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Comment on: "Hall and Ion-Slip effects on magneto-micropolar fluid with combined forced and free convection in boundary layer flow over a horizontal plate"

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In recent paper by Seddeek and Abdelmeguid [1] the effects of Hall and ion-slip currents on the steady magneto-micropolar of a viscous incompressible and electrically conducting fluid over a horizontal plate is studied numerically using the shooting method. It is shown here that the results obtained for the rate of heat transfer at the wall are incorrect.

The dimensionless energy equation (15) and the transformed boundary conditions (16) in ref.[1] are given by

$$\frac{2}{p_r}\phi'' + f\phi' + f'\phi = 0, \tag{15}$$

$$f(0) = f'(0) = 0,\ \ f'(\infty) = 1,\ \phi(0) = 1,\ \phi(\infty) = 0\,. \tag{16}$$

From Eqns. (15) and (16), one obtains $\phi'(0) = 0$, for both Newtonian fluid [2] and micropolar fluid [3].

This result indicates that there is no local heat transfer at the plate surface for all $x > 0$. Nevertheless, although dissipation has been neglected the temperature of the fluid is changed during the flow process. The paradox is resolved by recalling that the similarity solution requires a singular behavior of the wall temperature at $x = 0$, cf. equation (11) in ref.[1]. Thus all the heat necessary to change the fluid temperature must be transferred in the singular point $x = 0$, which is the leading edge of the plate [2]. However in the paper by Seddeek and Abdelmeguid [1], the values of $\phi'(0) \neq 0$ as shown in tables 1-5 in ref.[1], which contradicts the analytical solution, $\phi'(0) = 0$.

Since Eqns. (12)-(15) in ref.[1] are coupled, then all the results obtained for f', ϕ, h, g, $h'(0)$, $g'(0)$ and $f''(0)$ are also incorrect.

An example to show that the results obtained in ref. [1] are incorrect can be explained as follows: The coupled non-linear ordinary differential equations (12)-(15) with the boundary conditions (16) in ref.[1] are solved numerically using the shooting method . In order to check the accuracy of our results, we have compared it when neglecting the magnetic field with those obtained by Hassanien [3] for different values of $\Delta = 0.5, 1.5$ and 4.5 with $\lambda = \Omega = 0.5$, $B = 0.01$ and $p_r = 0.7$. Our results are in agreement with those obtained by Hassanien [3]. Then we calculated the values of $f''(0)$, $h'(0)$, $-g'(0)$ and $-\phi'(0)$ with $\beta_i = 0.4, M = 0.3$, $\Omega = 0.5$ as shown in the following table:

β_e	$f''(0)$	$h'(0)$	$-g'(0)$	$-\phi'(0)$
0.4	0.229358	0.007381	0.055351	$O(10^{-6}) \sim 0$
0.8	0.251879	0.010420	0.055763	$O(10^{-6}) \sim 0$
14	0.260535	0.011747	0.05691	$O(10^{-6}) \sim 0$
2	0.293218	0.010028	0.060819	$O(10^{-6}) \sim 0$
4	0.315599	0.006824	0.063193	$O(10^{-6}) \sim 0$

From this table we see that the values of $\phi'(0)$ are of order $O(10^{-6}) \sim 0$ which is clearly in agreement with the analytical solution $\phi'(0) = 0$.

References

[1] M. A. Seddeek and M. S. Abdelmeguid, J. KSIAM 8 (2004), 51.

[2] W. Schneider, Int. J. Heat Mass Transfer 22 (1979), 1401.

[3] I. A. Hassanien, ZAMP 48 (1997), 571.