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First-order perturbation for multi-parameter center families

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Abstract

In the weak 16th Hilbert problem, the Poincaré-Pontryagin-Melnikov function, $M_1(h)$, is used for obtaining isolated periodic orbits bifurcating from centers up to a first-order analysis. This problem becomes more difficult when a family of centers is considered. In this work we provide a compact expression for the first-order Taylor series of the function $M_1(h, a)$ with respect to a, being a the multi-parameter in the unperturbed center family. More concretely, when the center family has an explicit first integral or inverse integrating factor depending on a. We use this new bifurcation mechanism to increase the number of limit cycles appearing up to a first-order analysis without the difficulties that higher-order studies present. We show its effectiveness by applying it to some classical examples.

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