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On the solutions of multivalued problems governed by vector differential inclusions

In this work we consider second order vector differential inclusions with periodic boundary conditions and a general multivalued term. So let $T = [0, b]$. The multivalued boundary value problem under consideration is the following:

$$\left\{ \begin{array}{c} x''(t) \in F\big(t, x(t), x'(t)\big) \text{ a.e. on } T \\ x(0) = x(b),\ x'(0) = x'(b) \end{array} \right\} \tag{1}$$

Second order differential inclusions have been studied recently primarily with Dirichlet boundary conditions and with a multivalued term which is compact, convex valued and satisfies a growth condition. There have been some works where the convexity hypothesis on the values of the multifunction has been dropped and/or the Dirichlet boundary condition has been replaced by a more general nonlinear one. This development of the research on second order multivalued boundary value problems, can be traced in recent works. In the paper we combine the method of Hu–Papageorgiou with techniques from the theory of nonlinear operators and the multivalued Leray–Schauder principle, to establish the existence of a solution for problem (1) under very general hypotheses on $F(t, x, y)$.