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Analytical Study of the Stagnation Point Properties and Impact Forces for Non-Continuum Flow Out of Planar Exit Impinge on Inclined Flat Plate Surface

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Abstract: This paper investigated the stagnation point properties and the impact forces acting on the flat plate exposed to rarefied flow with arbitrary inclination angle issuing from planner nozzle. The gaskinetic method was used to investigate this problem. The analytical solutions for the drag and the shear forces were derived. The parameters that effect on drag, shear forces and their coefficients and the stagnation point properties were studied , focusing on the effect of plate inclination angle. The results were as follows: the drag and shear forces increased with the increasing the plate inclination angle, area of the plate, the temperature of issuing gas, and the temperature of the plate. The drag and the shear forces decreased with increasing the distance between the nozzle and the center of the plate and the exit speed ratio. The stagnation pressure and the heat flux coefficients increased with increasing the plate inclination angle, the exit speed ratio, and by decreasing the distance between the nozzle exit and the center of plate and the gas temperature. The direct simulation Monte Carlo method was used to validate the analytical results of this study. The comparisons between the numerical results that obtained from the direct simulation Monte Carlo method and the analytical solutions were in good agreement.