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The Role of Projectile Configuration and Viscosity on the Launch Dynamics of Supersonic Projectiles

C. K. Muthukumaran, G. Rajesh, H. D. Kim

(Submitted on 16 Apr 2012)

The aerodynamics of a projectile launched from barrels of various devices is quite complicated due to its interactions with the unsteady flow field around it. A computational study using moving grid method is performed here to analyze the effect of the projectile-shock wave interaction. Cylindrical and conical projectiles have been employed to study such interactions and the fluid dynamics of such flow fields. It is found that the overall effect of projectile overtaking a blast wave on the unsteady aerodynamic characteristics of the projectile is hardly affected by the projectile configurations. However, it is noticed that the projectile configurations do affect the unsteady flow structures and hence the drag coefficient for the conical projectile shows considerable variation from that of the cylindrical projectile. The projectile aerodynamic characteristics, when it interacts with the secondary shock wave, are analyzed in detail. It is also observed that the change in the characteristics of the secondary shock wave during the interaction is different for different projectile configurations. Both inviscid and viscous simulations were done to study the projectile aerodynamics. It is found that the effect of the viscosity on the projectile aerodynamics is negligible but the viscosity does affect the unsteady flow structures around the projectile.

Comments:	20 pages, 12 figures
Subjects:	**Fluid Dynamics (physics.flu-dyn)**
Cite as:	**arXiv:1204.3395v1 [physics.flu-dyn]**

Submission history

From: Rajesh Gopalapillai [view email]
[v1] Mon, 16 Apr 2012 08:05:20 GMT (2964kb)

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