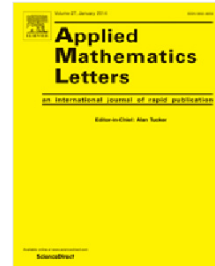


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# Infinitely many periodic solutions for a class of new superquadratic second-order Hamiltonian systems\*

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## Abstract

In this paper, we establish the existence of infinitely many periodic solutions for a class of new superquadratic second-order Hamiltonian systems. Our technique is based on the Fountain Theorem due to Bartsch.

**Key words:** Periodic solutions; Second-order Hamiltonian systems; Fountain Theorem

## 1 Introduction and main results

We consider the existence of infinitely many periodic solutions for the following second-order Hamiltonian systems

$$\begin{cases} \ddot{u}(t) + B(t)u(t) + \nabla F(t, u(t)) = 0, & a.e. t \in [0, T], \\ u(0) - u(T) = \dot{u}(0) - \dot{u}(T) = 0, \end{cases} \quad (1)$$

where  $T > 0$ ,  $B(t)$  is an  $N \times N$  symmetric matrix, continuous and  $T$ -periodic in  $t$ .  $F : [0, T] \times \mathbb{R}^N \rightarrow \mathbb{R}$  is  $T$ -periodic in  $t$  for all  $x \in \mathbb{R}^N$  and satisfies the following assumption:

(A)  $F(t, x)$  is measurable in  $t$  for each  $x \in \mathbb{R}^N$  and continuously differential in  $x$  for  $a.e. t \in [0, T]$  and there exist  $a \in C(\mathbb{R}^+, \mathbb{R}^+)$ ,  $b \in L^1(0, T; \mathbb{R}^+)$  such that

$$|F(t, x)| \leq a(|x|)b(t), \quad |\nabla F(t, x)| \leq a(|x|)b(t)$$

for all  $x \in \mathbb{R}^N$  and  $a.e. t \in [0, T]$ , where  $\nabla F(t, x)$  denotes the gradient of  $F(t, x)$  in  $x$ .

In 1978, Rabinowitz [11] published his pioneer paper for the existence of periodic solutions for problem (1) under the following Ambrosetti-Rabinowitz superquadratic condition: there exist  $\mu > 2$  and  $L^* > 0$  such that

$$0 < \mu F(t, x) \leq (\nabla F(t, x), x), \quad \forall |x| \geq L^*, \quad a.e. t \in [0, T]. \quad (2)$$

From then on, various conditions have been applied to study the the existence and multiplicity of periodic solutions for Hamiltonian systems by using the critical point theory, see [2, 5–17, 19] and references therein.

Over the last few decades, many researchers have successfully replaced the Ambrosetti-Rabinowitz superquadratic condition (2) by other superquadratic conditions. Especially, when  $B(t) \equiv 0$ , Fei [6] studied the existence of periodic solutions for problem (1) under a class of new superquadratic condition: there is  $\tau > 1$  such that

$$\liminf_{|x| \rightarrow \infty} \frac{(\nabla F(t, x), x) - 2F(t, x)}{|x|^\tau} > 0 \quad \text{uniformly for } a.e. t \in [0, T]. \quad (3)$$

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