

A normal form of your dynamical system

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Generally, the lowest order, most important, terms are near the end of each expression.

off echo;

Specified dynamical system

$$\dot{x}_1 = \varepsilon x_1 y_1$$

$$\dot{y}_1 = \sigma w_1 - y_1$$

off echo;

Time dependent normal form coordinates

$$y_1 = \sigma e^{-1t} \star w_1 + O(\varepsilon^4, \sigma^2) + Y_1$$

$$x_1 = -1/2\sigma\varepsilon^3 e^{-1t} \star w_1 X_1 Y_1^2 + \sigma\varepsilon^2 e^{-1t} \star w_1 X_1 Y_1 - \sigma\varepsilon e^{-1t} \star w_1 X_1 - 1/6\varepsilon^3 X_1 Y_1^3 + 1/2\varepsilon^2 X_1 Y_1^2 - \varepsilon X_1 Y_1 + O(\varepsilon^4, \sigma^2) + X_1$$

Result normal form DEs

$$\dot{Y}_1 = O(\varepsilon^5, \sigma^3) - Y_1$$

$$\dot{X}_1 = \sigma \varepsilon w_1 X_1 + O(\varepsilon^5, \sigma^3)$$