

A Comprehensive Review on AI-Based Material Selection and Property Prediction Using Artificial Neural Networks

Dengale Pravin Balasaheb¹, Prof. Dr. A. A. Khatri², Dr. Mrs. S. D. Gunjal³, Prof. S. B. Bhosale⁴

¹ Student, Department of Artificial Intelligence & Data Science

^{2,3,4} Assistant Professor, Department of Artificial Intelligence & Data Science

^{1,2} JCEI'S Jaihind College of Engineering, Kuran, Narayangaon (M.S) India

Abstract: *The integration of Artificial Intelligence (AI) in materials engineering has revolutionized the process of material selection and property prediction. Among various AI methods, Artificial Neural Networks (ANNs) have emerged as powerful tools capable of modeling complex nonlinear relationships between material composition, processing parameters, and mechanical or thermal properties. This review presents a comprehensive analysis of recent advances in AI-based material informatics, focusing on ANN-driven approaches for predicting properties such as tensile strength, hardness, and thermal conductivity, and for recommending suitable materials in engineering design. The study examines key methodologies, dataset sources, preprocessing techniques, and ANN architectures used across the literature. Additionally, it compares hybrid frameworks that integrate ANNs with multi-criteria decision-making (MCDM) techniques for intelligent material recommendation. Challenges such as data scarcity, model interpretability, and generalization across diverse material classes are critically discussed. Finally, the paper outlines potential research directions, including the integration of deep learning, uncertainty quantification, and cloud-based deployment for scalable material intelligence systems. This review aims to provide insights into current trends, technological developments, and future opportunities for AI-driven material selection and property prediction systems in mechanical and materials engineering.*

Keywords: Artificial Neural Network (ANN), Material Selection, Property Prediction, Machine Learning, Material Informatics, Deep Learning, Mechanical Engineering, Design Optimization

