Binary plasmonic waveguide arrays: energy localizarion, modulational instability and gap solitons

Aldo Auditore, Matteo Conforti, Costantino De Angelis
Dipartimento di Ingegneria dell'Informazione, Universit degli Studi di Brescia, Brescia 25123, Italy

Triantaphyllos R. Akylas
Department of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139, U. S. A.

Alejandro B. Aceves
Department of Mathematics, Southern Methodist University, Dallas, Texas 75275, U. S. A.

Abstract:

We first obtain solitary-wave solutions of a model describing light propagation in binary (linearly and nonlinearly) waveguide arrays. This model describes energy localization and transport in various physical settings, ranging from metal-dielectric (i.e., plasmonic) to photonic crystal waveguides. The solitons exist for focusing, defocusing, and even for alternating focusing-defocusing nonlinearity. We also consider a model consisting of two subsystems coupled exclusively by nonlinear terms. We show the existence of bright-dark gap solitons of both the discrete system and its continuous long wavelength limit, in spite of the absence of a gap in the linear (i.e. plane wave) spectrum. We find that these solitons are always modulationally unstable in the continuous limit, whereas they can be stable in the discrete system if the amplitude of the background component exceeds a certain threshold.