

## Separation of Variables for Nonlinear Wave Equation in Cylinder Coordinates

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### **Abstract**

Some classical types of nonlinear wave motion in the cylinder coordinates are studied within quadratic approximation. When the cylinder coordinates are used, the usual perturbation techniques inevitably leads to over determined systems of linear algebraic equations for the unknown coefficients (in contrast with the Cartesian coordinates). However, we show that these over determined systems are compatible for the special case of the nonlinear acoustical wave 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 acoustical wave equation which are found with the same accuracy as the equation is derived.

**Keywords:** Bessel functions, cylinder coordinates, nonlinear waves, Helmholtz equation.