The rotation number for the nonlinear p-Laplacian with a periodic potential and new results for the eigenvalue problem on a bounded interval

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We analyse the eigenvalue problem

$$-(|u'|^{p-2}u')' + Qu = \lambda|u|^{p-2}u, \qquad p \in (0, +\infty), \quad \lambda \geq 0, \tag{1}$$

with $Q \in L^1_{\text{loc}}(\mathbb{R})$, such that $Q(x + a) = Q(x)$, $a > 0$ for all $x \in \mathbb{R}$.

The notion of a rotation number $\rho = \rho(\lambda)$, $\lambda \geq 0$, has been used to study the problem (1) in the linear case, $p = 2$, and it is well known that the spectrum of (1) on $\mathbb{R}$ coincides with the union of the intervals where ρ takes the constant values $n\pi/a$, $n \in \mathbb{N}$.

Using a suitable version of the function ρ adapted to the equation (1), we show that in the case $p \neq 2$ there are additional intervals of λ that can be interpreted as elements of the spectrum of (1).

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