Scopus

Documents

Shaikh, J.S.[a] , Kumar, K.[a] , Pathan, K.A.[b] , Khan, S.A.[c] , Kharadi, F.H.[d] , Siddiqui, A.[e]

Estimation of the Damping Derivative in Pitch for a Wedge at Supersonic Mach Numbers using Design of Experiments

(2024) *Journal of Advanced Research in Experimental Fluid Mechanics and Heat Transfer*, 18 (1), pp. 106-117.

DOI: 10.37934/arfmts.18.1.106117

[a] Department of Applied Sciences and Humanities, MIT School of Engineering, MITADT University, Maharashtra, Pune, 412201, India
[b] Department of Mechanical Engineering, CSMSS Chh. Shahu College of Engineering, Aurangabad, 431011, India
[c] Department of Mechanical and Aerospace Engineering, Faculty of Engineering, International Islamic University Malaysia, Kuala Lumpur, 53100, Malaysia
[d] Shrimati Kashibai Navale College of Engineering, Maharashtra, Pune, 411041, India
[e] Department of Mathematics, School of Computational Sciences, Faculty of Science and Technology, JSPM University, Maharashtra, Pune, 412207, India

Abstract
This work primarily focuses on numerically modelling the damping derivative over the 2D wedge at different pivot points for considerable values of Mach number and incidence angles. The damping derivative is numerically simulated using regression model analysis. The two-dimensional piston theory of Ghosh is applied to obtain the analytical findings. The current study considers the variables Mach number, wedge angle and pivot location. In the present investigation, the wedge angle (θ) varies between 2° and 20°, while the Mach number (M) spans 2.2 to 4.0. The results of the damping derivatives are derived by analysing different Mach numbers (M) and angles of incidence (θ) at various pivot positions (h) ranging from 0.0 to 1.0. This study evaluates the damping derivative results against theoretical predictions, revealing a significant alignment between the two. Both the research findings and the theoretical forecasts show a striking similarity. This research demonstrates that the variation in damping derivative is influenced by factors like the Mach number (M), wedge angle (θ) and pivot position (h). At each pivot position, the magnitude of the damping derivative decreases with a rise in Mach number, which increases as the angle of incidence increases.

Author Keywords
angle of incidence; Mach number; supersonic flow

References

- Tsien, Hsue-shen
  Similarity laws of hypersonic flows
  (1946) *Collected Works of HS Tsien (1938-956)*, pp. 443-447.
- Lighthill, Mo J.
  Oscillating airfoils at high Mach number
  (1953) *Journal of the Aeronautical Sciences*, 20 (6), pp. 402-406.
- Hayes, Wallace D.
  On hypersonic similitude
  (1947) *Quarterly of Applied Mathematics*, 5 (1), pp. 105-106.
- Ghosh, K.
  A new similitude for aerofoils in hypersonic flow
  (1977) *Proceedings of the 6th Canadian Congress of Applied Mechanics*, pp. 685-686.
  Vancouver, Canada, May
- Miles, J. W.
  Unsteady flow at hypersonic speeds, Hypersonic flow
  (1960) *Butter worths Scientific Publications*, pp. 185-197.
  London

- Ghosh, Kunal, Mistry, Binoy Krishna
  Large incidence hypersonic similitude and oscillating nonplanar wedges
  (1980) *AIAA Journal*, 18 (8), pp. 1004-1006.

- Ghosh, Kunal
  Hypersonic large-deflection similitude for oscillating delta wings
  (1984) *the Aeronautical journal*, 88 (878), pp. 357-361.

- Khan, Sher Afghan, Aabid, Abdul, Ahamed Saleel, C.
  CFD simulation with analytical and theoretical validation of different flow parameters for the wedge at supersonic Mach number
  (2019) *International Journal of Mechanical and Mechatronics Engineering*, 1.

- Bashir, Musavir, Khan, S. A., Azam, Qummare, Janvekar, Ayub Ahmed
  Computational And Analytical Investigation Of Aerodynamic Derivatives Of Similitude Delta Wing Model At Hypersonic Speeds
  (2017) *International Journal of Technology*, 8 (3).

- Pathan, Khizar A., Khan, Sher A., Shaikh, N. A., Pathan, Arsalan A., Khan, Shahnawaz A.
  An investigation of boattail helmet to reduce drag
  (2021) *Advances in Aircraft and Spacecraft Science*, 8 (3), p. 239.

- Shaikh, Javed S., Kumar, Krishna, Pathan, Khizar A., Khan, Sher A.
  Analytical and computational analysis of pressure at the nose of a 2D wedge in high speed flow
  (2022) *Advances in aircraft and spacecraft science*, 9 (2), pp. 119-130.

- Shaikh, Javed S., Kumar, Krishna, Pathan, Khizar A., Khan, Sher A.
  Computational analysis of surface pressure distribution over a 2d wedge in the supersonic and hypersonic flow regimes
  (2023) *Fluid Dynamics & Materials Processing*, 19 (6).

- Shaikh, Javed Shoukat, Pathan, Khizar Ahmed, Kumar, Krishna, Khan, Sher Afghan
  Effectiveness of Cone Angle on Surface Pressure Distribution along Slant Length of a Cone at Hypersonic Mach Numbers
  (2023) *Journal of Advanced Research in Fluid Mechanics and Thermal Sciences*, 104 (1), pp. 185-203.

- Azami, Muhammed Hanafi, Faheem, Mohammed, Aabid, Abdul, Mokashi, Imran, Khan, Sher Afghan
  Experimental research of wall pressure distribution and effect of micro jet at Mach
  (2019) *International Journal of Recent Technology and Engineering*, 8 (2S3), pp. 1000-1003.

- Pathan, Khizar Ahmed, Dabeer, Prakash S., Khan, Sher Afghan
  Investigation of base pressure variations in internal and external suddenly expanded flows using CFD analysis
  (2019) *CFD Letters*, 11 (4), pp. 32-40.

- Khan, Sher Afghan, Aabid, Abdul, Veetil, Ahamed Saleel Chandu
  Influence of micro jets on the flow development in the enlarged duct at supersonic Mach number
  (2019) *International Journal of Mechanical and Mechatronics Engineering*, 19 (1), pp. 70-82.

- Pathan, Khizar, Dabeer, Prakash, Khan, Sher
  An investigation of effect of control jets location and blowing pressure ratio to control base pressure in suddenly expanded flows
  (2019) *Journal of Thermal Engineering*, 6 (2), pp. 15-23.

- Pathan, Khizar Ahmed, Ashfaq, Syed, Dabeer, Prakash S., Khan, Sher Afgan
(2019) *Analysis of parameters affecting thrust and base pressure in suddenly expanded flow from nozzle*,

- Pathan, Khizar Ahmed, Dabeer, Prakash S., Khan, Sher Afghan
Effect of nozzle pressure ratio and control jets location to control base pressure in suddenly expanded flows
(2019) *Journal of Applied Fluid Mechanics*, 12 (4), pp. 1127-1135.

- Pathan, Khizar A., Dabeer, Prakash S., Khan, Sher A.
Enlarge duct length optimization for suddenly expanded flows
(2020) *Advances in Aircraft and Spacecraft Science*, 7 (3), pp. 203-214.

- Pathan, Khizar Ahmed, Dabeer, Prakash S., Khan, Sher Afghan
Influence of expansion level on base pressure and reattachment length
(2019) *CFD Letters*, 11 (5), pp. 22-36.

- Fiqri, Muhammad Ikhwan, Pathan, Khizar Ahmed, Khan, Sher Afghan
Control of Suddenly Expanded Flow with Cavity at Sonic Mach Number
(2022) *International Conference on Advances in heat Transfer and Fluid Dynamics*, pp. 3-15.
Singapore: Springer Nature Singapore

- Asadullah, Mohammed, Khan, Sher Afghan, Asrar, Waqar, Sulaeman, E.
Low-cost base drag reduction technique
(2018) *International Journal of Mechanical Engineering and Robotics Research*, 7 (4), pp. 428-432.

- Azami, Muhammed Hanafi, Faheem, Mohammed, Aabid, Abdul, Mokashi, Imran, Khan, Sher Afghan
Inspection of supersonic flows in a CD nozzle using experimental method
(2019) *International Journal of Recent Technology and Engineering*, 8 (2S3), pp. 996-999.

- Khan, Slier Afghan, Rathakrishnan, E.
Active control of suddenly expanded flows from underexpanded nozzles-Part II
(2005) *International Journal of Turbo and Jet Engines*, 22 (3), pp. 163-184.

- Pathan, Khizar Ahmed, Chaudhary, Zakir Ilahi, Attar, Ajaj Rashid, Khan, Sher Afghan, Khan, Ambareen
Optimization of Nozzle Design for Weight Reduction using Variable Wall Thickness
(2023) *Journal of Advanced Research in Fluid Mechanics and Thermal Sciences*, 112 (2), pp. 86-101.

- Crasta, Asha, Pathan, Khizer Ahmed, Khan, Sher Afghan
Numerical simulation of surface pressure of a wedge at supersonic Mach numbers and application of design of experiments
(2023) *Journal of advanced research in applied mechanics*, 101 (1), pp. 1-18.

- Crasta, Asha, Pathan, Khizar Ahmed, Khan, Sher Afghan
Analytical and Numerical Simulation of Surface Pressure of an Oscillating Wedge at Hypersonic Mach Numbers and Application of Taguchi's Method
(2023) *Journal of Advanced Research in Applied Sciences and Engineering Technology*, 30 (1), pp. 15-30.

- Shaikh, Javed Shoukat, Pathan, Khizar Ahmed, Kumar, Krishna, Khan, Sher Afghan
Effectiveness of Cone Angle on Surface Pressure Distribution along Slant Length of a Cone at Hypersonic Mach Numbers
(2023) *Journal of Advanced Research in Fluid Mechanics and Thermal Sciences*, 104 (1), pp. 185-203.

- Khan, Sher Afghan, Fatepurwala, M. A., Pathan, K. N.
  CFD analysis of human powered submarine to minimize drag
  (2018) *Ratio (L/D)*, 4 (5).

- Pathan, Khizar A., Khan, Sher A., Shaikh, N. A., Pathan, Arsalan A., Khan, Shahnawaz A.
  An investigation of boattail helmet to reduce drag
  (2021) *Advances in Aircraft and Spacecraft Science*, 8 (3), p. 239.

- Fakhruddin, Ahmad'Afy Ahmad, Mahaboobali, Fharukh Ahmed Ghasi, Khan, Ambareen, Akhtar, Mohammad Nishat, Khan, Sher Afghan, Pathan, Khizar Ahmad
  Analysis of Base Pressure Control with Ribs at Mach 1.2 using CFD Method
  (2024) *Journal of Advanced Research in Fluid Mechanics and Thermal Sciences*, 123 (1), pp. 108-143.

- Khan, Ambareen, Rajendran, Parvathy, Singh Sidhu, Junior Sarjit, Thanigaiarasu, S., Raja, Vijayanandh, Al-Mdallal, Qasem
  Convolutional neural network modeling and response surface analysis of compressible flow at sonic and supersonic Mach numbers
  (2023) *Alexandria Engineering Journal*, 65, pp. 997-1029.

- Khan, Ambareen, Rajendran, Parvathy, Sidhu, Junior Sarjit Singh, Sharifpur, Mohsen
  Experimental investigation of suddenly expanded flow at sonic and supersonic Mach numbers using semi-circular ribs: a comparative study between experimental, single layer, deep neural network (SLNN and DNN) models
  (2023) *The European Physical Journal Plus*, 138 (4), p. 314.

- Chaudhari, Pavan Bhaskar, Arakerimath, Rachayya, Pathan, Khizar Ahmed, Khan, Sher Afghan
  Comparative Experimental Analysis and Performance Optimization of Single-Cylinder DI and HCCI Engine with Series Catalytic Converters
  (2024) *Journal of Advanced Research in Fluid Mechanics and Thermal Sciences*, 121 (1), pp. 173-187.

- Jain, Yogeshkumar, Kurkute, Vijay, Deshmukh, Sagar Mane, Pathan, Khizar Ahmed, Attar, Ajaj Rashid, Khan, Sher Afghan
  The Influence of Plate Fin Heat Sink Orientation under Natural Convection on Thermal Performance: An Experimental and Numerical Study
  (2024) *Journal of Advanced Research in Fluid Mechanics and Thermal Sciences*, 114 (2), pp. 118-129.

- Khalil, Shaikh Sohel Mohd, Sahai, Rai Sujit Nath, Gulhane, Nitin Parashram, Pathan, Khizar Ahmed, Attar, Ajaj Rashid, Khan, Sher Afghan
  Experimental Investigation of Local Nusselt Profile Dissemination to Augment Heat Transfer under Air Jet Infringements for Industrial Applications
  (2023) *Journal of Advanced Research in Fluid Mechanics and Thermal Sciences*, 112 (2), pp. 161-173.

- Shaikh, Sohel Khalil, Pathan, Khizar Ahmed, Chaudhary, Zakir Ilahi, Marlpalle, B. G., Khan, Sher Afghan
  An investigation of three-way catalytic converter for various inlet cone angles using CFD
  (2020) *CFD Letters*, 12 (9), pp. 76-90.

- Shaikh, Sohel Khalil, Pathan, Khizar Ahmed, Chaudhary, Zakir Ilahi, Khan, Sher Afghan
  CFD analysis of an automobile catalytic converter to obtain flow uniformity and to minimize pressure drop across the monolith
  (2020) *CFD Letters*, 12 (9), pp. 116-128.

- Kale, Dipak, Arakerimath, Rachayya, Pathan, Khizar Ahmed, Khan, Sher Afghan
  Investigation on Water Erosion Behavior of Ti-based Metal Matrix Composite: Experimental Approach

(2024) *Journal of Advanced Research in Fluid Mechanics and Thermal Sciences*, 122 (2), pp. 71-82.

- Sheikh, Fahim Rahim, Deshmukh, Suresh Pandurang, Ardhapurkar, Purushottam, Pathan, Khizar Ahmed, Shaikh, Sohel Khalil, Khan, Sher Afghan
  Modeling and Experimental Validation of NePCM-Nanofluid-Based PVT System
  (2024) *Journal of Advanced Research in Fluid Mechanics and Thermal Sciences*, 122 (1), pp. 205-222.

- Aqilah, Nur, Pathan, Khizar Ahmed, Khan, Sher Afghan
  Passive Control of Base Flow at Supersonic Mach Number for Area Ratio 4
  (2022) *International Conference on Advances in heat Transfer and Fluid Dynamics*, pp. 37-50.
  Singapore: Springer Nature Singapore

Correspondence Address
Khan S.A.; Department of Mechanical and Aerospace Engineering, Malaysia; email: sakhan@iium.edu.my

Publisher: Penerbit Akademia Baru

ISSN: 27568202
Language of Original Document: English
Abbreviated Source Title: J. Adv. Res. Exp. Fluid Mech. Heart Tranf.
2-s2.0-85216638283
Document Type: Article
Publication Stage: Final
Source: Scopus