Abstract Submitted
for the GEC12 Meeting of
The American Physical Society

Design and characterization of a plasma actuator for controlling dynamic stall[1] WILLIAM POLLARD, DAVID STAACK, Texas A&M University — A repetitive pulsed spark discharge inside of a ∼1 mm cavity generates a high velocity (100-600 m/s) gas jets potentially capable of controlling dynamic stall on an airfoil at Re ∼1e6. High temperature compressible 2D CFD was used to determine the design and geometry of the actuator slot and plasma cavity. Experimental results measuring the time dependent plasma discharge emission and density variations (using gated ICCD and Schlieren) indicate that the plasma can be modeled as constant volume heating over 100 ns. The energy input to the actuator is controlled by the high voltage and capacitance initiating the discharge. During the discharge air in the cavity is rapidly heated. Temperature and pressure increase 5-10x, causing strong gradients and shocks. The flow is directed using an angled slot. In CFD designed geometries shock fronts and high temperature gas velocities are experimentally determined. The force generated by the actuator is also experimentally determined. Experimental results from the actuator show that velocities of 500 m/s can be achieved through 1mm2 orifices with energy inputs of 50 mJ. The CFD model predicts time scales and velocities similar to those observed, and it also indicates cavity cooling as important in optimizing the actuator pulse repetition rate.

[1]Funded by NASA SBIR grant NNX12CG07P.

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Date submitted: 18 Jun 2012