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Generalized Monotone Method for Riemann-Liouville Fractional Reaction Diffusion Equation with Applications

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Abstract: Initially, we have obtained the integral representation for the solution of the linear Riemann-Liouville fractional reaction diffusion equation of order q, where $0 < q < 1$, in terms of Green's function. We have developed a generalized monotone method for the non-linear Riemann-Liouville reaction diffusion equation when the forcing term is the sum of an increasing and decreasing functions. The generalized monotone method yields monotone sequences which converge uniformly and monotonically to coupled minimal and maximal solutions. Under uniqueness assumption, we prove the existence of a unique solution for the non-linear Riemann-Liouville fractional reaction diffusion equation.

Keywords: *Riemann-Liouville fractional derivative; representation form; eigenfunction expansion; Mittag-Leffler function; coupled upper and lower solutions; generalized monotone method.*

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1 Introduction

Computation of explicit solutions of non-linear dynamic equation is rarely possible. It is more so with non-linear fractional dynamic equations with initial and boundary conditions. In general, the existence and uniqueness of solution of the fractional dynamic equation has been established mostly, using some kind of fixed point approach. See [1, 3, 7–9, 15–17, 28, 29, 31, 32] and the references therein for the existence, uniqueness and applications of fractional dynamic equations. The drawback of fixed point theorem results for the initial and/or boundary value problem is that they do not guarantee the

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