The Neumann problem for two-term fractional differential equations

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Abstract

We discuss the existence and uniqueness of solutions to two-term fractional differential equations ${}^cD^\alpha u(t) = a(t){}^cD^\beta u(t) + f(t, u(t))$ satisfying the Neumann boundary conditions $u'(0) = 0$, $u'(T) = 0$. Here, $\alpha \in (1, 2)$, $\beta \in (\alpha - 1, \alpha)$, $a \in C(J)$, $f \in C(J \times \mathbb{R})$ and ${}^cD$ denotes the Caputo fractional derivative. Existence results are proved by using the Leray-Schauder degree method. Examples demonstrate our results.