clusters. *Communications of the ACM*, 51(1), 107–113. https://doi.org/10.1145/1327452.1327492
6. Docker Inc. (2023). *Docker Documentation*. Retrieved from https://docs.docker.com/
7. The Kubernetes Authors. (2023). *Kubernetes Documentation*. Retrieved from https://kubernetes.io/docs/
8. Health Level Seven International (HL7). (2022). *FHIR Release 4 Specification*. Retrieved from https://www.hl7.org/fhir/
9. American College of Radiology. (2021). *DICOM Standards Committee: Digital Imaging and Communications in Medicine (DICOM) Standard*. Retrieved from https://www.dicomstandard.org/
10. ISO/IEC 27001:2022. Information security, cybersecurity and privacy protection — Information security management systems — Requirements. International Organization for Standardization.
11. Kairouz, P., McMahan, H.B., Avent, B., et al. (2021). Advances and open problems in federated learning. *Foundations and Trends® in Machine Learning*, 14(1–2), 1–210. https://doi.org/10.1561/2200000083
12. Topol, E. (2019). High-performance medicine: the convergence of human and artificial intelligence. *Nature Medicine*, 25(1), 44–56. https://doi.org/10.1038/s41591-018-0300-7
13. Chen, M., Hao, Y., Cai, Y., Wang, Y., & Zhang, L. (2017). Edge computing in IoT-based healthcare: architecture and performance. *IEEE Access*, 5, 5907–5916. https://doi.org/10.1109/ACCESS.2017.2694444
14. Sokol, K., & Flach, P.A. (2020). Explainability fact sheets: a framework for systematic assessment of explainable approaches. *Proceedings of the 2020 Conference on Fairness, Accountability, and Transparency* (FAT* ’20), 56–67. https://doi.org/10.1145/3351095.3372870
15. U.S. Department of Health and Human Services. (2013). *Health Insurance Portability and Accountability Act (HIPAA) Privacy Rule*. Retrieved from https://www.hhs.gov/hipaa/

M Akshara Vijayan, R Jayashree

Artificial Intelligence and Big Data for Medical Image Processing

Medical imaging has become an indispensable tool in modern healthcare, enabling clinicians to visualize internal structures of the human body and detect diseases at early stages. With the explosive growth of healthcare data and the advancements in artificial intelligence (AI), the integration of big data technologies with medical image processing has opened new horizons for research, clinical applications, and decision support systems.

This book aims to provide students, researchers, and professionals with a comprehensive yet concise understanding of how AI and big data are transforming the field of medical imaging. The chapters cover fundamental concepts, state-of-the-art techniques, real-world applications, and emerging challenges, making the book both an academic reference and a practical guide.

We have structured the book to gradually build knowledge — beginning with the basics of medical image processing, progressing through machine learning and deep learning techniques, and culminating with advanced applications and future directions. Each chapter is enriched with examples, case studies, and references to ensure readers gain both theoretical insight and practical exposure.

This work is intended for:
- Undergraduate and postgraduate students of computer science, biomedical engineering, and related fields
- Researchers working on artificial intelligence, big data, and healthcare applications
- Professionals seeking to understand the role of AI and big data in medical imaging systems.

It is our hope that this book inspires readers to contribute to the next generation of intelligent healthcare solutions.

DeepScience

9 789371 857840