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# Nonlinear Soil Response via Harmonic-Modal Hybrid Approach

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***Abstract*** **-** Non-linear behaviour of soils during a seismic event has a predominant role in current site response analysis. Soil response analysis consistently indicates that the stress–strain relationship of soils is non-linear and shows hysteresis. An equivalent linearization method, in which non-linear characteristics of shear modulus and damping factor of soils are modeled as equivalent linear relations of the shear strain is usually applied, but this assumption, however, may lead to a conservative approach of the seismic design. In this paper, we propose a new harmonic analysis formulation, able to address forced response simulation of soils exhibiting their characteristic non-linear behavior. A possibility for represent this non-linear analysis consist in combining modal and harmonic analysis for defining an hybrid integration scheme.

***Keywords*****:** Nonlinear soil behavior, Proper Generalized Decomposition, Harmonic analysis, Modal analysis, dynamics