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Comments on "Lie group analysis of natural convection heat and mass transfer in an inclined surface"

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In the above paper by Sivaskaran et al. [1] analysis of natural convection heat and mass transfer in an inclined surface has been made. Symmetries of nondimensional equations are derived and restrictions are imposed on infinitesimals from the boundary conditions. As a result of these restrictions the form of infinitesimals presented in [1] are:

$$\begin{aligned}&\xi_1 = 2c_1x - c_2x - c_3, \quad \xi_2 = \frac{1}{2}c_1y - \frac{1}{2}c_2y,\\&\eta_1 = c_1u, \quad \eta_2 = -\frac{1}{2}c_1v + \frac{1}{2}c_2v, \quad \eta_3 = c_2\theta - \frac{G_c}{G_r}c_4, \quad \eta_4 = c_2\phi + c_4.\end{aligned} \tag{1}$$

We feel that the infinitesimals given in the system of equations (1) need some corrections. We further understand that the infinitesimal generator in [1] would be

$$X = \xi_1\frac{\partial}{\partial x} + \xi_2\frac{\partial}{\partial y} + \eta_1\frac{\partial}{\partial u} + \eta_2\frac{\partial}{\partial v} + \eta_3\frac{\partial}{\partial \theta} + \eta_4\frac{\partial}{\partial \phi}. \tag{2}$$

After applying the infinitesimal generator on the boundary conditions the infinitesimals should read as follow:

$$\begin{aligned}&\xi_1 = 2c_1x - c_3, \quad \xi_2 = \frac{1}{2}c_1y,\\&\eta_1 = c_1u, \quad \eta_2 = -\frac{1}{2}c_1v, \quad \eta_3 = 0, \quad \eta_4 = 0.\end{aligned} \tag{3}$$

Comparing equations (3) and (1) it is clear that the system of equations (1) must also have c_2 and c_4 equal to zero. This is in fact the cause of all that we are going to say ahead.

While discussing the cases of translational and scaling symmetry in [1], the authors have assumed the parameters c_2 and c_4 as zero to achieve complete similarity in boundary conditions, although it is not warranted by system of equation (1). However system of equations (3) supports this requirement. This oversight is continued in [2, 3]. The main consequence of this omission is that, in fact similarity in the boundary conditions is not achieved. For example, in [2] the authors claim that the transformed boundary conditions are (p. 38 of [2])

$$F_3 = 1, \quad F_4 = 1 \quad \text{at } \eta = 0. \tag{4}$$

Although, according to similarity variables and functions defined in [2] the transformed boundary conditions should actually become

$$F_3 = \frac{1}{x}, \quad F_4 = \frac{1}{x} \quad \text{at } \eta = 0, \tag{5}$$

which are not similar.

We stress that the non-similarity in the boundary conditions appearing in [1–3], in fact has arisen because of considering the boundary conditions at $y = 0$ alone and ignoring the boundary conditions as $y \to \infty$. Therefore it is suggested that while imposing restrictions from the boundary conditions, all boundary conditions must have been taken into account. This important requirement must be adhered to in principal and may help as a guideline for any future work undertaken in this direction.

References

1. S. Sivasankaran, M. Bhuvaneswari, P. Kandaswamy, E.K. Ramasami, Lie group analysis of natural convection heat and mass transfer in an inclined surface, *Nonlinear Anal., Model. Control*, **11**, pp. 201–212, 2006.

2. S. Sivasankaran, M. Bhuvaneswari, P. Kandaswamy, E.K. Ramasami, Lie group analysis of natural convection heat and mass transfer in an inclined porous surface with heat generation, *Int. J. Appl. Math. Mech.*, **2**(1), pp. 34–40, 2006.

3. S. Sivasankaran, M. Bhuvaneswari, P. Kandaswamy, E.K. Ramasami, Lie group analysis of radiation natural convection flow past an inclined surface, *Commun. Nonlinear Sci. Numer. Simul.*, **13**, pp. 269–276, 2008.