Differential and Integral Equations Volume 15, Number 1, January 2002, Pages 17–32

PERIODIC SOLUTIONS OF SOME DIFFERENTIAL EQUATIONS WITH NONLINEAR DAMPING

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Introduction

The scientific legacy of Isaac Newton is remembered mainly for the discovery of infinitesimal calculus, at the same time of Leibniz, and gravitational theory, which explains completely the motion of the planets. After the revolution made by Newton's laws in the knowledge of the universe, the interest of the scientific community was centered mainly on conservative systems, due to the influence of celestial mechanics. However, Newton studied also the motion in resisting media, in which the energy is not constant, and the second book of his famous "Philosophiae Naturalis Principia Mathematica," written in 1682, is devoted to this class of problems. After that, nonconservative systems appeared in a wide variety of applications. Some particular cases of these systems are the ordinary second-order differential equations with a nonlinearity depending on the derivative of the solution; in the present century, many authors have focused their interest on this type of equation; see for instance the classical papers [7], [13] and [25].

In the recent paper [2], Cañada and Drábek have considered a class of equations where the nonlinearity depends only on the derivative,

$$x''(t) + f(x'(t)) = p(t), \qquad t \in [0, T],$$

with some boundary conditions (Dirichlet, Neumann or periodic). In the proofs, shooting and alternative methods are employed. Afterwards, Mawhin [18] improved and extended these results in many directions, by using fixed-point theory.

A nonlinearity depending on the derivative of the solution can be regarded as a nonlinear damping term, and it arises in a wide variety of applications,

[1]Supported by D.G.E.S. PB95-1203, M.E.C., Spain.
Accepted for publication: October 1997.
AMS Subject Classifications: 34C25.