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Internal modes of discrete solitons near the anti-continuum limit of the dNLS equation

Discrete solitons of the discrete nonlinear Schrödinger (dNLS) equation become compactly supported in the anti-continuum limit of the zero coupling between lattice sites. Eigenvalues of the linearization of the dNLS equation at the discrete soliton determine its spectral and linearized stability. All unstable eigenvalues of the discrete solitons near the anti-continuum limit were characterized earlier for this model. Here we analyze the resolvent operator and prove that it is uniformly bounded in the neighborhood of the continuous spectrum if the discrete soliton is simply connected in the anti-continuum limit. This result rules out existence of internal modes (neutrally stable eigenvalues of the discrete spectrum) of such discrete solitons near the anti-continuum limit.