International Journal of Mechanical and Production Engineering Research and Development (IJMPERD)
ISSN (P): 2249-6890; ISSN (E): 2249-8001
Vol. 8, Issue 5, Oct 2018, 173-184

THE COMPUTATION OF STIFFNESS DERIVATIVE FOR AN OGIVE IN THE HYPERSONIC FLOW

AYSHA SHABANA[1,2], RENITA SHARON MONIS[3,4], ASHA CRASTA[5] & S. A. KHAN[6]

[1]*Research Scholar, Department of Mathematics, Mangalore Institute of Technology & Engineering, Mangaluru, Karnataka, India*

[2]*Assistant Professor, Department of Mathematics, Sahyadri College of Engineering & Management, Mangaluru, Karnataka, India*

[3]*Research Scholar, Department of Mathematics, Mangalore Institute of Technology & Engineering, Mangaluru, Karnataka, India*

[4]*Assistant Professor, Department of Mathematics, Shri Madhwa Vadiraja Institute of Technology & Management, Bantakal, Karnataka, India*

[5]*Associate Professor, Department of Mathematics, Mangalore Institute of Technology & Engineering, Mangaluru, Karnataka, India*

[6]*Professor, Department of Mechanical Engineering, Faculty of Engineering, International Islamic University Malaysia-Gombak Campus, Kuala Lumpur, Malaysia*

ABSTRACT

Expression for Stiffness derivative for an Ogive is derived with the suppositions of the arc on the nose of the cone from the air is being considered as perfect gas and the viscosity being neglected, the motion is quasi-steady, and the nose deflection angle of the Ogive θ is in such a way that the M_2 after the shock is > 2.5.

It is seen that due to the increment in angle θ, the stiffness derivative increases linearly due the progressive increase in the plan form area of the nose shape. The results indicate that there is a 38 percent increase in the stability derivative when the flow deflection θ was enhanced in the range of 5 to 10 degrees. With the further enhancement in the flow deflection angle θ from ten degrees and above, does not yield substantial increase in the stability derivative. Due to this change in the surface pressure distribution will lead to shift the location of centre of pressure, from the hinged position h = 0.5 to 0.8. The centre of pressure also has shifted towards the downstream, which lies in the range from h = 0.72 to 0.85.

***KEYWORDS**: Stability Derivative, Surface Pressure, Ogive, Stiffness Derivative & Pitch Angle*

Received: Jul 23, 2018; **Accepted:** Aug 13, 2018; **Published:** Aug 31, 2018; **Paper Id.:** IJMPERDOCT201821

Original Article

1. INTRODUCTION

Stability derivative plays an important role and its significance in the performance of Rockets and Missiles at high Mach numbers. At high Mach numbers the nose of the aerospace vehicles either be non-slender or blunt as aerodynamic heating is of major concern. The evaluation of stability derivatives in pitch marks the point of importance and its study for axis-symmetric ogives at hypersonic flow is presented here. The present work is for attaching shock case for an ogive having sharp nose, which can be used in future to more useful shapes incorporating the factor due to blunt.

The present scenario of study of hypersonic flows helps in attaining a position of non-slender body shapes and at high angle of incidence which would form the basis of the remarkable development of efficient hypersonic vehicles.

The theory of similitude for hypersonic flow which is valid for the windward side of an aerofoil with high angle of incidence was developed by Ghosh [1] preconditioned with Mach number after the shock the M > 2.5 and with an attached bow shock. The extension of Ghosh's work on pitching non-planar wedges was developed by Crasta and Khan to evaluate the aerodynamic stability derivatives in pitch for both Supersonic [2] and Hypersonic flows [10] to [12].

Ghosh K. [2] has extended his theory of large deflection similitude [1] to attached shock axisymmetric bodies realising the equivalence of motion in a piston with axial symmetry. The wedge revolving around the stream wise axis results in a cone while the same realisation of the flow field which is independent of 1-D fluid slab[1]which resultsin similar conico-annular area. Ghosh, K., [2] proves that the flow field past the fully unsteady cone is equivalent to a piston-motion in the conico-annular area, which is known as1-D similitudinal slab. Ghosh, K., [2] gives a similitudinal flow basedsolution for a cone, which forms the solution for shock layer of fixed density. The pressure on the surface of the cone in terms of the inertia level at the piston surface is gauged by the constant density form of the compressible flow. Results are found for hypersonic flow for a thermally perfect gas over pitching ogives for various inertia level and flow deflection angles.

2. ANALYSIS

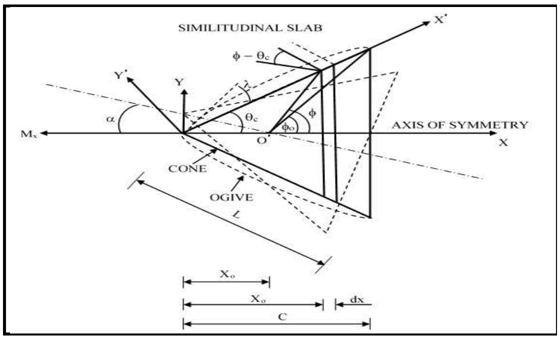

Figure 1: Cone and Ogive Geometry

From the geometry we have

$$\tan\phi = \frac{x\tan\theta_c}{(x - x_0)}\ ;\ \tan\phi_0 = \frac{c\tan\theta}{(c - x_0)}$$

Where ϕ is the angle subtended by A at O' with x-axis, and for various position of A, ϕ varies from π to ϕ_c,

θ_c is the flow deflection angle of the ogive and the chord length is c.

The Stiffness derivative presented by $C_{m\alpha}$, is

$$C_{m_\alpha} = \left[\frac{\partial M}{\partial \alpha}\right]_{\alpha,q\to 0} \frac{1}{\frac{1}{2}P_\infty U_\infty^2 S_b c}$$

Where S_b= base area of the ogive= $\pi(c\tan\theta_c)^2$, c = Length of the chord for ogive.

After simplification we get the following,

The equation for the ratio of pressure for a steady cone at zero angle of attack (Ghosh, K., 1984), provided the shock is attached at the nose of the cone, is

$$\frac{P_{bo}}{P_\infty} = 1 + \gamma M^2{}_{po}\left(1 + \frac{1}{4}\varepsilon\right) \quad (1)$$

Where the density ratio is

$$\varepsilon = \frac{2 + (\gamma - 1)M^2{}_{po}}{2 + (\gamma + 1)M^2{}_{po}} \quad (2)$$

and M_{po} is the local Mach number of the piston, which operates in a conico-annular area; P_{bo} is the surface body pressure of the ogive at zero angle of incidences.

$$M_{po} = M_\infty \sin\theta_c$$

Where θ_c is the semi angle of ogive

Now

$$\frac{dP_{bo}}{dM_{po}} = 2\gamma P_\infty M_{po}\left[1 + \frac{1}{4}\left(\varepsilon + \frac{1}{2}M_{po}.\frac{d\varepsilon}{dM_{po}}\right)\right] \quad (3)$$

Where

$$\frac{d\varepsilon}{dM_{po}} = \frac{-8M_{po}}{N^2} + \lambda' f\left\{\frac{8K(3(\gamma+1)K^2 - 2)}{N^3}\right\} \quad (4)$$

and $N = \left[2 + (\gamma+1)M_{Po}^2\right]$

On solving (3) we get

$$\frac{dP_{bo}}{dM_{po}} = 2\gamma P_\infty M_{po}\left[(a_1 + \lambda' a_2) - \frac{2a_2\lambda' h \tan\phi}{\tan\phi - \tan\theta_c}\right] \quad (5)$$

Where, $h = \frac{x_0}{c}$,

$\lambda' = \frac{\lambda}{\tan\theta_c}$ $a_1 = 1 + \frac{\varepsilon}{4} - \frac{K^2}{N^2}$, and $a_2 = 1 + \frac{\varepsilon}{4} - \frac{K^2(N+8)}{N^3}$

Thus utilizing the above derived definition the equation for Stiffness derivative is derived as

$$C_{m_\alpha} = [C_{m_\alpha}]_{cone} + \frac{2\lambda' a_2}{3(1+n^2)}\left[h^3\left\{1-2n^2-h(1-3n^2)\right\}+(1-h)\{H(1+h+h^2)+3n^2h^3\}\right]$$

Where,

$$[C_{m_\alpha}]_{cone} = D\left[h^3(1-2n^2)-(1-h)\left\{H(2+h)+n^2h(1+2h)\right\}\right]$$

$$D = \frac{2}{3(1+n^2)}\left[1+\frac{1}{4}\left(\varepsilon+\frac{1}{2}K\frac{d\varepsilon}{dM_{po}}\right)\right] \quad (6)$$

$$H = \left(1-h+n^2\right)$$

and $n = \tan\theta_c$

The above derived expression for stability derivative has been used to obtain the results for various geometrical as well as the inertia parameters and the same have been plotted and discussed in the section to follow.

3. RESULTS AND DISCUSSIONS

This section discusses the results in respect of stiffness derivative for the ogive nose shape. To achieve the ogive shape we have taken the basic shape of the cone and then an arc has been superimposed to achieve the desired Ogival shape. Initially the semi vertex angle (θ) of the cone is selected and then an arc has been superimposed for different values of λ which is positive as well as negative to get convex as well as the concave shape. For a given value of the λ, the semi-vertex angle (θ) has been varied from 5 degrees to 25 degrees, keeping the shape of the ogive circular arc the same. The main objective here is to study the effect of the variations of the semi-vertex angle which basically will result in a continuous increase in the plan form area of the nose of the cone. Once the shape of the nose with the conic shape is done, then an arc for λ = ± 5 is super imposed on the nose of the cone. The shape of the nose of the cone will vary depending upon the λ, when the λ is positive the shape will be convex and when the λ is negative the nose shape will become concave. Results for λ = 5 are shown in Figures. 2 to 6. Results for Mach 5 and λ = 5 are shown in Figure 2, for the semi vertex angles(θ) in the range from 5 to 25 degrees, it is seen that due to the enhancement in angle θ, the stiffness derivative increases linearly due the progressive increase in the plan form area of the nose shape. From the results of the figure 2 it is found that there is a 38 percent increase in the stiffness derivative when angle θ was increased from five degrees to ten degrees. When the angle θ is further increased from ten degrees up to fifteen degrees, does not yield substantial increase in the stability derivative in pitch. The physics behind this behaviour may be that when the angle θ was increased from five degrees to ten degrees, and then later when the circular arc was superimposed that leads to the maximum gain in the plan form area. Later with further increase in the angle θ will not result in appreciable incremental in the plan form area which was achieved when the angle θ was increased from 5 to 10 degrees. Further, it is seen that the due to the area distribution, with continuous increase in the magnitude of the semi-vertex angle the surface pressure will vary and may this surface pressure distribution may align most of its surface area towards the trailing edge, thereby shifting the location of centre of pressure. Due to this change in the surface pressure distribution on the ogive which will lead in the shift of the centre of pressure, and this movement of the centre of pressure is varying from the pivot position h = 0.5 to 0.8. In view of this shift in the location of the centre of pressure will definitely result to enhancement in the magnitude of the stiffness derivative, thereby; increasing the static margin of the system where they employed. While deciding on the angle θ and λ we need to take care of the range of the static margin, in case if the static margin is very high would lead to restricted manoeuvrability of the system, it may not be desirable in some specific cases like for instance fighter aircraft. For the fighter aircraft normally, the static margin is either zero or negative to enhance its capability during the war time fight when entering into the enemy air space. Here the variation in the semi vertex angle will have the major role to play, as the arc radius has been kept constant for various Mach numbers and the flow deflection angle θ.

Results for Mach number of 7 are shown in the Figure 3. Due to the increment in the Mach number and the increased values of the inertia there will be a marginal change in the surface pressure over the nose, and also, this surface pressure value will get modified. In view of these two factors the magnitude of stiffness derivative is getting reduced continuously all along the pivot positions. The similar trends of continuous decrease in the stiffness derivative are seen for Mach 9, 10 and 15 are also seen in Figures. 4 to 6, with the exception that the magnitude of decrement is less as compared to the previous case. Here, once again the trend of decrease in the stiffness derivative continues all along the nose length of the ogive, and reversal in the trends is not seen in any of these cases.

Results for semi-vertex angles in the range from θ = 5 to 25 degrees, and λ = - 5 for Mach numbers in the range from M = 5 to 15 are shown in the Figures 7 to 11. For this case the λ being negative implies that the shape of the arc is just opposite of the previous case when the λ was 5 with a positive sign. This will lead to a reduction in the plan form area of the nose portion. Obviously this will result in a decrease of the stiffness derivative with the increase in the angle θ. Figure 7 presents the variation in stiffness derivative as a function of hinged position h for various flow deflection angles θ in the same range as discussed above and also, for fixed value of Mach number 5 and λ = -5.

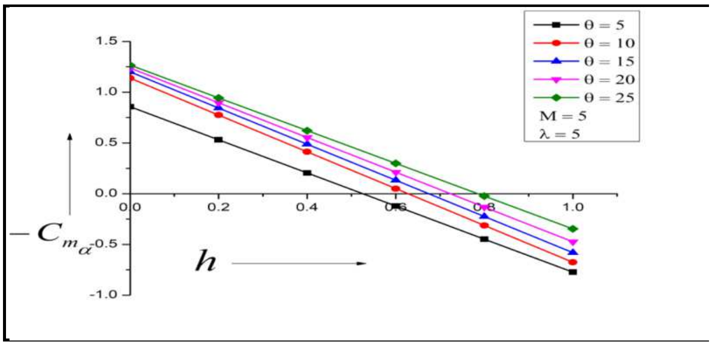

Figure 2: Variation of Stiffness Derivative with h for M=5

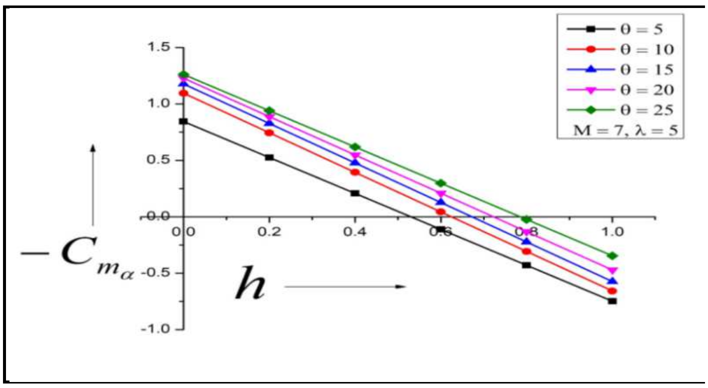

Figure 3: Variation of Stiffness Derivative with h for M=7

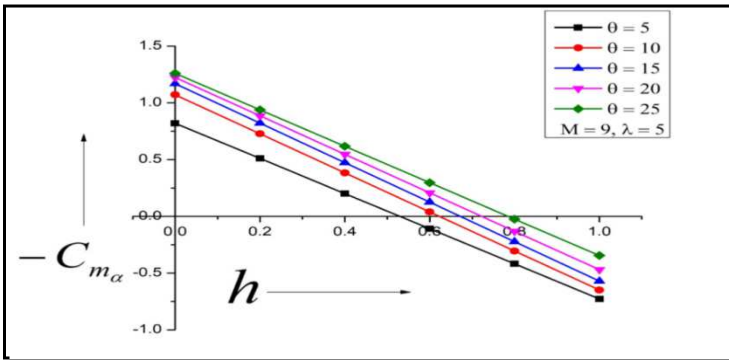

Figure 4: Variation of Stiffness Derivative with h for M=9

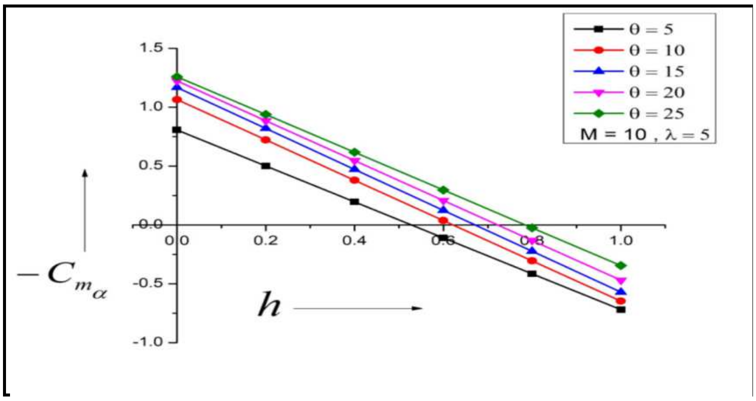

Figure 5: Variation of Stiffness Derivative with h for M=10

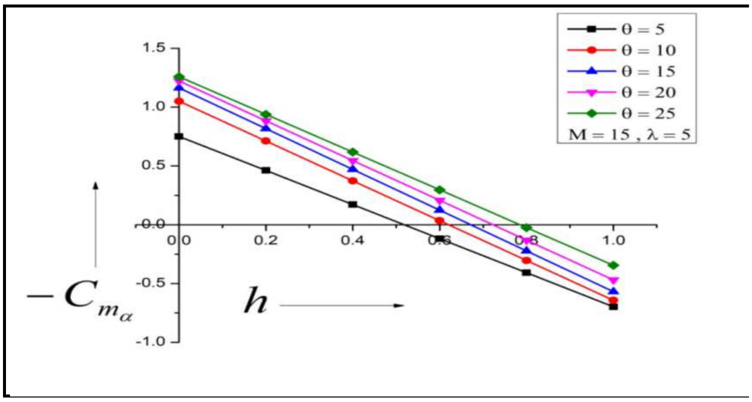

Figure 6: Variation of Stiffness Derivative with h for M=15

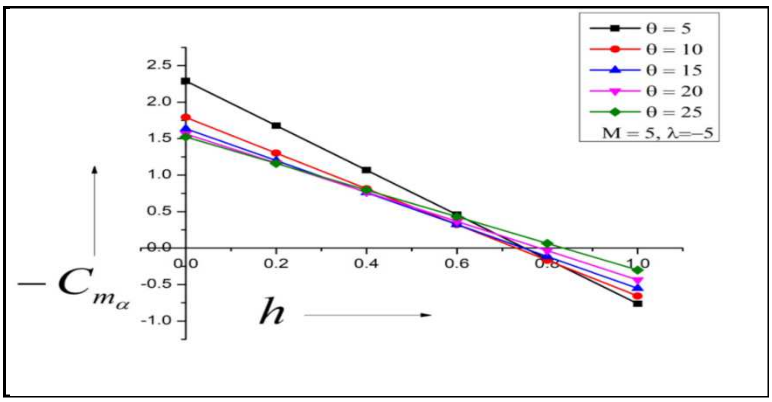

Figure 7: Variation of Stiffness Derivative with h for M=5

Results for semi-vertex angles from θ = 5 to 25 degrees, and λ = - 5 for Mach numbers in the range from M = 5 to 15 are shown in the Figure 7 to 11. For this case the λ being negative implies that the shape of the arc is just opposite of the previous case when the λ was 5 with positive sign. This will lead to reduction in the plan form area of the nose portion. Obviously, this will result in decrease of the stiffness derivative with the increase in the angle θ. Figure 7 presents the variation in stiffness derivative as a function of hinged position h for a wide range of angles θ in the same range as discussed above and also, for a fixed value of Mach number 5 and λ = -5. The figure indicates that the magnitude of the stiffness derivative is very high as compared to the previous case when λ = 5. Also, it is seen that with the increase in the value of θ there is a continuous reduction in the value of the stiffness derivative, which is in contrast with the previous case when λ = 5. This reversal in the trend is due to the change in shape of the nose and redistribution of the area along the length of the nose. The location of centre of pressure also has shifted in the direction of the trailing edge and it lies in the range from h = 0.72 to h = 0.85. This once again shows that due to the change in the shape of the Ogive these changes are taking place. When the Mach number is increased to 7 it shows almost similar results except the magnitude has come down as seen in Figure 8. However, there is no change in the centre of pressure due to the change in the inertia level. Similar results are seen for Mach 9, 10, and 15 with a marginal change in the magnitude of the stiffness derivatives. It is seen that the location of the centre of pressure does not change due to the increase in the Mach number which also indicate that for the higher Mach number the flow has achieved the steady state condition and does not vary with the enhancement in the Mach number. Another interesting observation is that when λ was positive the, with the increase of θ values the increment in the stiffness derivative was linear and uniform all along, whereas in the case of λ being negative due to the shape change of the nose and due to the variation in the surface pressure the trend are totally different, even though the trend in the shift of the centre of pressure remained in the direction of the trailing edge.

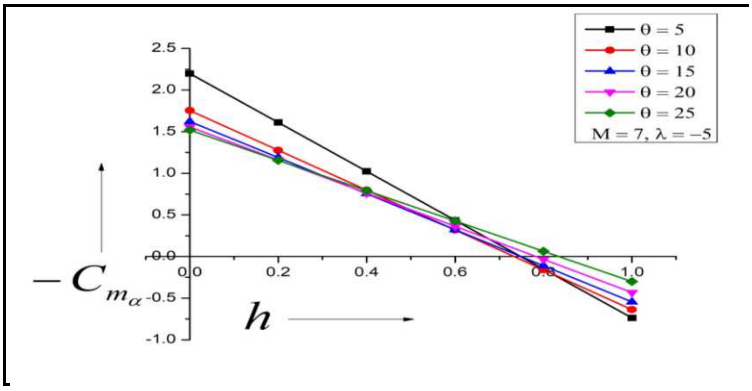

Figure 8: Variation of Stiffness Derivative with h for M = 7

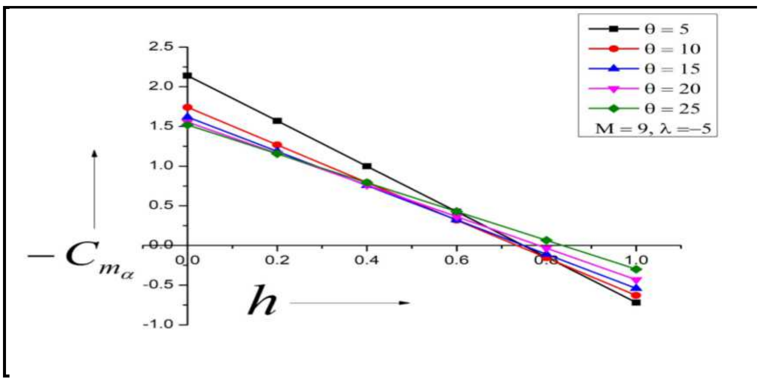

Figure 9: Variation of Stiffness Derivative with h for M = 9

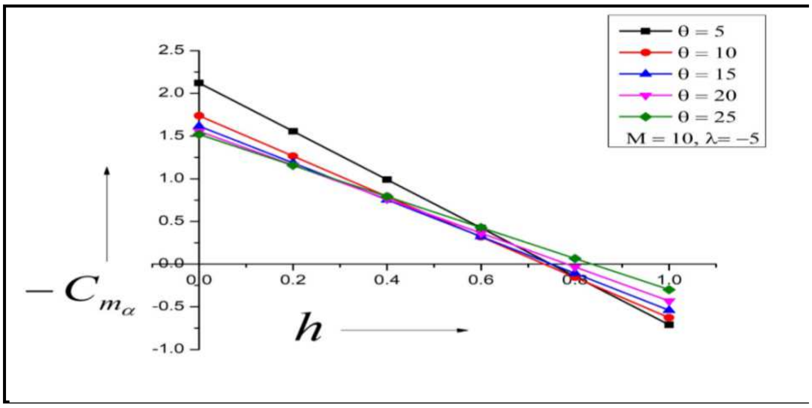

Figure 10: Variation of Stiffness Derivative with h for M = 10

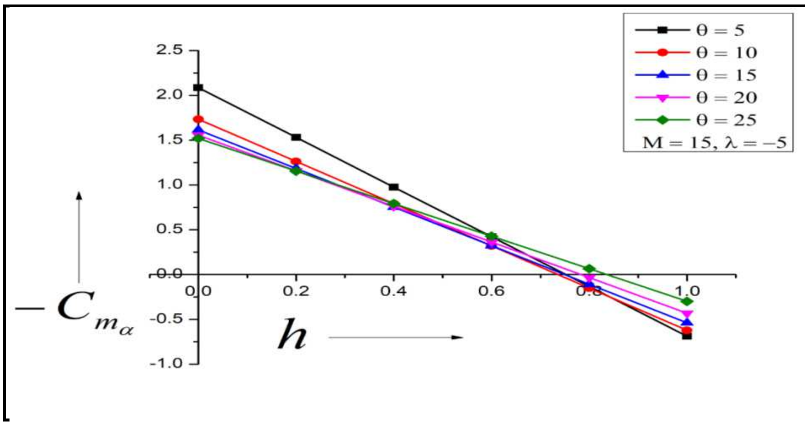

Figure 11: Variation of Stiffness Derivative with h for M = 15

4. CONCLUSIONS

In view of the above discussions we conclude the following:

From the results, it is seen that due to the increase in the angle θ, the stiffness derivative increases linearly due the progressive increase in the plan form area of the nose shape.

From the results it is observed that there is a 38 percent increase in the stiffness derivative when the angle θ was increased from 5 to 10 degrees. With further increase in the angle θ from ten degrees and above, does not yield substantial increase in the stiffness derivative.

Further, it is seen that due to the change in the semi-vertex angle and hence the area distribution, the surface pressure will vary and this surface pressure distribution may align most of its surface area towards the trailing edge, thereby shifting the location of the center of pressure.

Due to this change in the surface pressure distribution on the Ogive which will lead in the shift of the centre of pressure, and this shift in the centre of pressure is varying from the pivot position h = 0.5 to 0.8.

In view of this shift in the location of the centre of pressure will definitely result to enhancement in the magnitude of the stiffness derivative, thereby; increasing the static margin of the system where they employed.

While deciding on the angle θ and λ we need to take care of the range of the static margin. Here the variation in the semi vertex angle will have the major role to play, as the arc radius has been kept constant for various Mach numbers and the semi-vertex angle.

The magnitude of stiffness derivative is getting reduced continuously all along the pivot positions with the increment in the inertia level and the semi-vertex angle, with further increase in the Mach does not yield the same results.

For this case the λ being negative implies that the shape of the arc is just opposite of the previous case when the λ was 5 with a positive sign. This will lead to a reduction in the plan form area of the nose portion. Obviously this will result in a decrease of the stiffness derivative with the increase in the angle θ.

Also, it is seen that with the increase in the value of θ there is a continuous reduction in the value of the stiffness derivative, which is in contrast with the previous case when $\lambda = 5$. This reversal in the trend is due to the change in shape of the nose and redistribution of the area along the length of the nose. The centre of pressure also has shifted towards the trailing edge and it lies in the range from $h = 0.72$ to $h = 0.85$. However, there is no change in the centre of pressure due to the change in the inertia level. Similar results are seen for Mach 9, 10, and 15 with a marginal change in the magnitude of the stiffness derivatives.

Another interesting observation is that when λ was positive the, with the increase of θ values the increment in the stiffness derivative was linear and uniform all along, whereas in the case of λ being negative due to the shape change of the nose and due to the variation in the surface pressure the trend are totally different, even though the trend in the shift of the centre of pressure remained towards the trailing edge

REFERENCES

1. *Ghosh, K. (1977). A New Similitude for Aerofoils in Hypersonic Flow. Proceedings of the 6th Canadian Congress of Applied Mechanics, Vancouver, Canada, May 29-June 3, pp. 685-686.*
2. *Ghosh K., (1984). Hypersonic large deflection similitude for oscillating delta wings. The Aeronautical journal, pp. 357-361.*
3. *Asha Crasta and Khan S. A., (2012). High Incidence Supersonic similitude for Planar wedge. International Journal of Engineering research and Applications, 2(5), pp. 468-471.*
4. *Asha Crasta and S. A. Khan, (2012). Estimation of Stability derivatives of an Oscillating Hypersonic delta wings with curved leading edges. IJMET, 3(3), pp. 483-492.*
5. *Asha Crasta, M. A. Baig, S. A. Khan, (2012). Estimation of Stability derivatives of a Delta wing in Hypersonic flow. International Journal of Emerging trends in Engineering and Developments , 6(2), pp. 505-516.*
6. *Asha Crasta and S. A. Khan, (2012). Oscillating Supersonic delta wing with Straight Leading Edges. International Journal of Computational Engineering Research, 2(5), pp. 1226-1233.*
7. *Asha Crasta and S. A. Khan, (2014). Effect of Angle of Incidence on Stability derivatives of a Wing. International Journal for Research in Applied Science and Engineering Technology, 2(V), pp. 411-422.*
8. *Asha Crasta and S. A. Khan, (2014). Hypersonic Similitude for Planar Wedges. International Journal of Advanced Research in Engineering and Technology, 5(2), pp. 16-31.*
9. *Asha Crasta and S. A. Khan, (2014). Estimation of Stability Derivatives for a Planar Wedge in the Newtonian Limit. IOSR Journal of Mathematics, 10(2), pp. 01-06.*
10. *Asha Crasta and S. A. Khan, (2014). Effect of Mach number on Stiffness and Damping Derivatives for Oscillating Hypersonic Non-Planar Wedge. IOSR Journal of Mechanical and Civil Engineering, 11(2), pp. 04-11.*

11. *Asha Crasta and S. A. Khan, (2014). Effect of Angle of Incidence on Stiffness and Damping derivatives for Oscillating Hypersonic Non-planar Wedge. International Journal for Research in Applied Science and Engineering Technology, 2(IV), pp. 229-242.*

12. *Asha Crasta and S. A. Khan, (2014). Supersonic Similitude for Oscillating Non-Planar wedge. IOSR Journal of Mathematics, 10(2), pp. 15-24.*

13. *Khan S. A. and Asha Crasta, (2010). Oscillating Supersonic delta wings with curved leading Edges. Advanced Studies in Contemporary Mathematics, 20(3), pp. 359-372.*

14. *Asha Crasta and S. A. Khan (2015). Effect of Angle of attack on Stiffness derivative of an oscillating supersonic delta wing with curved leading edges. IOSR-JMCE, issue 1, Volume 12, December, pp 12-25.*

15. *Asha Crasta and S. A. Khan, (2015). Effect of Angle of attack on Damping derivative of a delta wing with full sine curved leading edges. IJETED Journal issue 5, Volume 1, December- January.*

16. *Asha Crasta and S. A. Khan, (2015). Estimation of Damping derivative of a delta wing with half sine curved leading edges. IOSR Journal of Mechanical and civil engineering, Vol. 12, issue 1, February, pp 40-44.*

17. *Asha Crasta and S. A. Khan (2015). Estimation of Damping derivative in pitch of a Supersonic delta wing with curved leading edges. IOSR Journal of Journal of Mathematics, Vol. 1, issue 1, Jan-feb, pp.07-15.*

18. *Asha Crasta and S. A. Khan (2015). Effect of Aspect ratio with angle of attack of an oscillating Hypersonic delta wing with Straight Leading edges". Mathematical Sciences International research Journal, volume 4, issue 2, pp.28-33., ISSN2278-8697.*

19. *Aysha Shabana, Renita Monis, Asha Crasta and S. A. Khan. Pressure and its derivative with respect to piston Mach number for an oscillating cone. IOSR Journal of Mechanical and Civil Engineering , volume 2, pp. 74-78.*

20. *Asha Crasta, Aysha Shabana, Renita Monis, and S. A. Khan. Analysis of Variation of Stiffness Derivative with Mach number and angle of attack for a supersonic flow. IOSR Journal of Mechanical and Civil Engineering, volume 2, pp. 97- 104.*

21. *Renita Monis, Aysha Shabana, Asha Crasta and S. A. Khan. Supersonic Flow Analysis and Evaluation of Damping Derivative. IOSR Journal of Mechanical and Civil Engineering, Volume 3, pp. 29- 36.*

22. *Asha Crasta, S. A. Khan. Determination of Surface Pressure of an axisymmetric ogive in Hypersonic Flow. Mathematical sciences International Research Journal, Vol. 2, Issue 2, August 2013, pp.333-335, ISSN: 2278-8697.*

23. *Asha Crasta and Khan S. A., (2014). Stability derivatives of a Delta Wing with Straight leading edge in the Newtonian Limit. International Journal of Engineering research and Applications, Vol. 4, Issue 3, Version 2, March, pp. 32-38.*

24. *Asha Crasta and S. A. Khan, (2013). Stability Derivatives in the Newtonian Limit. International Journal of Advanced Research in Engineering and Technology, Volume 4, Issue 7, Nov-Dec., pp. 276-289.*

25. *Asha Crasta, S. A. Khan, (2014). Effect of angle of incidence on Roll damping derivative of a delta Wing. International Journal of Emerging trends in Engineering and Developments Vol. 2, Issue 4, March 2014, pp. 343-356.*

26. *Kanth, U., Sandeep, C. S., & Prasad, U. S. Comparison Of Wall Temperatures On Scramjet Inlets At Hypersonic Velocities.*

27. *Asha Crasta and S. A. Khan, (2014). Effect of Angle of attack on Stability derivatives of a Delta wing with Straight leading edge in Supersonic Flow. International Journal of Mathematics, Vol. 10, issue 5, Sep-oct 2014. Pp. 01-08.*

28. *Asha Crasta, S. A. Khan, (2014). Effect of sweep angle on Roll damping derivative of a delta Wing. International Journal of Emerging trends in Engineering and Developments Vol 15, Issue 4, Aug-Sep, pp. 45-55.*

29. *Asha Crasta and S. A. Khan, (2014). Effect of Angle of attack on Stability derivatives of a Delta wing in Hypersonic flow with Straight leading edge. International Journal of Mechanical and civil engineering, Vol. 11, issue 5, Sep-oct (ver.2). Pp. 21-29.*
30. *Asha Crasta and S. A. Khan (2014). Effect of sweep angle on rolling moment derivative of an oscillating supersonic/hypersonic delta wing. International journal of modern Engg. Research, Vol. 4, issue 10, ver3, pp.15-22.*
31. *Asha Crasta and S. A. Khan, (2016). Effect of Aspect ratio with roll moment derivative of a delta wing in supersonic flow. International Journal of Advances in Engineering Research, (IJAER) Vol. No. 12, Issue No. I, July, pp.10-15, e-ISSN: 2231-5152, p-ISSN: 2454-1796.*
32. *Aysha Shabana, Renita Sharon Monis, Asha Crasta and S. A. Khan, (2017). Estimation of stability Derivative Of an Oscillating cone in Hypersonic Flow. International Journal of Recent Research Aspects ISSN: 2349-7688, Vol. 4, Issue 4, Dec 2017, pp. 46-52.*
33. *Renita Sharon Monis, Aysha Shabana, Asha Crasta and S. A. Khan (2017). Computation of Stiffness Derivative for an unsteady delta wing with curved leading edges. International Journal of Recent Research Aspects ISSN: 2349-7688, Vol. 4, Issue 4, Dec 2017, pp. 69-72.*