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Eprints ID: 3313

**To cite this version :** MICHON, Guilhen BERLIOZ, André, LAMARQUE, Claude-Henry. Couplings in parametrically excited inclined cables systems : [abstract]. **In :** *Twelfth conference on nonlinear vibrations, dynamics, and multibody systems*, 1-5 June 2008, Virginia Polytechnic Institute and State University, USA, 2 p.

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## Couplings in parametrically excited inclined cables systems

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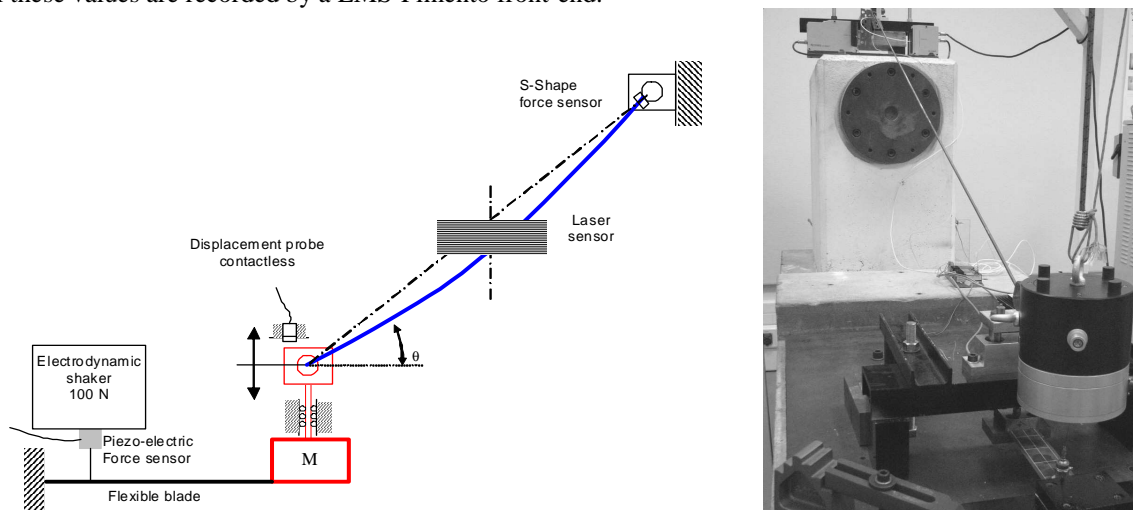
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Cables in stayed bridges are subjected to important dynamic solicitations for which dynamic model are now well established. Due to their design, such structures highlight resonance phenomena and instabilities frequently observed [1-4]. Nevertheless, some structures exhibit important vibration amplitudes that can not be explained simply. Measurement recently performed on a bridge point a coupling of the cable with the deck or the pillar [5].

The present paper suggests to consider the deck flexibility coupled to the nonlinear dynamic of the inclined cable. Results of previous study [6-9] are used.

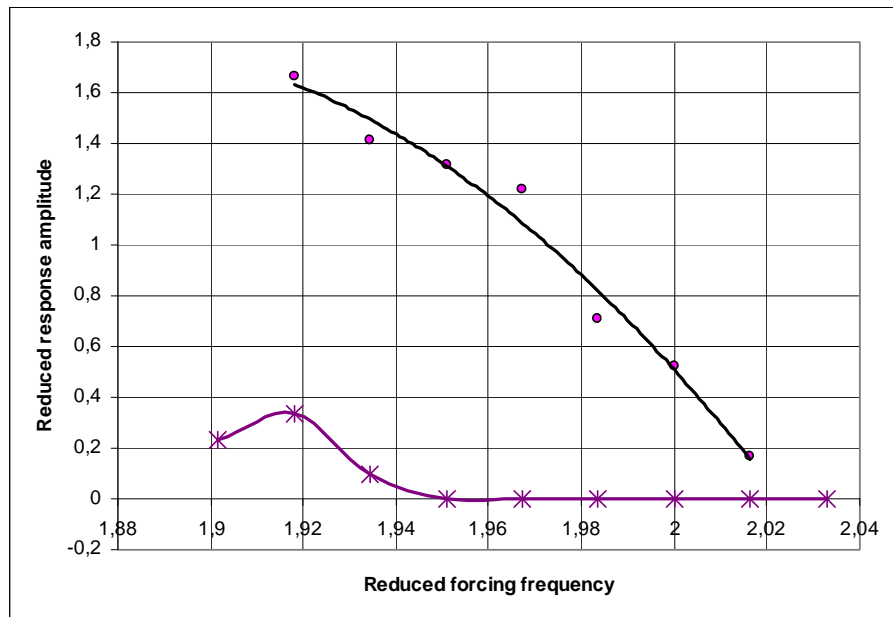
The retained nonlinear model of the cable include two degrees of freedom for the in-plane motion. Considering the bridge mass and deck rigidity adds one DOF, assumed linear in a first approach. The excitation is created on the deck, which produce an external force (such as the wind or the car traffic for example).

An experimental set-up uses a specific device in order to highlight expected coupling phenomena on the parametric instabilities, see Figure 1. It is composed of a flexible blade which represents the deck, and an inclined cable. Both elements are linked to a mass forced to move vertically, and which represent the anchor point and the equivalent mass of a section of the deck. Therefore, the cable has a given initial static tension. An electrodynamic shaker applies a force close to blade clumping. The transmitted force from the shaker to the structure is measured thanks to a piezo-electric sensor. The instantaneous cable tension is measured via a S-shape force sensor. And a high resolution laser sensor captures without contact the in-plane motion of the cable. All these values are recorded by a LMS-Pimento front-end.



**Figure 1: Experimental set-up**

Analytically, the multiple scales method is applied to solve the nonlinear equations of motion. In-plane vibration of the cable and stability in the vicinity of the primary resonance  $\omega_1$  and sub-harmonic resonance  $2\omega_1$  are computed. The competition between the behaviour at  $2\omega_1$  and  $\omega_2$  are of particular interest, as it is observed experimentally on Figure 2.



**Figure 2: Experimental results: reduced displacement vs reduced frequency.**  
**x :  $\omega_2$  response - o :  $2\omega_1$  response,.**

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