Wave dynamics in optically modulated waveguide arrays

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A new model describing wave propagation in optically modulated waveguide arrays is proposed. In the weakly guided regime, a two-dimensional semi-discrete nonlinear Schrödinger equation with the addition of bulk diffraction term and an external optical trap is derived from first principles, i.e., Maxwell equations. When the nonlinearity is of the defocusing type, a family of unstaggered localized modes are numerically constructed. It is shown that the equation with an induced potential is well-posed and gives rise to localized dynamically stable nonlinear modes. The derived model is of the Gross-Pitaevskii type, a nonlinear Schrödinger equation with a linear optical potential, which also models Bose-Einstein condensates in a magnetic trap.