Documents

Ghalambaz, M., Mehryan, S.A.M., Ismael, M.A., Chamkha, A., Wen, D.

Fluid–structure interaction of free convection in a square cavity divided by a flexible membrane and subjected to sinusoidal temperature heating

(2019) *International Journal of Numerical Methods for Heat and Fluid Flow*, .

Abstract

Purpose: The purpose of the present paper is to model a cavity, which is equally divided vertically by a thin, flexible membrane. The membranes are inevitable components of many engineering devices such as distillation systems and fuel cells. In the present study, a cavity which is equally divided vertically by a thin, flexible membrane is model using the fluid–structure interaction (FSI) associated with a moving grid approach. Design/methodology/approach: The cavity is differentially heated by a sinusoidal time-varying temperature on the left vertical wall, while the right vertical wall is cooled isothermally. There is no thermal diffusion from the upper and lower boundaries. The finite-element Galerkin technique with the aid of an arbitrary Lagrangian–Eulerian procedure is followed in the numerical procedure. The governing equations are transformed into non-dimensional forms to generalize the solution. Findings: The effects of four pertinent parameters are investigated, i.e., Rayleigh number (104 = Ra = 107), elasticity modulus (5 × 1012 = ET = 1016), Prandtl number (0.7 = Pr = 200) and temperature oscillation frequency (2p = f = 240p). The outcomes show that the temperature frequency does not induce a notable effect on the mean values of the Nusselt number and the deformation of the flexible membrane. The convective heat transfer and the stretching of the thin, flexible membrane become higher with a fluid of a higher Prandtl number or with a partition of a lower elasticity modulus. Originality/value: The authors believe that the modeling of natural convection and heat transfer in a cavity with the deformable membrane and oscillating wall heating is a new subject and the results have not been published elsewhere. © 2019, Emerald Publishing Limited.

2-s2.0-85067886580
Document Type: Article
Publication Stage: Article in Press
Source: Scopus