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Shirvan, K.M., Mirzakhanlari, S., Chamkha, A.J., Mamourian, M.

Numerical simulation and sensitivity analysis of effective parameters on natural convection and entropy generation in a wavy surface cavity filled with a nanofluid using RSM

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Abstract
In this work, a 2-D numerical investigation and a sensitivity analysis have been done on the natural convection heat transfer in a wavy surface cavity filled with a nanofluid. For this purpose, the effects of three parameters, the Rayleigh number (103 ≤Ra ≤ 105), nanoparticles volume fraction (0.00 ≤ϕ ≤ 0.04), and the shape of the nanoparticles (spherical, blade, and cylindrical), are studied. Discretization of the governing equations is performed using a finite volume method (FVM) and solved with the SIMPLE algorithm. The effective parameters analysis is processed utilizing the Response Surface Methodology (RSM). Comparison with previously published work is performed and the results are found to be in good agreement. The results showed that increasing the Rayleigh number and ϕ increases the mean Nusselt number and the total entropy generation. Also, the nanofluids with spherical- and cylindrical-shaped nanoparticles have the highest and lowest Nusselt numbers and entropy generations, respectively. The sensitivity of the mean Nusselt number and entropy generation ratio to Ra and ϕ is found to be positive, whereas it is predicted to be negative to nanoparticles shape. © 2016, Copyright © Taylor & Francis Group, LLC.

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