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Existence of space periodic solutions for semi-linear hyperbolic systems

The paper aims to develop a new methodology for investigations of a certain type of superlinearities for semilinear hyperbolic systems with two point in time and periodic conditions for space variables. It is well known that topological as well variational methods strongly use structural form of nonlinearities occurring in differential equations. Dual variational methods which we develope also essentially use the form of nonlinearity in the equation which we study together with the linear part of it. The equation we are interested in is:

$$\begin{aligned}
&x_{tt}(t,y) - \Delta x(t,y) + g(t,y,x(t,y)) = 0 \quad \text{for } y \in \mathbf{R}^n,\ t \in [0,T],\\
&\qquad x(0,y) = 0,\ x_t(T,y) = 0, \quad \text{for } y \in \mathbf{R}^n,\\
&\qquad x(t,y+P) = x(t,y) \quad \text{for} \quad t \in [0,T] \quad \text{and} \quad y \in \mathbf{R}^n,
\end{aligned}$$

where $P = (P_1, \ldots, P_n)$ is a given vector. By using a new variational method the existence results are derived.