Comments on "HPM for the slip velocity effect on a liquid film over an unsteady stretching surface with variable heat flux" by Ahmed M. Megahed, Eur. Phys. J. Plus (2011) 126: 82

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Abstract

The author claimed that the film thickness has two values and , the slip velocity parameter is given in dimensional form. In the present work it is derived that the film thickness equal to 1 and the slip velocity parameter is corrected in dimensionless form.

Introduction

The above paper [1] presents numerical study for the problem of the flow and heat transfer in a thin liquid film over an unsteady stretching sheet with variable heat flux in the presence of slip velocity.

Comments

1. In the above paper, the dimensionless film thickness have two values:

   (i) equal to β (below Eq.(14)) .

   (ii) equal to $\gamma = \beta^2$ also (below Eq.(19)).

   This is not correct because the film thickness is unique.

2. In Eq.(17) the slip parameter λ is defined as $\lambda = \frac{1}{\beta}\sqrt{\frac{\rho b}{\mu}}$. Using Eqs.(5), (9) and (10) it is easy to see that this definition of λ is wrong (because λ is not in dimensionless form but has unit (length / time)) .

3. In ref. [1] the author defined the dimensionless film thickness β as

$$\beta = (\frac{\rho b}{\mu_0})^{1/2}(1-at)^{-1/2}h(t).$$

This definition obtained as the value of $\eta = (\frac{\rho b}{\mu_0})^{1/2}(1-at)^{-1/2} y$ at $y = h$.

While the similarity variable η in ref. [1] is given as

$\eta = (\frac{\rho b}{\mu_0})^{1/2}(1-at)^{-1/2}\ \beta^{-1} y$,

which leads to that the film thickness equal to 1 as following:

Using Eq. (14) in Eq. (9), then $\eta = \frac{y}{h}$, where $h(t)$ is the thickness of the liquid film .

At $y = h$, the dimensionless thickness film equal to 1. At this point β does not represent the film thickness.

Using Eqs. (14) with Eqs. (9) - (13), then Eqs. (2)-(4) with the boundary conditions (5)-(7) become

$$f''' + \frac{\rho b h^2}{\mu(1-at)}(ff'' - f'^2 - S(f' + \frac{\eta}{2} f'')) = 0,$$

$$\frac{1}{\Pr}\theta'' + \frac{\rho b h^2}{\mu(1-at)}(f\theta' - 2f'\theta - S(\frac{3}{2}\theta + \frac{\eta}{2}\theta')) = 0.$$

$$f = 0, \quad f' = 1 + \lambda^* f'', \quad \theta' = -1 \quad at \quad \eta = 0,$$

$$f'' = 0, \quad \theta' = 0, \quad f = \frac{S}{2} \quad \text{at } \eta = 1,$$

where $\lambda^* = \lambda\sqrt{\frac{\rho b}{\mu}}$ is the slip parameter and λ is the slip coefficient and has dimension of length.

The similarity solution exists only when $h = (\frac{b}{\mu/\rho})^{1/2}(1-at)^{-1/2}$,

then, the above transformed equations become

$$f''' + (ff'' - f'^2 - S(f' + \frac{\eta}{2} f'')) = 0,$$

$$\frac{1}{\Pr}\theta'' + (f\theta' - 2f'\theta - S(\frac{3}{2}\theta + \frac{\eta}{2}\theta')) = 0.$$

$$f = 0, \quad f' = 1 + \lambda^* f'', \quad \theta' = -1 \quad at \quad \eta = 0,$$

$$f'' = 0, \quad \theta' = 0, \quad f = \frac{S}{2} \quad \text{at } \eta = 1,$$

where $\lambda^* = \lambda\sqrt{\frac{\rho b}{\mu}}$ is the slip parameter and λ is the slip coefficient and has dimension of length.

Since the dimensionless thickness film equal to 1, then there is one value for $S = (S = 1.26863)$ which satisfy the constraint condition $f = S/2$ at $\eta = 1$ for fixed value of λ.

Then the transformed equations (15) and (16) in ref.[1] are wrong and the results obtained due to the numerical solution for these equations are wrong. This is common error in many published papers [2-5] .

References

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