POLITECNICO DI TORINO

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EARTHQUAKE ENGINEERING RESEARCH INSTITUTE

Dipartimento di Ingegneria Strutturale e Geotecnica

DIRECT AND INVERSE PROBLEMS IN ELASTIC SUSPENDED CABLES WITH DAMAGE

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Abstract

In cable-stayed structures cables are subjected to potential damage, mainly due to fatigue and galvanic corrosion. The lecture presents the recent results obtained on both the direct and the inverse problems. Firstly, an analysis of damage effects on the statics and dynamics of suspended cables is presented. An elastic continuous monodimensional model for damaged cables, including geometric nonlinearities, is formulated for the purpose. The damage is described as a diffused reduction of the cable axial stiffness, and defined through its intensity, extent and position. Exact solutions of the equations governing the cable static equilibrium under self-weight are achieved, and the significance of the tension loss and sag augmentation resulting from damage are investigated under variation of practically significant parameters.

The system spectral properties characterizing the free undamped dynamics are obtained in a closed-form fashion for shallow cables within the low frequency range. The sensitivity of the frequencies to the intensity and extent of damage is discussed, outlining two damage effects, which alternatively stiffen or soften the cable modes, whose respective static and geometric origin is recognized. Finally, the symmetry-breaking induced by damage on the static profile is verified to destroy the crossing phenomenon (crossover) characterizing the frequency loci of undamaged cables, which degenerates into a narrow frequency veering phenomenon.

Secondly, the frequencies of the dominant transversal motion of the cable are chosen as damage indicators, since they are sufficiently sensitive to the damage intensity and extent, while the damage position requires additional information. The damage identification problem is formulated by defining an objective error-function between the measured and the model frequencies, to be minimized in the space of the damage parameters.

Pseudo-experimental data are initially used to test the effectiveness and resolution of the procedure. The results confirm the uniqueness of the problem solution and its correctness. The robustness of the solution is discussed while considering the presence of random errors of increasing amplitude. The procedure is positively verified also with experimental measures from a prototype model of an artificially damaged spiral strand.

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TIME: 4:00 PM
LOCATION: AULA ALBENGA 2nd floor, Department of Structural and Geotechnical Engineering (DISTR), Polytechnic of Torino

Faculty, graduate students, and all others are invited to attend.

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