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Simulation of SDBD Plasma Actuators on Arbitrarily Shaped Surfaces[1] BENJAMIN MERTZ, THOMAS CORKE, University of Notre Dame, MEHUL PATEL, Orbital Research Inc. — The results from the simulation of a Single Dielectric Barrier Discharge (SDBD) based "plasma actuator" on an arbitrarily shaped surface are presented. The actuators are made up of two electrodes separated by a dielectric barrier. By applying a high voltage a.c. signal to the electrodes, the air ionizes around the regions of largest electric potential. The asymmetric placement of the electrodes produces an electric field gradient which will impose a body force vector field on the ionized air which can be used for flow control applications. The simulation of the actuator uses a lumped-circuit model, which simulates the plasma formation at the a.c. time scales, to provide the unsteady boundary conditions for the solution of the governing electrostatic equations. The electrostatic equations are solved at each time step in a generalized coordinate system using a second order central difference approximation for the spacial derivatives. The body force is then calculated and time-averaged to produce a force field which can be used in flow simulations. Simulations involving plasma actuator control of turbulent separated flows for different surface geometries are then presented.

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