



Systems of Ordinary Differential Equations > Nonlinear Systems of Three and More Equations

9. $x''_{tt} = xF$, $y''_{tt} = yF$, $z''_{tt} = zF$, where $F = F(x, y, z, t, x'_t, y'_t, z'_t)$.

First integrals (laws of conservation of areas):

$$zy'_t - yz'_t = C_1,$$

$$xz'_t - zx'_t = C_2,$$

$$yx'_t - xy'_t = C_3,$$

where C_1 , C_2 , and C_3 are arbitrary constants.

Corollary of the conservation laws:

$$C_1x + C_2y + C_3z = 0.$$

Consequently, all integral lines are plane curves.

Remark. The function Φ may also depend on the second- and higher-order derivatives with respect to t .