Comments on the paper" Numerical study of hydromagnetic radiative stagnation point flow of nanofluid across a curved surface by Khan et al. [1]"

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Abstract: The present comment refers to some doubtful results included in the paper"Numerical study of hydromagnetic radiative stagnation point flow of nanofluid across a curved surface by Khan et a1. [1]".

Keywords: nanofluid, stagnation point, curved surface, hydromagnetic, radiation

Introduction

Convective heat transfer is the fundamental heat transmission process in a fluid flow. Convection is improvable by modifying the boundary conditions, the geometry, or by increasing the thermal conductivity. Therefore, nanometer-sized particles were established by Choi [2] in (1995) to industrial fluids, known as "Nanofluids", extended also byBuongiorno [3].Khan and Pop [4], reported, for the first time, the stretched sheet of nanofluid using Boungiorno's nanofluid model. Excellent on nanofluid can get in the books by Shenoy et al. [5] and Merkin et al. [6]. Te signifcance of thermal radiation in many industrial and engineering processes like electric power, nondestructive testing, solar cell panels, and many others is vital. Terefore, it is crucially to comprehend the aspect of thermal radiation to attain the desired quality of products in industrial processes (see Owhail et al. [7]).

My comments on the paaper by Khan et al. [1], are the following;

1. Equation 3 is **wrongly** presented: it is missed the term $u_e \partial u_e / \partial s$

2. The magnetic term in Eq. 3 should be:

$$-\frac{\sigma_{nf} B_0^2}{\rho_{nf}} (u - u_e)$$

   and in Eqs. (4) and (8), the Joule heating term should be:

$$+\frac{\sigma_{nf} B_0^2}{(\rho\, C_p)_{nf}} (u - u_e)^2$$

   due to the boundary condition $u_e(s) \to a\, s$ when $r \to \infty$.

3. In order that Eqs. (1) to (4) inKhan et al. [1], have similarity solutions, the temperature of the surface of the shet $T_w(s)$, should be maintained at the temperature $T_w(s) = T_\infty + T_0 (s/l)^2$, where T_0 is a characteristic temperature of the base nanofluid, with $T_0 > 0$ for the heated nanofluid, $T_0 < 0$ for the cooled nanofluid and l is the characteristic length of the sheet, while T_∞ is the free stream temperature.

There fore, Eqs. (14) and (15) from Khan et al. [1] should be:

$$\left.\begin{aligned}\frac{\rho_f}{\rho_{nf}}\frac{2\,K}{\eta\,+\,K} = \frac{\nu_{nf}}{\nu_f}\left[f''' - \frac{1}{(\eta\,+\,K)^2}(f'-1) + \frac{1}{\eta\,+\,K}f''\right] - \frac{K}{\eta\,+K}(1-f')^2 + \\ \frac{K}{\eta\,+\,K}ff'' + \frac{K}{(\eta\,+K)^2}ff' - \,M^2\frac{\sigma_{nf}}{\sigma_f}\frac{\rho_f}{\rho_{nf}}(f'-1)\end{aligned}\right\}$$

$$\left.\begin{aligned}\frac{1}{Pr}\frac{k_{nf}}{k_f}\frac{(\rho\,C_p)_f}{(\rho\,C_p)_{nf}}\left(1+\frac{4}{3}Rd\right)\left(\theta''+\frac{1}{\eta+K}\theta'\right)+\frac{K}{\eta+K}(f\theta'-2f'\theta)+ \\ \frac{\mu_{nf}}{\mu_f}\frac{(\rho\,C_p)_f}{(\rho\,C_p)_{nf}}Ec\left(f''-\frac{f'-1}{\eta+K}\right)^2+M^2Ec\frac{(\rho\,C_p)_f}{(\rho\,C_p)_{nf}}\frac{\sigma_{nf}}{\sigma_f}(1-f')^2=0\end{aligned}\right\}$$

Subject to the boundary conditions

$$\left.\begin{aligned}f(0)=0,\;\; f'(0)=\lambda=\frac{c}{a},\;\; \theta(0)=1 \\ f'(\eta)\to 1,\;\; f''(\eta)\to 0,\qquad \theta(\eta)\to 0\;\;\text{as}\;\;\eta\to\infty\end{aligned}\right\}$$

It is clear that if the surface temperature is constant (T_w),it means that the problem treated in [1] is non-similar, so that the partial differential equations (1) to (4)subject to the boundary conditions (9) and (10) cannot be reduced to the ordinary (similarity) differential equations (16) and (17) subject to the boundary conditions (18). However, the authors ignored this fact and treated the problem as similar. In non-similar problems, in contrast to similar problems, the basic flow quantities change along the streamwise direction, as it has been shown by Minkowycz and Cheng [8], Minkowycz and Sparrow [9], and Pantokratoras [10,11], who solved numerically several boundary layer non-similar problems.

Therefore, the results of this paper are **completely wrong!**

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