MICHIGAN STATE UNIVERSITY
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A Workshop on Future Directions in Fractional Calculus Research and Applications

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Complexity Science and Fractional Calculus

Abstract

Almost every scientific discipline has, over the past decade or so, encountered barriers to research that trace their origins to our failure to understand complexity. Such failure can be connected to one or more of the fundamental assumptions made in modeling phenomena, for example, using analytic function theory that solve the differential equations for mechanical force laws. Complexity topics include, but are not limited to, turbulence, control, wave propagation, decision making, multi-scale phenomena, medical imaging, intelligent systems, biomaterials, theory of failure, and more. Procedures developed to overcome complexity-induced barriers in linear systems, which are heterogeneous in space, time or both, invariably involve the fractional calculus. In this overview I shall attempt to outline some of the outstanding science/engineering problems of importance to the Army and where complexity science and the fractional calculus may facilitate their solution.