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Spatial and Temporal Variability of a Geo-Structural System

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Boundary value problem formulations that efficiently incorporate multiple sources of stochasticity empower applied science practitioners to develop tailored solutions through comprehensive uncertainty characterization. Deployment of such solutions enhances the performance and sustainability of public assets (e.g., physical infrastructure). A combined geometric-constitutive-temporal-spatial stochastic framework based on nonlinear dynamic analysis is presented for the purpose of efficiently assessing geo-structural system response to non-*a priori* transient excitation. Within this framework, statistical descriptions of structural resistance, spatially varying soil properties, and time-varying site conditions are shown to collectively produce response predictions (e.g., changes in natural boundary conditions) that compare favorably with on-site measurements for a selected bridge structure. Further, the framework is shown to provide statistical characterization of quantities such as initial excitation (kinetic) energy, which constitutes a significant advantage over traditional (empirical, deterministic) frameworks. The proliferation of advanced frameworks that are palatable to applied science practitioners is emphasized as a worthwhile, long-term objective.

Keywords: Stochastic numerical analysis, Spatial variability, Geo-structural analysis, Soil-structure interaction