Data Driven Approximation of Topological Insulators

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Abstract

The field of Topological Insulators (T.I.s) study the propagation of electromagnetic waves through waveguide arrays. The interaction between waveguides (arranged in one dimension) can be modeled by a coupled set of differential equations with constant interaction coefficients that describe the interaction of waveguides with neighboring waveguides by a reduced order model of the Schrodinger wave equation using Bloch theory known as the Su-Schrieffer-Heeger (SSH) model. Using the SSH model, we seek to create a program that is useful to researchers studying the one dimensional T.I.s that can reproduce physical and topological properties of the system by applying the Gauss-Newton method for nonlinear regression. The SSH model has an issue of two orientations with similar interaction coefficients that have different topological properties. One orientation will allow the propagation of waves along the boundary of the waveguide array, whereas the other orientation will not allow propagation along the edges. We seek to produce best fit interaction coefficients and topological properties based on a given potential, an initial guess, and a specified number of interaction coefficients.