Symmetry Breaking Instability in a Mixed Convection Problem

J. C. Cajas, L. Martínez-Suástegui and C. Treviño

Abstract In this work, the stability of a strongly non-parallel symmetrical counterflow mixed convection problem is studied, using numerically generated eigenfunctions. The base flow is numerically obtained for each value of the buoyancy parameter (Richardson number), and the stability of this flow is analyzed by increasing its value while all the others remained fixed. The perturbed linear functions are numerically generated by introducing a transient modulated asymmetrical buoyancy, relaxing at later times to 'numerical eigenfunctions'. The time evolution of the amplitude of these perturbations is used to obtain the stability characteristics. Symmetry breaking instability occurs, for fixed geometry, Reynolds and Prandtl numbers, for values of the buoyancy parameter larger than a critical one. However, there is also a window for the buoyancy parameter below this critical value, where the system shows instability, producing a slightly asymmetric thermal and flow response.

1 Introduction

Mixed convection is defined as heat transfer situations where both natural and forced convection mechanisms interact. In particular, the oscillatory behavior in mixed convection flows is of great interest because of its rich dynamical features and useful

J. C. Cajas (✉)
Facultad de Ciencias, Universidad Nacional Autónoma de México, 04510 México, D. F., México
e-mail: jc.cajas@gmail.com

L. Martínez-Suástegui
ESIME Azcapotzalco, Instituto Politécnico Nacional, Avenida de las Granjas No. 682, Colonia Santa Catarina, Delegación Azcapotzalco, 02250 México, D. F., México
e-mail: lamartinezs@ipn.mx

C. Treviño
Facultad de Ciencias, UMDI Universidad Nacional Autónoma de México Sisal, Yucatán, México
e-mail: ctrev@correo.unam.mx

J. Klapp and A. Medina (eds.), *Experimental and Computational Fluid Mechanics*, Environmental Science and Engineering, DOI: 10.1007/978-3-319-00116-6_1,