Institute of Structural Engineering

Seminar

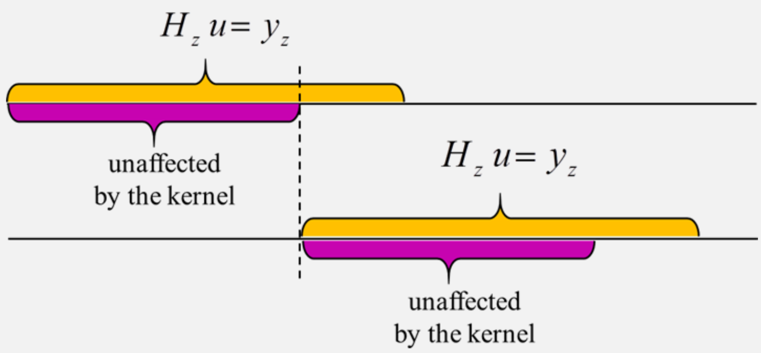
July 6th 2015

On the Identification of Inputs

Monday, July 6th 2015
From 17.00 to 18.00
Auditorium HIL E 1
ETH Zürich, Hönggerberg, 8093 Zürich

Professor Dr. Dionisio Bernal
Center for Digital Signal Processing
Department of Civil and Environmental engineering
Northeastern University, Boston, MA, USA

$$u = H_z^{-*} y_z + Null(H_z) \cdot Y$$



Theory on input identification finds applications in the determination of contact forces, as in the case of rails and wheels, in trains, (for condition monitoring), in the estimation of (approximately) equivalent load regimes for wind loads in existing structures (when the information is useful for retrofit, for example) and in cases where inputs are corrective forces in linear models of systems with localized nonlinearities, to mention some. This talk begins by addressing the problem of identifying the number and locations of loads assumed to be fixed in space. It shows that the number problem has a data-driven solution and that localization can be determined without resorting to combinatorics. The presentation moves on to formalize the issue of identifiability of time histories and in this regard shows that a sufficient condition is that there are no invariant zeros, while the necessary condition is that the transmission zeros set is empty. It is shown that rank deficiency in the Toeplitz matrix that implements numerical deconvolution is a reflection of causality and is thus associated with a kernel that is zero over the portion of the time axis where the outputs constraint the inputs – approximations proposed in the literature to force full rank formulations are thus unnecessary. A formulation that eliminates numerical stability considerations by projecting the output in the left kernel of the observability block is introduced and is shown to offer advantages over a dynamic programming alternative when initial conditions are important.