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NEUTRAL FUNCTIONAL FRACTIONAL DIFFERENTIAL INCLUSIONS WITH IMPULSES AT VARIABLE TIMES

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Abstract. In this work, we investigate the existence of solutions for a class of initial value problems of fractional-order impulsive neutral functional differential inclusions with variable moments.

Keywords. Caputo fractional derivative: Existence and uniqueness; Functional differential inclusions; Impulsive differential inclusions; Variable times.

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1 Introduction

This article is concerned with the existence of solutions to the following initial value problem (IVP) of impulsive fractional-order neutral differential inclusions with variable times:

$$\begin{aligned} {}^{C}D^{\alpha}\left[u(t)-g(t,u_t)\right] &\in F(t,u_t),\ a.e.\ t\in J,\ t\neq\tau_k(u(t)), && (1)\\ u(t^{+}) &= I_k(u(t)),\ t=\tau_k(u(t)),\ k=1,2,\ldots,p, && (2)\\ u(t) &= \phi(t),\ t\in[-r,0]\,,\ 0<r<\infty, && (3)\end{aligned}$$

where $0<\alpha\leq 1$, ${}^{C}D^{\alpha}$ is the Caputo fractional derivative, $J=[0,T]$, $F: J\times\mathcal{Z}\to\mathcal{P}(R)$ is compact convex valued multivalued map ($\mathcal{P}(R)$ is the family of all non-empty subsets of R), $\mathcal{Z}=\{\Phi:[-r,0]\to R$ is continuous with the exception of a finite number of points s where $\Phi(s^-)$ and $\Phi(s^+)$ exist with $\Phi(s^-)=\Phi(s)\}$, and $g: J\times\mathcal{Z}\to R$, $I_k: R\to R$ and $\tau_k: R\to R$, $k=1,2,\ldots,p$ are given functions satisfying certain assumptions to be specified later. For any function u defined on $[-r,T]$ and any $t\in J$, we denote by u_t the element of $\mathcal{Z}$ defined by $u_t=u(t+\theta)$, $\theta\in[-r,0]$.

The topic of fractional-order impulsive differential equations and inclusions has recently been addressed by many researchers as this branch of