Collision-induced Amplitude Shifts in Fast Two-Pulse Collisions in Weakly Perturbed Linear Systems of Coupled-PDEs

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Abstract: We present that the pulses of weakly perturbed linear systems of coupled-PDEs exhibit soliton-like behavior in fast collisions. The behavior is demonstrated for linear waveguides with weak nolinear loss and for systems described by linear diffusion-advection models with weak quadratic loss. We show that in both systems, the expressions for the collision-induced amplitude shifts due to the nonlinear loss have the same form as the expression for the amplitude shift in a fast collision between two solitons of the nonlinear Schrödinger equation in the presence of weak nonlinear loss. Our analytic predictions are confirmed by numerical simulations with the corresponding weakly perturbed linear systems of coupled-PDEs. Our work shows that conclusions drawn from analysis of fast two-soliton collisions in the presence of dissipation can be applied for understanding the dynamics of fast two-pulse collisions in a large class of weakly perturbed linear systems of coupled-PDEs, even though the pulses in the linear systems are not shape preserving.

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