# Edge states in the discrete slowly-varying SSH model

**Xuenan Li**, Michael I. Weinstein

*Department of Applied Physics and Applied Mathematics, Columbia University*

*xl3383@columbia.edu*

The Su-Schrieffer-Heeger (SSH) model has long served as a cornerstone in the study of topological phases of matter, offering profound insights into the emergence of edge states and their robustness against perturbations. The standard SSH model exhibits well-known topological properties: a Dirac point exists in the band structure when the inter-cell and intra-cell hopping coefficients are the same. Building on this foundation, we explore how deforming the SSH model—such as by modifying its hopping coefficients—opens the door to richer and more nuanced phenomena. In this work, we investigate deformations of the SSH model by slowly varying its inter-cell hopping parameters and uncover the precise conditions that give rise to edge states. The existence of these edge states can be quantitatively analyzed using an effective Dirac operator. For each edge state, we derive a leading-order approximation and rigorously establish its convergence rate with respect to a small parameter that characterizes the slowness of the variation in deformation. Our method of deriving the effective Dirac operator is general and can be applied to other discrete models. This is a joint work with Michael I. Weinstein.