

Solving by Elimination

Exercise. Use the method of elimination to solve the following system.

$$\begin{aligned}\dot{x} &= x + 3y \\ \dot{y} &= x - y.\end{aligned}$$

Answer.

Step 1. Let us eliminate x by solving the second equation for x . We get

$$x = y + \dot{y} \tag{1}$$

Replacing x everywhere by $y + \dot{y}$ in the first equation gives

$$\ddot{y} - 4y = 0. \tag{2}$$

Step 2. The characteristic equation for (2) is $(r - 2)(r + 2) = 0$, so the general solution for y is

$$y = c_1 e^{2t} + c_2 e^{-2t}.$$

Step 3. From the solution for y and equation (1), that was originally used to eliminate x , we get $x = 3c_1 e^{2t} - c_2 e^{-2t}$.

Step 4. The solution to the system is thus

$$\begin{aligned}x &= 3c_1 e^{2t} - c_2 e^{-2t} \\ y &= c_1 e^{2t} + c_2 e^{-2t}.\end{aligned}$$

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