

A slow manifold of your dynamical system

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

Specified dynamical system

$$\dot{u}_1 = c^{-1}\sigma w_1 + c^{-1}\varepsilon^4 u_2^3 u_1^2 \gamma + c^{-1}\varepsilon^2(-u_2^3 \gamma + u_2^3) - c^{-1}\varepsilon u_1^2$$

$$\dot{u}_2 = -u_2 + c^{-1}\sigma w_2 - c^{-1}\varepsilon u_2 u_1 + c^{-1}u_1$$

off echo;

Time dependent slow manifold parametrisation

$$u_1 = s_1 + O(\varepsilon^2, \sigma^2)$$

$$u_2 = c^{-1}s_1 - c^{-2}s_1\sigma\varepsilon e^{-1t\star}(e^{-1t\star}(w_2)) + c^{-3}s_1\sigma\varepsilon e^{-1t\star}(e^{-1t\star}(w_1)) + O(\varepsilon^2, \sigma^2) + c^{-1}\sigma e^{-1t\star}(w_2) - c^{-2}\sigma e^{-1t\star}(w_1)$$

Result slow manifold DEs

$$\begin{aligned} \dot{s}_1 = & c^{-4}s_1^3\varepsilon^2(-\gamma+1)-c^{-1}s_1^2\varepsilon+c^{-4}s_1^2\sigma\varepsilon^2(-3w_2\gamma+3w_2)+c^{-5}s_1^2\sigma\varepsilon^2(3w_1\gamma- \\ & 3w_1)+c^{-4}s_1\sigma^2\varepsilon^2(-3e^{-1t\star}(w_2)w_2\gamma+3e^{-1t\star}(w_2)w_2)+c^{-5}s_1\sigma^2\varepsilon^2(- \\ & 3e^{-1t\star}(w_2)w_1\gamma+3e^{-1t\star}(w_2)w_1+3e^{-1t\star}(w_1)w_2\gamma-3e^{-1t\star}(w_1)w_2)+ \\ & c^{-6}s_1\sigma^2\varepsilon^2(3e^{-1t\star}(w_1)w_1\gamma-3e^{-1t\star}(w_1)w_1)+O(\varepsilon^3, \sigma^3)+c^{-1}\sigma w_1 \end{aligned}$$