ROCKY MOUNTAIN
JOURNAL OF MATHEMATICS
Volume 27, Number 2, Spring 1997

p-LAPLACIAN AND LIENARD-TYPE EQUATION

RAÚL MANÁSEVICH AND STANISŁAW SĘDZIWY

ABSTRACT. It is shown that the generalized Liénard-type equation

$$(|u'|^{p-2}u')' + \mu f(u)|u'|^{p-2}u' + g(u) = 0$$

where $p > 1$ and μ is a small parameter has exactly one limit cycle.

1. Introduction. We will consider here a generalized Liénard-type equation of the form

$$(\phi_p(u'))' + \mu f(u)\phi_p(u') + g(u) = 0, \tag{1.1}$$

where $p > 1$ and $\mu > 0$ is a small parameter. The functions $f, g : \mathbf{R} \to \mathbf{R}$ are continuous.

The quasilinear operator

$$((\phi_p(u'))' := \frac{d}{dt}\left[\left|\frac{du}{dt}\right|^{p-2}\frac{du}{dt}\right],$$

called the one-dimensional p-Laplacian, has been dealt with in several papers, see [**4, 5, 3, 2**]. For $p = 2$ equation (1.1) reduces to the classical Liénard equation.

In this paper we are concerned with existence and uniqueness of a limit cycle for (1.1). Our method is based on an old, seldom cited, result due to Pontryagin concerning the existence of limit cycles for perturbed Hamiltonian systems. This approach has been recently used by Sędziwy in [**7**] to obtain a proof, different from the one based on

Received by the editors on November 10, 1991.
Key words and phrases. p-Laplacian, Liénard equation, limit cycle, perturbed Hamiltonian systems.
AMS *Subject Classifications.* 34C05, 34A08, 34E10.
This research was sponsored by FONDECYT, research grant 1209-91 and was performed when both authors were visiting the Universitá di Udine, Italy.