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Simulations of Direct Current Glow Discharges in Supersonic Air Flow SHANKAR MAHADEVAN, LAXMINARAYAN RAJA, The University of Texas at Austin — In recent years, there have been a significant number of computational and experimental studies investigating the application of plasma discharges as actuators for high speed flow control. The relative importance of the actuation mechanisms: volumetric heating and electrostatic forcing can be established by developing self-consistent models of the plasma and bulk supersonic flow. To simulate the plasma discharge in a supersonic air stream, a fluid model of the glow discharge is coupled with a compressible Navier-Stokes solver in a self-consistent manner. Source terms for the momentum and energy equations are calculated from the plasma model and input into the Navier-Stokes solver. In turn, the pressure, gas temperature and velocity fields from the Navier-Stokes solution are fed back into the plasma model. The results include plasma species number density contour maps in the absence and presence of Mach 3 supersonic flow, and the corresponding effect of the glow discharge on gas dynamic properties such as the gas pressure and temperature. We also examine the effect of increasing the discharge voltage on the structure of the discharge and its corresponding effect on the supersonic flow.

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