

NUMERICAL ANALYSIS AND SCIENTIFIC COMPUTING
SEMINAR

*Applications of Fractional Operators from Optimal Control to
Machine Learning*

Harbir Antil
George Mason University

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. In the first part of the talk, we plan to introduce both linear and nonlinear, fractional-order differential equations. As applications, we will develop new physical models for geophysical electromagnetism and a new notion of optimal control will be discussed. In the second part of the talk, we will focus on novel Deep Neural Networks (DNNs) based on fractional operators. We plan to discuss the approximation properties and apply them to image denoising and tomographic reconstruction problems. We will establish that these DNNs are also excellent surrogates to PDEs and inverse problems with multiple advantages over the traditional methods. If time permits, we will conclude the talk by showing some of our initial results on chemically reacting flows using DNNs which clearly shows the effectiveness of the proposed approach.

Friday, March 19, 2021, 1:30 pm
<https://emory.zoom.us/j/95900585494>

MATHEMATICS
EMORY UNIVERSITY