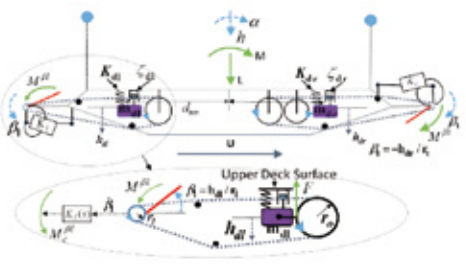
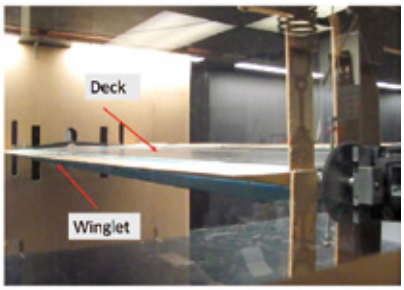
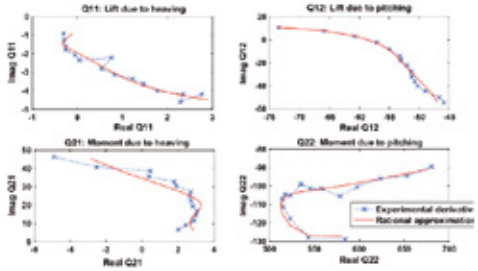
# Aeroelastic control of long-span suspension bridges with controllable winglets

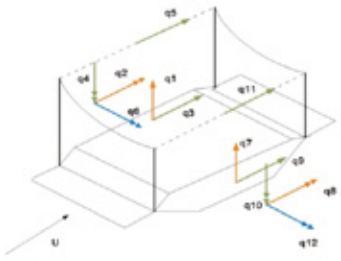
Aeroelastic instabilities like flutter and torsional divergence pose limits to the length increase of cable-supported bridges, with the now iconic Tacoma Narrows Bridge disaster serving as a reminder of the importance of aeroelastic design. Increasing span lengths pose a challenge to aeroelastic stability, and experience gained from record span projects showed that classic aerodynamic design either in the form of deep truss girders (e.g. Akashi Kaikyo Bridge, JP) or the more modern flat box girder solution (e.g. Great Belt East Bridge, DK) reaches its limit for spans approaching 2000m. To overcome these limitations, appropriate counter-measures should be adopted, which traditionally have focused on the deck's aerodynamic improvement or alternatively on the implementation of active and passive control methodologies.

Research activities have been carried out to devise a passively controlled deck-flap network, with special attention to robustness against uncertainties. First, a kinematic flap arrangement has been introduced, which is based on a general passive controller, including inerters, rather than the classical spring-damper configuration. An important advantage is that there is no need for preselecting the network layout, which is instead determined by an optimization process. Second, a suspended mass inside the box girder has been introduced to provide a driving force to the flaps through a simple linkage. The proposed mechanical layout avoids the use of external components, which interfere with the deck's aerodynamic characteristics, and of additional cables which complicate the system and increase dead load.





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Main research topics:

- Modelling and simulation of mechanical systems
- Optimization of mechanical systems
- Analysis and reduction of mechanical vibration