The Kinks, the Solitons, and the Shocks in Series Connected Discrete Josephson Transmission Lines

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Abstract : We analytically study the localized running waves in the discrete Josephson transmission lines (JTL), constructed from Josephson junctions (JJ) and capacitors. The quasi-continuum approximation reduces the calculation of the running wave properties to the problem of equilibrium of an elastic rod in the potential field. Making additional approximations, we reduce the problem to the motion of the fictitious Newtonian particle in the potential well. We show that there exist running waves in the form of supersonic kinks and solitons and calculate their velocities and profiles. We show that the nonstationary smooth waves, which are small perturbations on the homogeneous non-zero background, are described by Korteweg-de Vries equation, and those on zero background -by the modified Korteweg-de Vries equation. We also study the effect of dissipation on the running waves in JTL and find that in the presence of the resistors, shunting the JJ and/or in series with the ground capacitors, the only possible stationary running waves are the shock waves, whose profiles are also found.

Keywords : Josephson transmission line, shocks, solitary waves, nonlinear waves
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