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SmartBridge: Towards Active, Energy-Efficient Distributed Mitigation of Wind Effects on Long-Span Bridges

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In November 1940, the Tacoma Narrows Bridge showed the possible consequences of a wind-induced resonance of a bridge. The bridge's design made it receptive for wind forces which finally caused its collapse. This catastrophe clearly showed that wind is a crucial factor in bridge design and should be carefully taken into account.

The SmartBridge project aims at investigating the possibilities of stabilizing a long span suspension bridge through distributed active control. State-of-the-art solutions for this problem deployed on real bridges are purely passive elements. In research laboratories single winglets on both sides of the bridge deck to attenuate the bridge's movement have been investigated using reduced scale bridge models. This project goes a step further by aiming at implementing a distributed system with multiple winglets along the bridge allowing a more adaptive and less error-prone operation.

A simple model of such system is depicted in Figure 1. The bridge deck has 2 degrees of freedom (height *h* and tilt angle α).

First experiments have been undertaken at a flat plate model mounted on springs in a wind tunnel. The measurements showed an approximately exponential decay of *h* and α. Figure 2 shows the measured height as a function of time for a Step response of the system.

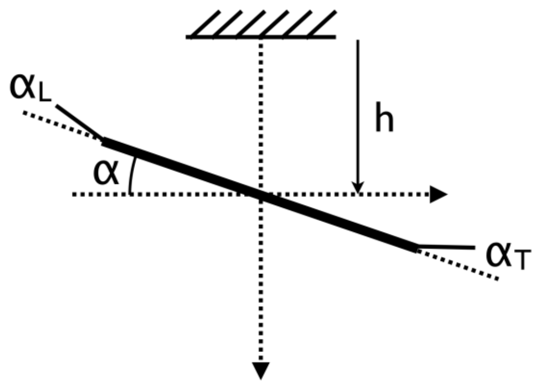

Figure 1: 2d cross-section of bridge with winglets

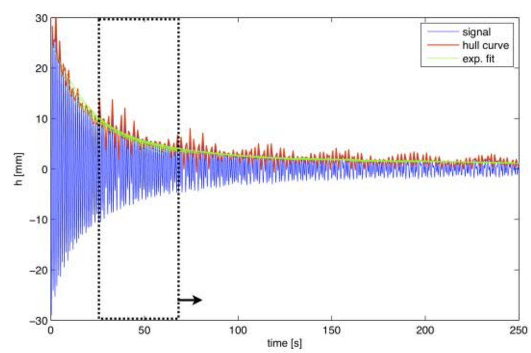

Figure 2: Height h as a function of time for a step response