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Simulations of glow discharge phenomena for high-speed flow control THOMAS DECONINCK, SHANKAR MAHADEVAN, LAXMINARAYAN RAJA, University of Texas at Austin — Plasma actuators offer a promising opportunity for high-speed flow control applications. The forcing of the flow occurs through three primary mechanisms: bulk heating of the flow, electrostatic forcing and Lorentz forcing (in the presence of external magnetic fields). In typical experiments with plasma actuators, several of these forces act simultaneously. By developing detailed computational models for the plasma and bulk flow we hope to gain a better understanding of each of these factors. The plasma model we are using is based on a two-dimensional, self-consistent, multi-species continuum description of the plasma. A surface plasma actuator with two electrodes on a single plane is considered. A DC plasma is generated between the two exposed electrodes to produce body forces that perturb the flow. Results include maps of charge density, temperature and electric potential profiles. For an argon plasma at a pressure of 5 Torr and an applied voltage of 100 V, the sheath region in front of the cathode is about 1 mm thick. In this region where electrohydrodynamic effects are dominant, the electrostatic body force is $\sim$100 N/m^3. For a magnetic flux density of 1 Tesla and in a region $\sim$1cm thick above the electrodes, the resulting Lorentz force is $\sim$10 N/m^3. Relative contributions of the body forces as a function of geometry and operating conditions will be explored in this study.

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