

Developments Of Artificial Intelligence Based Approaches For Metamaterial Design And Discovery

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Conventional optimization-based approaches usually are not suitable for metamaterial design since the computation scales with the number of design variables rapidly. To this end, novel design frameworks are proposed for metamaterials to achieve user-defined performances. For 1D periodic metamaterials, a reinforcement learning-based approach is proposed to design the unit-cell properties given a user-defined dispersion behavior. For 1D non-periodic metamaterials, a neural network-based approach capable of learning the behavior of individual units is presented. The design is then achieved via network concatenation serving as the surrogate model of the metamaterial. In the case of 2D metamaterials, a deep auto-encoder based approach that provides physics constraints during training is proposed to design the assemblies of acoustic scattering elements satisfying a user-defined downstream pressure fields. The robustness of the proposed approaches is evaluated with numerical simulations.