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Investigate a Class of Fractional q-Integro-Differential Equations: Existence and Stability Theorems

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Abstract

In this study, we discuss about the existence and uniqueness of solutions for a class of fractional q-integro-differential $\mathbb{BVP}$s involving both Riemann-Liouville and Caputo fractional q-derivatives, and supplemented with multi-point and nonlocal Riemann-Liouville fractional q-integral and Caputo fractional q-derivative boundary conditions. Our results are based on some known tools of fixed point theory. We also study the Ulam-Hyers stability for the proposed fractional problems. Finally, some illustrative examples are included to verify the validity of our results.

The subject of fractional q-calculus has undergone significant growth with the generalization of innovation $\mathbb{FD}$ operators that handle classical derivatives to discrete and nonlinear complex systems [1, 3, 5]. Inspired and motivated by the recent papers [2, 4], in this work, we introduce a new class of boundary value problems of q-integro-fractional differential equations supplemented with nonlocal Riemann-Liouville fractional q-integral and Caputo fractional q-derivative boundary conditions.

Keywords: Stability, Riemann-Liouville fractional q-integral, Caputo fractional q-derivative, nonlinear analysis, nonlocal boundary conditions.

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