Optimal Control and Deep Learning with Fractional Operators

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Abstract

Fractional calculus and its application to anomalous diffusion has recently received a tremendous amount of attention. In complex/heterogeneous material mediums, the long-range correlations or hereditary material properties are presumed to be the cause of such anomalous behavior. Owing to the revival of fractional calculus, these effects are now conveniently modeled by fractional-order differential operators and the governing equations are reformulated accordingly. Similarly, the potential of fractional operators has been harnessed in various scientific domains like geophysical electromagnetics, imaging science, deep learning, etc.

In this talk, fractional operators will be introduced and both linear and nonlinear, fractional-order differential equations will be discussed. New notions of optimal control and optimization under uncertainty will be presented. A special emphasis will be given on enriching Deep Neural Networks using fractional operators. Several applications from geophysics, imaging science, and deep learning will be presented.