Computational Study of Aero-Spike on Blunt Body

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Abstract. An Aero-Spike involved to the stagnation point of a Semi-circular Blunt frame modifications its movement field and reduces the sweptback graft. The blunt body with aero-spike with different L/D relations (1, 2) and aero-spike shapes of truncated hemisphere, extended hemisphere, Simple spike and flat faced cone at Mach number 2 and at different angles of attack (0, 5, 10, 15) were computationally analysed using ANSYS Fluent. A recirculation zone forms in front of the blunt body and its gives more streamlined shape to the blunt body. Larger recirculation zone reduces the coefficient of drag efficiently, thus increasing length of the spike results in increase of recirculation sector and reduction in drag. By increasing angles of attack the coefficient of drag also increased. At 0 deg position of spell single disk with L/D ratio of 2 reduces the co efficient of drag efficiently. Keywords— Aero-Spike, Aerodynamic drag, coefficient of drag.

1. Introduction

A grind dipping aero-spike is a ploy used to diminish the sweptback graft of frank frames at supersonic hustles. The aero-spike generates a removed shudder done the figure ahead. Among the shudder and the front frame a recirculation area ensues which acts like a further modernised frame and hence sinking the graft. This concept was castoff on the UGM-96 Trident 1 and it is valued to have improved the collection by 550 Km. The Trident aero-spike comprises of a smooth spherical bowl riding on a extensible successful which is installed presently next the shell pauses complete the obvious of the liquid next take-off from sea. The habit of aero-spike acceptable a copious franker nose contour, providing better heart size for shipment and momentum minus collective the graft. For to growth in kind over the Poseidon C-3 shell Trident 1 C-4 was dynamic.

To fit within the present sea unveiling cylinders the third step motor taken to be riding in the core of the post-boost vanguard per the return vehicles organised nearby the motor. At the equal despite the circumstance (middle 1970s) aero-spike was advanced in KBM for 9M39 surface-to-air rocket of 9K38 Igla MANPADS (in order to weaken heating of ultraviolet homing chaser fairing and cut wave strain), open-handed the label to the uncut co-ordination Spike. Further development in this impression has ensued in the Air-spike. This is grown by tireless energy, since the electric arc incinerate or a beaten laser, likely forward from the frame. This has the improvement concluded a operational aero-spike that the air mass is lower than that ahead a shock as long as increased drag saving.

We study the Aero-spike concept for a blunt body to reduce the gravity drag on the blunted build. The drag reduces the thrust force and hence the range of the bullet, so we incorporate an Aero-spike on the nose of a blunt body. Also we check which Aero-disk shape gives us efficient drag reduction. That’s why we fix different shapes for an Aero-disk, and change the length of the Aero-spike and check which length reduces the drag efficiently. Also we can try different combinations of aero-disk shapes.

Main neutral of the study is to diminish the burden drag on the blunt body at supersonic flow condition. We can condense the graft on the blunted frame by introducing a recirculation zone ahead of the blunt body. To create a recirculation zone we need to incorporate an Aero-spike on the nose of the blunt body.

Different kinds of Aero-spikes are used to reduce the drag. In that we concentrate on some Aero-spike shapes which are efficiently reduces the drag, also we study different length to diameter ratio of Aero-spike, in that we observe which L/D Ratio reduces the drag efficiently, also we study different combinations of Aerospike and compare the results and find which is suitable for real time applications.
[1] Says that Untried and computational lessons have been ended consuming spines of changed characters riding on a curved blunted bulk at supersonic hurry of Mach numerical of [2]. A series of wind tunnel tests have been performed on an aero-spike-protected missile dome at a Mach number of [5] High-speed tide over a blunt body spawns a bow shock wave which bases high outward gravity and as a result the change of high clean drags.

[6] Spike with frontward facing devoted to a hemispherical body pointedly alter its flow field aerodynamic drag and heat flux in wall of high speed flow.

[7] A advancing incrustation aero-spike involved to a unsharpened frame of a bullet and re-entry typical fluctuations its f-drag reduction.

[8] High surface pressure origin by Bow shock wave influence high aerodynamic drags desired governor outside at hypersonic hustles. In the modern year’s interstellar truck like speeds, re-entry means of transportation irrespective their exclusive designs desired governor outside at hypersonic hustles.

2. **Methodology**

   Model is designed using CATIA V5 Designed model meshed using ANSYS ICEM CFD 15 Meshed model analysed using ANSYS FLUENT 15 Results were taken using FLUENT 15 and CFD Post processing Finally results were compared and graph plotted

2.1 **Model geometry**

   - Diameter of base model-300 mm.
   - Length of base model- 750 mm.
   - Diameter of spike-30 mm.
   - Diameter of disk- 60 mm.
   - Length of spike- 300 mm (L/D₁) 600mm(L/D₂).

2.2 **Mesh details:**

   - Number of Elements- 45216.
   - Number of Nodes- 46819.
   - Relevance centre- Fine Smoothing- Medium Min size- 0.3 mm Max size- 10 mm Growth rate - 1.20.

2.3 **Design and mesh:**

   ![Simple spike L/D₁](image)

   Extended Hemisphere L/D of 1
Truncated hemisphere L/D of 1

Flat faced cone L/D of 1

2.4 Viscous model:
- k-ω sst, Energy- on, Material: air
- Density- ideal gas kg/m³,
- Specific heat Cp- 1006.43 J/kg-k,
- Thermal conductivity- 0.0242 W/m-k,
- Viscosity: southerland kg/m-s (three coefficient method),
- Reference viscosity- 1.716e-05 kg/m-s,
- Reference temperature- 273.11 K,
- Effective temperature- 110.56 K

2.5 boundary condition
- All the four sides of domain- pressure far field
- Mach no- 2,
- Pressure- 101.325 Pa
- Blunt body: wall (standard wall condition)

3. Results
Blunt Body with Simple Spike L/D Of 1/0 Deg AOA
3.1 Graphs

Cd Value of various shapes of aero spikes for four different angles

3.2 Discussions
Aero spikes with three disk shapes namely truncated hemisphere, extended hemisphere, flat faced cone and one simple aero-spike without any disk have been analysed at Mach no 2 and at different angles of attack. We noticed increment of spike length increased the recirculation zone; recirculation zone dramatics a main person in the drop of coefficient of drag. Larger recirculation zones acts as a more
stream lined body and reduce the drag. The position of outbreak increase the grind similarly increased. Spike with L/D share of 2 reduces the grind ably.

4. Conclusion

From all the aero-spike reproductions which were investigated it can be publicised that the competent drag saving given by spike with L/D fraction of 2 and 0 degree position of spasm for all the prototypes principally Flat faced cone and stretched hemisphere shrinks the quantity of drag well 0.39 and 0.38 respectively.

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