Existence and Stability of Solitons in DNLS with Saturable Nonlinearity

<u>V.M. Rothos</u>*

School of Mathematics, Physics and Computational Sciences, Faculty of
Engineering,Aristotle University of Thessaloniki, Thessaloniki 54124 Greece
* Electronic Address: `rothos@gen.auth.gr`

In the first part, we investigate the existence of periodic and decaying solutions in DNLS with saturable nonlinearity. Using the method of calculus of variations and Nehari manifolds we prove the existence of these two type solutions. Next, we consider the discrete solitons bifurcating from the anti-continuum limit of the discrete nonlinear Schrodinger (NLS) lattice with saturable nonlinearity. The discrete soliton in the anti-continuum limit represents an arbitrary finite superposition of in-phase or anti-phase excited nodes, separated by an arbitrary sequence of empty nodes. By using stability analysis, we prove that the discrete solitons are all unstable near the anti-continuum limit, except for the solitons, which consist of alternating anti-phase excited nodes. Also, we study effects of nonlinearity saturation on existence and stability of discrete cavity solitons. Unlike in the previously studied case of Kerr nonlinearity some of the solitons exist in the regime where the linear cavity detuning is not compensated by the nonlinearity detuning. Surprisingly enough these solutions even persist into the conservative "zero-dissipation" limit.

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