Recent Advances in Differential Equations and Applications
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Have the classical Riemann-Liouville fractional integrals been fully understood before?

In this presentation, I shall present the new notion of a generalized Riemann-Liouville (R-L) fractional integral and properties including its domain and range. The new notion and properties provide new insight and understanding into the classical R-L fractional integral and its properties. Based on the new generalized R-L fractional integral, when one intends to employ the semigroup property involving the classical R-L fractional integral operator, derivative of a second order fractional R-L fractional integral or a variety of first order fractional integral equations, one should use the generalized R-L fractional integral operator instead of using the classical R-L fractional integral operator. Therefore, some previous well-known results are not precise.

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Evolutionary Stability of Bacterial Persister Cells

We model the switching process of bacteria between antibiotic dormant features and normal active replication using an integro-reaction-diffusion-advection partial differential equation (PDEs). The PDE captures the impacts of epigenetic inheritance of

metabolic state by implementing a non-local term that models a birth jump process. We prove the well-posedness of the non-local PDE model followed by the corresponding stability analysis of the positive steady-state solutions. Of primary interest is an extension of the model to a wider scenario of biological evolution by examining the evolutionarily stable strategies (ESSs) of persister cells. The idea is that genetic mutations will occasionally occur, and these mutations can alter any of the parameters describing the persister cell dynamics. As a first step we prove that, in a finite dimensional version of the model, the ESS strain is one that optimizes resource consumption irrespective of its pattern of dormancy. The next step will be to apply semigroup methods to the infinite dimensional system.

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