We review machine learning and its application in a wide range of electromagnetic problems, including radar, communication, imaging and sensing. We extensively discuss some recent progress in development and use of intelligent algorithms for antenna design, synthesis, and characterization. We also provide some perspective for future research directions in this emerging field of study.

Numerous antenna simulations, synthesis, and pattern recognition of radiations as well as non-linear inverse scattering-based object identifications are now leveraging ML techniques.

In this context, this paper aims to present an overview of machine learning, and its applications in Electromagnetics, including communication, radar, and sensing. It extensively discusses recent research progress in the development and use of intelligent algorithms for antenna design, synthesis and analysis, electromagnetic inverse scattering, synthetic aperture radar target recognition, and fault detection systems. It also provides limitations of this emerging field of study. The unique aspect of this work is that it surveys the state-of the art and recent advances in ML techniques as applied to EM. Keywords: electromagnetics; antenna; machine-learning; DoA; object detection; 5G technology

This review is divided into six sections. Section 1 provides the introduction, Section 2 includes necessary background information to understand ML, Section 3 describes different ML applications in the EM field, Section 4 discusses the limitations of ML algorithms, Section 5 suggests future scopes, and Section 6 concludes the article with necessary explanations supporting this innovative research area.

the detection and identification of remote objects and faulty components in systems as well as pattern recognition of radiating signals in electrical systems are the latest trends in EM. On the other hand, the optimization of EM systems for superior performance given the constraints has been a recurrent challenge. ML-based approaches have the potential to address such complex and multifaceted challenges.

Abstract

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