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Abstract:
At hypervelocity flows the design place a major role. To sustain such impact the design, need to be more aerodynamic. Blunt body is key factor to achieve and sustain those hypersonic velocities that is mainly focused beyond Mach number 5. Blunt body design in aerodynamic and structural aspects become more crucial factors in hyper velocity vehicles. The paper mainly focuses on effective blunt body design. In order to achieve the effectiveness various radius of curvature taken into account and comparative study were done. Along with that flow compressibility, chemical reaction, aerodynamic heating, stagnation conditions were discussed. Extensive review was done to select most efficient blunt body design in both aerodynamic and structural aspects

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I. Introduction (Heading 1)

Hypersonic region means, one is travelling five times faster or more than that in compare with speed of sound. The flow compressibility, chemical reaction, stagnation conditions, aerodynamic heating plays important role during high speed flight. Further increase in Mach number, produces more strong shock around body and its start moving closer to the body surface. The ionization of gas occurs and the radiative heat transfer starts dominate the heat transfer in flow. All occurs at hypersonic region. The paper will discuss the variation in design parameters of nose cone and its effect in hypersonic region. Stagnation point, aerodynamic heating calculation as well as detail study of the both aerodynamic and structural parameter will be presented in paper. In order to find the efficient nose shape design for the hypersonic region, experimental study has been done by comparing different nose shape design. The flight conditions have set to be at sea-level reference. This efficient design was chosen by altering the nose cone radius of curvature simultaneously. Bluntness ratio are set to be varying according to the design parameters. Designing hypersonic vehicle with minimum drag is the major goal for all the designers. The drag value directly relates to the heat transfer rate of the hypersonic vehicle. If low drag is the prime goal then sharp edges produces better result. But considering the aerodynamic performance using the sharp edge may decrease the performance. So, based on the velocity front radius need to be altered in order to get better aerodynamic performance [1] . Considering the sharp leading edges leads to less drag but heat transfer rate will be high. In hypersonic vehicle the most important part will be aerodynamic heating, so instead of using sharp cone spherically blunted and parabolic structures will produces better aerodynamic efficiency [2] . In studies that shows clearly the fineness ratio decides the flow properties. Based on computational and experimental analysis they proved that fineness ration less than 1.2 in blunted cone provides less drag. Parabolic nose cone with 1.2 and above fineness ratio values provides huge decrement in the drag value. Some experimental investigation [3] shows the aerodynamic heating rate is dependent on the leading edge radius or diameter. To reduces the heating rate different technics were used like spikes, gaseous jet, porous in the leading edge. At the same time apex angle also place a major role in varying the flow property. The researchers produced better aerodynamic heating performance in blunt cone using gaseous jet. To minimize the aerodynamic drag over blunt body different designing technics were used. Experimental study on tangent ogive [4] taken into analysis due to its high leading-edge surface area. Passive porosity layers were introduced with different hole intend diameter. Initially with zero yaw angle the design has been tested experimentally and computationally. Later change of yaw angle also incorporated to get much impact on the stagnation point. To achieve more output low gradient pores were made. Comparing to all different design this bi-cone section were used in many re-entry vehicles, while designing normal bi-cone section with small fineness ratio the lift to drag ratio were optimal but aerodynamic heating rate is immense. So, the researchers from USA [5] went with the blunt bi-cone section where the output lift to drag ratio is high and heat transfer rate will be low. The same computational design was tested with different apex angle and produced unexpected output comparing to supersonic speed in hypersonic speed, the flow parametric change is favorable using blunt bi-cone. Hypersonic vehicle's design objective is vast comparing to other

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normal design. To achieve the optimal design with all the objectives covers is impossible. So, using defined algorithm to achieve the result will be the future for engineering fields. Normally single objective optimization and multi objective optimization we can obtain the design [6] . In that single objective optimization method provides better output with all the prescribed objectives, but time-consuming progress comparing to multi objective method. The current study shows the comparative analysis on five different bluff bodies. All the design taken from the literature undergone a multiple analysis in order to find the flow property changes in the hypersonic level. ANSYS software was used for all computational analysis

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