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NEW RESULTS OF PERIODIC SOLUTIONS FOR RAYLEIGH EQUATION WITH TWO DEVIATING ARGUMENTS

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Abstract. In this work, we study the following Rayleigh equation with two deviating arguments:

$$x''(t) + f(t, x'(t)) + g_1(t, x(t - \tau_1(t))) + g_2(t, x(t - \tau_2(t))) = e(t).$$

Some criteria to guarantee the existence and uniqueness of periodic solutions of this equation is given by using Mawhin's continuation theorem and some new techniques. Our results are new and complement some known results.

Keywords. Periodic solution; Existence and uniqueness; Deviating argument; Rayleigh equation.

AMS (MOS) subject classification: 34B15; 34K13.

1 Introduction

In this present paper, we investigate the existence and uniqueness of the periodic solutions of the following Rayleigh equation with two deviating arguments

$$x''(t) + f(t, x'(t)) + g_1(t, x(t - \tau_1(t))) + g_2(t, x(t - \tau_2(t))) = e(t), \qquad (1.1)$$

where $\tau_1, \tau_2 \in C(\mathbb{R}, \mathbb{R})$; $f, g_1, g_2 \in C(\mathbb{R}^2, \mathbb{R})$; $\tau_1(t)$, $\tau_2(t)$, $f(t, x)$, $g_1(t, x)$, $g_2(t, x)$ are T-periodic functions with respect to t, $T > 0$; $f(t, 0) = 0$ for all $t \in \mathbb{R}$; $e \in C(\mathbb{R}, \mathbb{R})$, and $e(t)$ is a T-periodic function.

As it is well known, the Rayleigh equation can be derived from many fields, such as physics, mechanics and engineering technique fields, and an important question is whether this equation can support periodic solutions. During the past several years, many authors have contributed to the theory of this equation with respect to existence of periodic solutions. For example, in 1977, Gaines and Mawhin [2] introduced some continuation theorems and applied them to discussing the existence of solutions of differential equations. In particular, a specific example is provided in [2, p. 99] on how T-periodic

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