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INFINITELY MANY CONSTANT-SIGN SOLUTIONS FOR A DISCRETE PARAMETER-DEPENDING NEUMANN PROBLEM

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Abstract. The existence of infinitely many constant-sign solutions for a nonlinear parameter depending Neumann boundary value problem involving a discrete p-Laplacian operator is investigated. Our approach is fully based on the critical point theory for functionals defined on a finite dimensional Banach space.

Keywords. Discrete nonlinear Neumann boundary value problems, p-Laplacian, infinitely many solutions, constant-sign solutions, critical points theory.

AMS (MOS) subject classification: 39A10, 34B15.

1 Introduction

In this paper we consider the following nonlinear discrete Neumann boundary value problem

$$\begin{cases} -\Delta(\phi_p(\Delta u(k-1)) + q(k)\phi_p(u(k)) = \lambda f_k(u(k)), & k \in [1,N], \\ \Delta u(0) = \Delta u(N) = 0, \end{cases} \qquad (N_\lambda^f)$$

where N is a positive integer number, $[1,N]$ denotes the discrete interval $\{1,...,N\}$, $\phi_p(s) := |s|^{p-2}s$, $p \in [1, +\infty[$, λ is a positive parameter, for each $k \in [1,N]$, $q(k) > 0$, $\Delta u(k-1) := u(k) - u(k-1)$ indicates the forward difference operator and $f_k : \mathbb{R} \to \mathbb{R}$ is a continuous function.

In these last years, discrete nonlinear problems involving both different boundary value conditions and various nonlinear difference operators have been investigated through classical tools of nonlinear analysis: fixed point theorem [4, 24], upper and lower solutions [6, 26, 27], Brouwer fixed point theorem [7], variational methods [2, 3, 5, 8, 9, 22, 23].

Recently, the existence and the multiplicity of solutions for discrete parameter depending Dirichlet or Neumann problems have been studied in [10, 14, 18, 20, 21]. Roughly speaking, in such results, by using some critical

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