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## PERIODIC SOLUTIONS OF DELAY DIFFERENTIAL EQUATIONS WITH TWO DELAY VIA BI-HAMILTONIAN SYSTEMS \*†

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## Abstract

Using the theory of existence of periodic solutions of a bi-Hamiltonian system and the method of symmetry groups, the existence of periodic solutions for some two-delay differential equation is obtained. Some new sufficient conditions are given

Keywords periodic solution, delay equation, bi-Hamiltonian system, symmetry group action

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## 1 Introduction and Statement of the Main Result

In this paper, we shall study the existence of periodic solutions for the two following differential delay equations

$$x'(t) = -f(x(t-r_1))g(x(t-r_2)) - f(x(t-r_2))g(x(t-r_1)),$$
(1)

and

$$x'(t) = f(x(t-r_1))g(x(t-r_2)) + f(x(t-r_2))g(x(t-r_1)),$$
 (2)

where  $r_i$  (i = 1, 2) are positive constants. When the function  $g(x) \equiv 1$ , equations (1) and (2) become respectively

$$x'(t) = -f(x(t-r_1)) - f(x(t-r_2)), \tag{3}$$

and

$$x'(t) = f(x(t - r_1)) + f(x(t - r_2)). \tag{4}$$

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