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Periodic orbits for perturbed non-autonomous differential equations ☆

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Abstract

We consider non-autonomous differential equations, on the cylinder $(t, r) \in \mathcal{S}^1 \times \mathbb{R}^d$, given by $dr/dt = f(t, r, \varepsilon)$ and having an open continuum of periodic solutions when $\varepsilon = 0$. From the study of the variational equations of low order we obtain successive functions such that the simple zeroes of the first one that is not identically zero control the periodic orbits that persist for the unperturbed equation. We apply these results to several families of differential equations with $d = 1, 2, 3$. They include some autonomous polynomial differential equations and some Abel type non-autonomous differential equations.

MSC: 34C23; 34C25; 37C27

Keywords: Bifurcation; Periodic orbit; Limit cycle; Variational equation

1. Introduction and main results

Consider the non-autonomous differential equation

$$\frac{dr}{dt} = f_0(t, r), \quad t \in [0, T], \ r \in \mathbb{R}^d, \tag{1}$$

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