A FRAMEWORK FOR IDENTIFICATION OF GEOTECHNICAL SYSTEMS

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ABSTRACT

Geotechnical systems and natural soil deposits are massive and have distributed parameters and state variables. Some systems are in fact semi-infinite and have no well-defined boundary conditions. These systems exhibit a broad range of response patterns and mechanisms under static and dynamic loading conditions. This response is essentially multi-dimensional in the presence of complex topography or structural elements (e.g., a pile or retaining wall). The availability of a new generation of miniature sensors enables an instrumentation approach that relies on dense local arrays. In view of their small size, these arrays may be installed virtually at any location within a system without affecting its integrity.

This thesis presents a framework for local and local-global identifications of geotechnical systems. The developed local identification algorithms rely on using acceleration records provided by a cluster of closely spaced sensors (dense arrays). Local-global identification analyses can be conducted when a local array is supplemented by sensors installed at sparse locations.

The developed identification techniques are based on a control-motion-problem formulation and the use of the finite element method. These techniques do not require solution of the entire system boundary value problem or the availability of recordings of the system boundary conditions. The constitutive response of soil contained within the instrumented zone is analyzed independently of adjacent soil strata. The identification objective function is expressed in terms of out-of-balance accelerations.

Computer simulations of retaining wall-soil systems were used to assess the capabilities of the developed identification techniques under various instrument configurations and analyzed system conditions. Acceleration histories obtained from centrifuge tests of a soil-retaining wall system were used to examine the performance of the proposed algorithms with real world data.