

# **Two Very Different Research Topics in Dynamics for Civil Infrastructure Performance Assessment**

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## **Abstract :**

Prof. Smyth will discuss recent research in two very different topics in dynamics for civil engineering systems. The first part of the presentation presents a survey of some his research in structural system identification and data fusion. At the heart of this research is the exploration of dual state and parameter estimation techniques for extracting system model parameters from structures instrumented with dynamic sensor networks. A survey of fundamental theoretical aspects of the underlying algorithms as well as application examples on laboratory structures and large-scale bridge structures in New York City will be presented. The innovative use of dynamic differential GPS in combination with an accelerometer network will be highlighted as part of the bridge vibration monitoring studies.

The second topic concerns the modeling and simulation of the dynamic response of rigid bodies on a moving base. This is often referred to as the rocking problem in earthquake engineering and has been considered since the 1960's in the seminal work of Housner. Recent research results will be presented which include previously unaddressed phenomena which are critical to the overall dynamical performance and have heretofore not been considered in combination: 1) 3-dimensional modeling, 2) interface friction, 3) bouncing and 4) the inclusion of geometric nonlinearities. The simulation models developed have implications in a variety of application areas such as seismic vulnerability of the toppling of non-structural objects such as electrical transformers, computer server racks and ancient stone monuments. In addition, the 3-dimensional models have been enhanced to include wheels, so that cart systems such as those commonly found in hospitals may also be considered.