Documents

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Modeling and optimization of gaseous thermal slip flow in rectangular microducts using a particle swarm optimization algorithm

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Abstract

In this study, pressure-driven flow in the slip regime is investigated in rectangular microducts. In this regime, the Knudsen number lies between 0.001 and 0.1. The duct aspect ratio is taken as $0 \leq \varepsilon \leq 1$. Rarefaction effects are introduced through the boundary conditions. The dimensionless governing equations are solved numerically using MAPLE and MATLAB is used for artificial neural network modeling. Using a MAPLE numerical solution, the shear stress and heat transfer rate are obtained. The numerical solution can be validated for the special cases when there is no slip (continuum flow), $\varepsilon = 0$ (parallel plates) and $\varepsilon = 1$ (square microducts). An artificial neural network is used to develop separate models for the shear stress and heat transfer rate. Both physical quantities are optimized using a particle swarm optimization algorithm. Using these results, the optimum values of both physical quantities are obtained in the slip regime. It is shown that the optimal values ensue for the square microducts at the beginning of the slip regime. © 2019 by the authors.

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