

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

10.
$$x_{tt}'' = F_1$$
, $y_{tt}'' = F_2$, $z_{tt}'' = F_3$, where $F_n = F_n(t, tx_t' - x, ty_t' - y, tz_t' - z)$.

1°. The transformation

$$u = tx_t - x, \quad v = ty'_t - y, \quad w = tz'_t - z$$
 (1)

leads to the system of first-order equations

$$u'_t = tF_1(t, u, v, w), \quad v'_t = tF_2(t, u, v, w), \quad w'_t = tF_3(t, u, v, w).$$
 (2)

2°. Suppose a solution to system (2),

$$u(t) = u(t, C_1, C_2, C_3), \quad v(t) = v(t, C_1, C_2, C_3), \quad w(t) = w(t, C_1, C_2, C_3),$$
 (3)

where C_1 , C_2 , and C_3 are arbitrary constants, is known. Then, on substituting (3) into (1) and on integrating the resulting relation, one arrives at a solution of the original system in the form

$$x = C_4 t + t \int \frac{u(t)}{t^2} dt$$
, $y = C_5 t + t \int \frac{v(t)}{t^2} dt$, $z = C_6 t + t \int \frac{w(t)}{t^2} dt$,

where C_4 , C_5 , and C_6 are arbitrary constants.

• Reference: A. D. Polyanin, EqWorld, 2004 (Private communication, received 23 April 2004).

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http://eqworld.ipmnet.ru/en/solutions/sysode/sode0410.pdf