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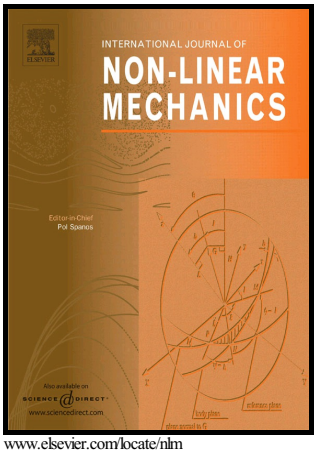

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An analysis of the relaxation oscillations of a nonlinear thermosyphon

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Abstract

The oscillatory behavior of an asymmetrically forced thermosyphon constituted by two connected vessels has been subjected to an asymptotically valid analysis using the vessel-volume ratio as expansion parameter. Due to the structure of the governing equations, the problem could not be dealt with using standard techniques; instead a phase-plane analysis was conducted. The analytically determined corrections to the previously established lowest-order discontinuous results proved to be useful even for comparatively large values of the expansion parameter. The relationship between these asymptotically valid corrections and the physics underlying the relaxation oscillation as well as the behavior of the system for strong thermal forcing is discussed. The study is concluded by an overview of some specific inconsistencies associated with the discontinuous lowest-order analysis and how these were alleviated by the asymptotically valid corrections.

Keywords: Thermosyphon, Nonlinear dynamics, Relaxation oscillations, Asymptotic analysis

1. Introduction

A thermosyphon is basically a heat-transfer device employing either standard thermal convection (single-phase devices) or the principle of evaporation and condensation of the working fluid (two phases). A single-phase

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