

Systems of Ordinary Differential Equations > Linear Systems of Two Equations

14.
$$x_{tt}'' = f(t)(a_1x_t' + b_1y_t'), \quad y_{tt}'' = f(t)(a_2x_t' + b_2y_t').$$

Let k_1 and k_2 are roots of the quadratic equation

$$k^2 - (a_1 + b_2)k + a_1b_2 - a_2b_1 = 0.$$

Then the system in question can be reduced, by adding together the two equations multiplied by appropriate constants, to the following two independent equations:

$$z_1'' = k_1 f(t) z_1', \quad z_1 = a_2 x + (k_1 - a_1) y;$$

 $z_2'' = k_2 f(t) z_2', \quad z_2 = a_2 x + (k_2 - a_1) y.$

Integrating these and returning to the original variables, one arrives at a linear algebraic system for the unknowns x and y:

$$a_2x + (k_1 - a_1)y = C_1 \int \exp[k_1 F(t)] dt + C_2,$$

$$a_2x + (k_2 - a_1)y = C_3 \int \exp[k_2 F(t)] dt + C_4,$$

where C_1, \ldots, C_4 are arbitrary constants and $F(t) = \int f(t) dt$.

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