

Comments on three published papers

By

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In

- 1. Numerical solution for the flow and heat transfer due to a permeable stretching surface embedded in a porous medium with a second-order slip and viscous dissipation [Eur. Phys. J. Plus 129: 10(2014)] .**
- 2. Differential transformation method for the flow and heat transfer due to a permeable stretching surface embedded in a porous medium with a second-order Slip and viscous dissipation[ASMEJ Heat Transfer 136: 072602. 7 pp. (2014)].**
- 3. Effect of viscous dissipation on boundary layer flow and heat transfer past a permeable stretching surface embedded in a porous medium with a second-order slip using Chebyshev finite difference method [Transp Porous Med 105:487–501(2014)].**

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The main aim of the above three papers is to study the effects of second-order slip and viscous dissipation on the boundary layer flow and heat transfer of an incompressible Newtonian fluid past a permeable stretching surface embedded in a porous medium using the implicit finite difference method (FDM) in the first paper [1], the differential transformation method (DTM) in the second paper [2] and Chebyshev finite difference method in the third paper [3].

It is known that the heat transfer results may alter appreciably due to viscous dissipation in two cases namely: (i) the fluid is very viscous even though low speed velocity i.e. liquid fluids and (ii) high speed velocity. While in the case of high speed velocity, the rigid matrix resistance is no longer given by Darcy's law, i.e. the velocity – square term in the momentum equation (3) becomes significant [4].

The authors used Darcy model in the presence of viscous dissipation (liquid fluid with $P_r = 1$). Also, the authors used second-order slip velocity in the boundary conditions (see Eq.(5)).

Wu [5] derived the second-order slip model for rarefied gas flows for arbitrary Knudsen number. It is known that the typical values for the Prandtl number P_r around 0.7 – 0.8 for air and gases.

Then it is clear that the second-order slip (for rarefied gas flows) can not be used in the presence of viscous dissipation (liquid fluid) term in the energy equation (4).

The authors added the thermal jump condition in the third paper [3] (see Eq.(5)). There is no kinetic theory for liquid fluids [6]. Therefore, calculations for heat transfer at the microscale assume that there is no thermal jump comparing the velocity jump.

However, for liquids the velocity slip which is assumed to be proportional to the local wall shear stress as follows [7]:

$$u_s = l \frac{\partial u}{\partial y} \quad \text{at } y = 0$$

where l is slip length as a proportional constant of the velocity slip and u_s is the slip surface velocity. In liquids, the molecules are densely packed and a mean free path is not a meaningful quantity. Therefore, l is defined as the interaction length. Because the mean free paths of liquids are much smaller than those of gases, the continuum assumption may hold for liquids but fail for gases [8]. Using liquid fluids such as water, blood plasma tend to avoid having temperature jump on the boundary conditions.

Conclusions

From the above discussions it is obvious that the mathematical formulation used to describe the physical model in the above three papers is wrong .

References

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- [2] M.M.Khader and Ahmed M. Megahed , " Differential transformation method for the flow and heat transfer due to a permeable stretching surface embedded in a porous medium with a second- order Slip and viscous dissipation," ASME J Heat Transfer 136 :072602. 7pp. (2014).
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