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Periodic and Subharmonic Solutions for a Class of Noncoercive Superquadratic Hamiltonian Systems

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Abstract: Some existence theorems are obtained for periodic and subharmonic solutions to noncoercive first order Hamiltonian systems and to similar second order Hamiltonian systems, when the Hamiltonian satisfies a superquadratic condition and need not satisfy the global Ambrosetti–Rabinowitz condition. For the resolution, we use minimax methods in critical point theory, especially a Local Linking Theorem and a Generalized Mountain Pass Theorem.

Keywords: *Hamiltonian systems; periodic solutions; subharmonics; critical points.*

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1 Introduction

Consider the nonautonomous first order Hamiltonian systems

$$J\dot{x} - u^*A(t)u(x) + u^*G'(t, u(x)) = 0, \tag{1.1}$$

where $u : \mathbb{R}^{2N} \longrightarrow \mathbb{R}^m$ $(1 \leq m \leq 2N)$ is a linear operator, A is a continuous $T-$periodic function $(T > 0)$ from $\mathbb{R}$ into the space of symmetric $(m\times m)$-matrices, $G : \mathbb{R}\times\mathbb{R}^m \longrightarrow \mathbb{R}$ is a continuous function, $T-$ periodic in the first variable, differentiable with respect to the second variable and its derivative $G'(t, x) = \frac{\partial G}{\partial x}(t, x)$ is continuous, and J is the standard symplectic matrix:

$$J = \begin{pmatrix} 0 & -I \\ I & 0 \end{pmatrix}.$$

When $A(t) = 0$ for all $t \in \mathbb{R}$, $m = 2N$ and $u = id_{\mathbb{R}^{2N}}$, Rabinowitz has proved in [7] the existence of periodic solutions for (1.1) under some suitable conditions, in particular the following superquadratic condition:

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