fractal and fractional

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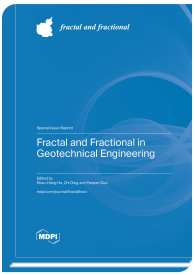
Special Issue Reprint

Fractal and Fractional in Geotechnical Engineering



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Fractal theory provides a robust framework for microscale quantification of geological materials, establishing critical bridges between their microstructural characteristics and macroscopic mechanical behavior. This paradigm-shifting approach offers innovative solutions to longstanding challenges in geotechnical engineering. The fractal dimension has demonstrated exceptional versatility across multiple domains, enabling precise characterization of soil porosity, permeability evolution, strength parameters, pore-size distributions, and particle morphology, while also facilitating accurate predictions of soil–water characteristic curves. Concurrently, fractional calculus has emerged as a transformative tool in constitutive modeling, particularly in addressing complex phenomena such as time-dependent soil creep deformations, tunnel lining viscoelasticity, and structural integrity assessment of shield tunnel segments. These advancements are further amplified through integration with artificial intelligence frameworks, underscoring the indispensable role of fractional-order mechanics in modern geotechnical design. This Reprint seeks to showcase cutting-edge developments at the intersection of fractal geometry and fractional theory within geotechnical engineering.

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