Application of machine learning methods to electrodynamics problems

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We consider different approaches to the application of machine learning methods for problems of electrodynamics. Approaches to solving differential equations based on machine learning methods can be roughly divided into two categories: fully data-driven approaches and physics-based approaches. In completely data-driven approaches, algorithms are trained directly on datasets, without knowing the laws of connection between inputs and outputs. It is believed that there is no physical prior information that could limit the training of machine learning models. It usually takes a long time to generate enough data samples to train machine learning models. The effectiveness of fully data-driven approaches depends on the quality of the training data, and the ability to generalize is also limited. Physics-based approaches include a priori physical or mathematical models that show better performance and improved generalization after sufficient training. Traditional numerical methods for solving differential equations bring additional semantics to machine learning methods. Neural network methods can be considered as a family of powerful methods for the numerical solution of electrodynamics equations. Physics based neural networks (PINNs) are one important approach to electrodynamics modeling.