EXACT NONLINEAR SOLUTIONS OF THE SASA–SATSUMA EQUATION

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Abstract

We are now in a position to interpret a wide range of physical phenomena—both real and hypothetical—as approximations arising from soliton theory. By focusing on soliton solutions, we extend these methods to nonlinear equations of the nonlinear Schrödinger (NLS) type. Solitons play a crucial role in diverse fields such as hydrodynamics, quantum gases, optical fiber communications, and plasma physics, owing to their stable, localized wave patterns. To derive exact solutions, we employ the Darboux transformation together with a Lax pair, ensuring the integrability condition is satisfied. Starting from a simple seed solution, we recover soliton-like structures analytically. By modifying the seed, we obtain qualitatively different solutions, namely breather modes.