Invariant manifold of your dynamical system

A. J. Roberts, University of Adelaide
http://orcid.org/0000-0001-8930-1552

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Throughout and generally: the lowest order, most important, terms are near the end of each expression.

The specified dynamical system

$\dot{u}_1 = u_2$

$\dot{u}_2 = -\varepsilon u_1 u_3 - u_1$

$\dot{u}_3 = 5\varepsilon u_1^2 - u_3$

Invariant subspace basis vectors

$\vec{e}_1 = \{\{1, i, 0\}, e^{ti}\}$

$\vec{e}_2 = \{\{1, -i, 0\}, e^{-ti}\}$

$\vec{z}_1 = \{\{1/2, 1/2i, 0\}, e^{ti}\}$

$\vec{z}_2 = \{\{1/2, -1/2i, 0\}, e^{-ti}\}$

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The invariant manifold These give the location of the invariant manifold in terms of parameters s_j.

$u_1 = e^{-ti} s_2 + e^{ti} s_1$

$u_2 = - e^{-ti} s_2 i + e^{ti} s_1 i$

$u_3 = e^{-2ti} s_2^2 \varepsilon(2i + 1) + e^{2ti} s_1^2 \varepsilon(- 2i + 1) + 10 s_2 s_1 \varepsilon$

Invariant manifold ODEs The system evolves on the invariant manifold such that the parameters evolve according to these ODEs.

$\dot{s}_1 = s_2 s_1^2 \varepsilon^2 (11/2i + 1)$

$\dot{s}_2 = s_2^2 s_1 \varepsilon^2 (- 11/2i + 1)$