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Numerical Modeling and Analysis of Damping Derivatives for a 2D Wedge at Hypersonic Mach Numbers and Variable Pivot Points

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Abstract
This investigation primarily underscores the numerical modeling of damping derivative across a two-dimensional wedge at diverse pivot points, particularly for considerable Mach numbers and angles of incidence values. The damping derivative is simulated numerically via regression model analysis. Analytical results are derived by employing Ghosh's two-dimensional piston theory. This study considers factors including Mach number, wedge angle, and pivot position. The current inquiry observes that the wedge angle (θ) spans from 3° to 30°, whereas the Mach number (M) fluctuates between 5.5 and 10.0. Damping derivatives results are acquired through the examination of various Mach numbers (M) and angles of incidence (θ) at multiple pivot locations (h) ranging from 0.0 to 1.0. This research evaluates the damping derivative findings against theoretical forecasts, revealing a notable correlation between them. Research results and theoretical predictions exhibit a remarkable resemblance; however, this study demonstrates that changes in damping derivative are influenced by factors such as Mach number (M), angle of the wedge (θ), and position of the pivot (h). At every pivot position, the damping derivative magnitude diminishes with an increase in Mach number; however, it ascends with an increase in the angle of incidence. This phenomenon is noteworthy because it underscores the complex interplay between these variables (factors), although one might posit that the relationship could be more linear under certain conditions.

Author Keywords
angle of incidence; hypersonic flow; Mach number; pivot position

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