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Analysis of High-Speed Rotating Flow in 2D Polar *(r - θ)* Coordinate S. PRADHAN, Dept of Chemical Engineering, Indian Institute of Science — The generalized analytical model for the radial boundary layer in a high-speed rotating cylinder is formulated for studying the gas flow field due to insertion of mass, momentum and energy into the rotating cylinder in the polar $(r-\theta)$ plane. The analytical solution includes the sixth order differential equation for the radial boundary layer at the cylindrical curved surface in terms of master potential (χ), which is derived from the equations of motion in a polar $(r-\theta)$ plane. The linearization approximation (Wood & Morton, *J. Fluid Mech*-1980; Pradhan & Kumaran, *J. Fluid Mech*-2011; Kumaran & Pradhan, *J. Fluid Mech*-2014) is used, where the equations of motion are truncated at linear order in the velocity and pressure disturbances to the base flow, which is a solid-body rotation. Additional assumptions in the analytical model include constant temperature in the base state (isothermal condition), and high Reynolds number, but there is no limitation on the stratification parameter. In this limit, the gas flow is restricted to a boundary layer of thickness *(Re^{−1/3}R)* at the wall of the cylinder. Here, the stratification parameter $A = \surd$*((mΩ^2 R^2)/(2 k_B T))*. This parameter $A$is the ratio of the peripheral speed, ΩR, to the most probable molecular speed, $\surd$*(2 k_B T/m),* the Reynolds number Re = (*ρ_w* Ω *R^2/μ*), where m is the molecular mass, Ω and R are the rotational speed and radius of the cylinder, *k_B* is the Boltzmann constant, T is the gas temperature, *ρ_w* is the gas density at wall, and μ is the gas viscosity. The analytical solutions are then compared with direct simulation Monte Carlo (DSMC) simulations.

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