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Fluid–structure interaction analysis of free convection in an inclined square cavity partitioned by a flexible impermeable membrane with sinusoidal temperature heating

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Abstract
The problem of unsteady natural convection inside an inclined square cavity partitioned by a flexible impermeable membrane is studied numerically using the finite-element method along with the Arbitrary Lagrangian–Eulerian (ALE) approach. The bottom and top walls of the cavity are kept adiabatic. The left side wall is kept isothermal at a high temperature, while the right wall is cooled in a sinusoidal fashion. The cavity is provided by two eyelets to compensate volume changes due to the movement of the flexible membrane. The studied pertinent parameters are the Rayleigh number (in the range of 1E4–1E7), the amplitude of the sinusoidal wall temperature (A in the range of 0–1.0), the inclination angle of the cavity (in the range of −π/3 to π/3), and the body force parameter (Fv in the range of −1.64E−2 to +1.64E−2) whereas the Prandtl number is fixed at 6.2. The results show that at a low Rayleigh number, the membrane shape is a function of the imposed body force. While at a high Rayleigh number, the buoyancy force becomes responsible for the membrane deflection. The natural convection is appreciably affected by the inclination angle of the cavity which in turn, affects the concave or convex shape of the membrane. © 2017, Springer Science+Business Media Dordrecht.

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