Nonlinear aerostatic stability of a curved 275-m span suspension footbridge between Spain and Portugal

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Abstract

This study reports the nonlinear aerostatic stability studies carried out for a suspension footbridge with a curved deck spanning 275 meters over the Miño River between Spain and Portugal. The footbridge's aerostatic performance is controlled by its highly aesthetic but complex three-dimensional configuration, the high slenderness of the deck, the construction process, and the aerodynamic characteristics of the triangular 4.5-meter-wide bluff deck cross-section, which demands a detailed aerodynamic study. The analysis is conducted using a nonlinear modal-based method recently developed by the authors. The deck's rotation is driven not only by the aerodynamic moment-induced rotation but also by the drag-induced rotation due to the configuration of the cable supporting system and, very significantly, by the lift-induced rotation due to the deck's curvature.

Keywords: footbridges; curved decks; suspension bridges; aerostatic stability; wind tunnel; dynamic analysis; root-finding algorithms; lift-induced rotation

1 Introduction

Curved footbridges are a very popular design alternative given their remarkable aesthetic attributes and its efficient structural performance. Notable examples are the Gateshead Millennium Bridge, Gateshead, UK, with 126 meters of main span, the Ponte de Mare, Pescara, Italy, which spans 172 m, and the Puente de Santa María de Benquerencia, Toledo, Castilla-La Mancha, Spain, 2011, spanning 170 m. However, the increasing span lengths adopted in contemporary projects turns wind-resistant analysis an important part of their design.

This study reports the nonlinear aerostatic stability studies carried out for a footbridge linking Goián-Tomiño (Pontevedra), Spain, with Vila Nova de Cerveira (Minho), Portugal. This suspension footbridge designed for pedestrians and cyclists spans 275 meters over the Miño River. Two pylons support the three-dimensional curved main cable of the suspension system that sustains the curved deck, as shown in the visualizations presented in Figure 1. The footbridge's aerostatic performance is

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