

Separation of Variables for Nonlinear Wave Equation in Polar Coordinates

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Some classical types of nonlinear wave motion in the polar coordinates are studied within quadratic approximation. When the nonlinear quadratic terms in the wave equation are arbitrary, the usual perturbation techniques used in the polar coordinates leads to overdetermined systems of linear algebraic equations for the unknown coefficients. However, we show that these overdetermined systems are compatible for the special case of the nonlinear shallow water equation and express explicitly the coefficients of the first two harmonics as polynomials of the Bessel functions of radius and of the trigonometric functions of angle. It gives a series of solutions to the nonlinear shallow water equation that are periodic in time and found with the same accuracy as the equation is derived.