Dec. 1984, pp. 1827-1828.
[2]Berman, A. and Nagy, E.J., "Improvement of a Large Analytical Model Using Test Data," *AIAA Journal*, Vol. 21, Aug. 1983, pp. 1168-1173.
[3]Noble, B., "Methods for Computing the Moore-Penrose Generalized Inverse and Related Matters," *Generalized Inverses and Applications*, edited by M.Z. Nashed, Academic Press, New York, 1976, pp. 245-301.

Comment on "Laminar Stagnation-Point Heat Transfer for a Two-Temperature Argon Plasma"

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IN Ref. 1, the authors attempt to simplify the heat transfer problem by assuming that "the freestream static temperature near the stagnation point is constant along the x direction and is equal to that at the stagnation point." While they considered the Joule heating term to be constant, as shown in Eq. (16), they neglected to balance the global energy in the freestream. If the above assumption is used in the global energy equation, the current density should be zero in the freestream. And if the Joule heating in the boundary layer is constant, as they have assumed, then it should be zero. On the other hand, if the externally applied electric field is a nonzero constant, then there should be additional terms in the energy equations from (18) through (20) pertaining to the freestream temperature variation along the x direction.

It is apparent that a stream function ψ is used so that the continuity equation is satisfied by $\rho ur_w = \partial\psi/\partial y$ and $\rho vr_w = -\partial\psi/\partial x$. However, the stream function is not defined, nor is the velocity component in the y direction defined in terms of the "dimensionless normal velocity." The sign for the term $\rho_0 U_0 \mathrm{d}U_0/\mathrm{d}x$ in Eq. (9) is incorrect.[2] This term is then dropped completely from Eq. (17), which does not, therefore, represent the flow configuration considered in the paper.

References

[1]Bose, T. K. and Seeniraj, R. V., "Laminar Stagnation-Point Heat Transfer for a Two-Temperature Argon Plasma," *AIAA Journal*, Vol. 22, Aug. 1984, pp. 1080-1086.
[2]Sutton, G. W. and Sherman, A., *Engineering Magnetohydrodynamics*, McGraw-Hill Book Co., New York, 1965.

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Reply by Authors to H. Chuang

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IN response the Comment, we would like to point out some errors in the paper.[2] First, the freestream velocity, U_0, in Fig. 1 is to be replaced by U_∞, the approaching flow velocity. For an axisymmetric spherical shaped body, the relation between the two in the stagnation region is $U_0 = 3U_\infty x/(2R_w)$. Second, as pointed out in by Chuang, the sign in the first term on the right-hand side of Eq. (9) is positive. Third, in Eq. (4), x_i is replaced by x_e.

The term $\rho_0 U_0 \mathrm{d}U_0/\mathrm{d}x$ in Eq. (9) can easily be transformed to a pressure gradient parameter $\beta = (2s/U_0)(\mathrm{d}U_0/\mathrm{d}x)$, which, as is well-known, has a value of ½ for the present case.[3] This value is used in the third term of Eq. (17). In addition, because of the above freestream velocity distribution in the stagnation region, $U_0 = 0$ as $x \to 0$. Furthermore, at the stagnation point, $\partial h/\partial x = 0$ due to symmetry. Thus, in the freestream the first term in Eqs. (10) and (12) is zero, and it is left to the other y-dependent terms to balance the Joule heating term in the freestream. The obvious conclusion is that the $\partial/\partial y$ terms in these two equations are not zero, unless the Joule heating term in the freestream is balanced by a term due to a dissipative mechanism such as radiation, which has not been included in the present study. However, the problem is not serious, since in a differential equation of second order only two boundary conditions are to be prescribed—the temperatures at $\eta = 0$ and $\eta_{\max}$—and nonzero values of the temperature gradients in the freestream need not be taken into account. Actual numerical calculation shows that this gradient at the freestream ($\eta = \eta_{\max}$) for the current density range studied in the paper[1] is indeed very small.

As Chuang correctly surmises, the transformation of the continuity, momentum, and energy equations from the body-based coordinate system to those in the (s,η) coordinate system requires introduction of stream function and "dimensionless normal velocity." These definitions were thought to be quite standard, and were left out to save space. However, Refs. 2 and 3 will give details about these definitions.

References

[1]Bose, T.K. and Seeniraj, R.V., "Laminar Stagnation-Point Heat Transfer for a Two-Temperature Argon Plasma," *AIAA Journal*, Vol. 22, Aug. 1984, pp. 1080-1086.
[2]Bose, T.K., "Anode Heat Transfer for a Flowing Argon Plasma at Elevated Electron Temperature," *International Journal of Heat and Mass Transfer*, Vol. 15, Nov. 1972, pp. 1745-1763.
[3]Bose, T.K., "Turbulent Boundary Layers with Large Free-stream to Wall Temperature Ratio," *Wärme-und Stoffübertragung*, Vol. 12, 1979, pp. 211-220.

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Comment on "Dynamic Condensation"

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IN Ref. 1, Paz has pointed out some of the shortcomings of static condensation methods such as those of Guyan[2] and Irons[3] when used to reduce the number of degrees of freedom considered in vibration analysis and dynamic response analysis of systems having large numbers of degrees of freedom. He has presented a technique of dynamic condensation that greatly improves the accuracy of both eigenvalues and eigenvectors for such methods. Moreover, in principle, the dynamic condensation method, iteratively applied, can lead to exact solutions for the eigenvalues and eigenvectors of the complete unreduced matrix equation subject only to the usual limitations of computational accuracy.

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