Second International Conference "Mathematics Days in Sofia"
July 10–14, 2017, Sofia, Bulgaria

Numerical Simulation of 2D Sine-Gordon Waves

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Keywords: system of 2D Sine-Gordon equations, finite difference method, fast Fourier transform, standing wave solutions, cavity and background oscillations

Systems of perturbed 2D Sine-Gordon equations

$$S(\varphi_{tt} + \alpha\varphi_t + \sin\varphi - \gamma) = \Delta\varphi, \ \ (x, y) \in \Omega \subset R^2,$$

under Neumann boundary conditions and appropriate initial conditions are investigated. Ω is a given rectangular domain in R^2 and S is a cyclic tridiagonal matrix. Such problems are well known to be very good models for the phase dynamics in inductively coupled intrinsic Josephson junctions [2].

Reliable and efficient second order finite difference schemes are worked out to solve the problems numerically. New type of standing wave solutions, which consist of two parts: static part and oscillating one, are found. Fast Fourier transform analysis shows that the oscillating part is a sum of cavity (linear) and background (nonlinear) oscillation. This new result is in contrast to the results in some previous works (see the review [1]), where the entire nonlinearity is put in the static part of the solution and the analytical computations are made under this assumption.

Acknowledgements. This work is partially supported by the National Science Fund of BMSE under Grant DFNI-I02/9 and Grant DFNI-I02/8. The work of the second author is supported also by Sofia University Grant 80.10-11/2017.

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