Study on the effects of plasma actuators on the flow over a projectile

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A key component of a smart projectile is the control mechanism. The control mechanism must be capable of altering the trajectory of the projectile in such a way that impact point errors induced at launch and in flight can be corrected. At the same time, the control mechanism must be rugged to withstand high acceleration loads at launch, small so that payload space is not compromised, and inexpensive for cost considerations. Control mechanisms for gun launched projectiles include configurations capable of manipulating aerodynamic loads, generating jet thrust, and altering inertial loads on the body. More recently, plasma actuators have shown the ability to control flow separation in a large number of applications.

The objective of this present paper is to experimentally demonstrate the use of plasma actuators (AC-DBD and nano-second plasma actuators) to produce changes in aerodynamic loading that can control side forces on a projectile model. Projectile models with varying configurations on the downstream end was experimentally examined to determine the ability of plasma actuators to provide asymmetric aerodynamic loading under different flow speeds that could be used for flight control without moving surfaces. The differences between nano-second plasma actuators and the AC-DBD plasma actuators, and their physical mechanism will be further discussed for seeking the strategies to design the smart projectile control mechanism.