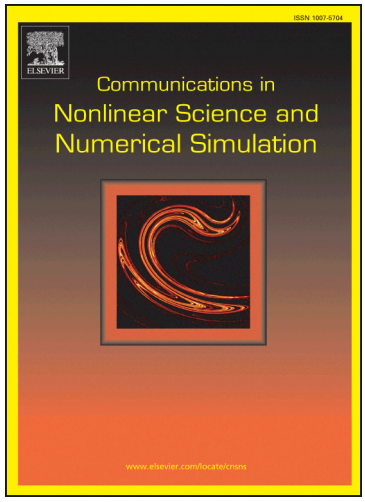

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Innovative Modeling of Tuned Liquid Column Damper Motion

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Abstract

In this paper a new model for the liquid motion within a Tuned Liquid Column Damper (TLCD) device is developed, based on the mathematical tool of fractional calculus. Although the increasing use of these devices for structural vibration control, it is shown that existing model does not always lead to accurate prediction of the liquid motion. A better model is then needed for accurate simulation of the behavior of TLCD systems. As regards, it has been demonstrated how correctly including the first linear liquid sloshing mode, through the equivalent mechanical analogy well established in literature, produces numerical results that highly match the corresponding experimental ones. Since the apparent effect of sloshing is the deviation of the natural frequency from the theoretical one, the authors propose a fractional differential equation of motion. The latter choice is supported by the fact that the introduction a fractional derivative of order α alters simultaneously both the resonant frequency and the degree of damping of the system. It will be shown, through an extensive experimental analysis, how the proposed model accurately describes liquid surface displacements.

1 Introduction

Since their first appearance in 1989 in the work by Sakai et al. [1], Tuned Liquid Column Damper (TLCD) devices received growing attention among researchers who deal with structural control. TLCD is in fact of great interest among passive vibration control systems, because of its characteristics such as easy implementation, low cost of construction and maintenance, no need to