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**Open Invited Track**

# Advanced Processes of Fractals-Fractional AI-Based Theories, Analyses and Applications

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## Abstract

Fractal which is an intriguing form of an infinitely complicated shape in mathematics owns a pattern of its own with unique properties, repeating in continuum, while providing a unified point of view on diverse trajectories of complexities in the natural world by paving frontiers with multi-layered tessellations. Thus, innumerable natural phenomena manifest peculiar structures on a broad array of scales that are interwoven by pertinent laws of degrees. Fractals, fractal theory and analysis are oriented towards assessing the fractal characteristics of data, several methods being in question to assign fractal dimensions to the datasets. Dynamical processes and systems of fractional order in relation to natural and artificial phenomena, on the other hand, can be modeled by ordinary or partial differential equations with integer order, which can be described fittingly by ordinary and partial differential equations. Within that perspective, fractal analysis provides expansion of knowledge regarding the functions and structures of complex dynamic systems while acting as a potential way for the evaluation of the novel areas of thought-provoking holistic research so that the roughness of objects, their nonlinearity, randomness, and other properties can be captured. Furthermore, the use of artificial intelligence allows the maximization of model accuracy and minimization of functions like computational burden, mathematical-informed frameworks can enable reliable and robust understanding of various complex processes that display numerous heterogeneous temporal and spatial scales. This complexity requires a holistic understanding of different processes through multi-stage integrative models that are capable of capturing the significant attributes and peculiarities on the respective scales to expound complex systems whose behavior is confounding to predict and control with the ultimate goal of achieving a global understanding, while keeping up with actuality along the evolutionary and historical path, which itself has also been through different critical points on the manifold.

The conception of fractals, fractional-order integration and differentiation, artificial intelligence, machine learning based theories, analyses, models and applications, and so forth besides the multilevel relationship between these aspects enable novel models in order that optimized solutions can be attained catered for the need to develop analytical and numerical methods, encompassing the fractional calculus applications in various realms spanning across science, mathematics, medicine, biology, data science, applied disciplines and engineering, amongst the others. Hence, importance of coming up with applicable solutions to problems for various areas, entails predictability, interpretability, accuracy, and reliance on mathematical sciences at the intersection with different fields while being characterized by complex, nonlinear, dynamic and transient components to validate the significance and applicability of optimized approaches.

Based on this sophisticated integrative approach with computer-assisted translations and applications, our session aims at providing a bridge to merge interdisciplinary perspectives to open new crossroads both in real systems and in other respective realms.

The potential topics include but are not limited to:
Fractal and / or multifractional applications in science engineering
Fractal calculus and its applications
Differentiability of solutions of fractional differential equations with relation to initial complex data
Fractional order differential, integral equations and systems
Multifractal systems
Computational methods for dynamical systems of fractional order
Data-driven fractional modeling in complex biological systems
Data mining with fractional calculus methods
Nonlinear modeling for biological/epidemic/neurological diseases
Fractional differential equations with uncertainty
Fractals and / or fractional dynamic processes in medicine and / or biomedicine
Computational medicine and/or fractional calculus in nonlinear systems
Fractional calculus with deep neural networks
Control and dynamics of multi-agent network systems
Synchronization of fractional dynamic systems on time scales
Fractional calculus and computational complexity
Fractional-calculus-based control schemes for dynamical systems
Computational intelligence-based methodologies with fractional techniques
Fractional mathematical modeling based on computational complexity
Fractional mathematical modeling and bioengineering applications
Among many other related points with mathematical and computational modeling.