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Evaluation of Stiffness Derivatives of a Wedge at Supersonic Speeds using Design of Experiment Methodology
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Abstract
The current research focuses on numerically simulating the stiffness derivative across the wedge for various supersonic Mach numbers and wedge angles at different pivot points. The knowledge of the stiffness derivatives is of prime importance from the stability point of view. The stiffness derivative is a measure of the stability of aerospace vehicles. The regression model analysis method is applied for the numerical simulation of the stiffness derivative. The analytical results are derived by applying Ghosh's two-dimensional piston theory. The factors Mach number, wedge angle, and pivot position are considered for the current investigation. For the current study, the Mach number (M) ranges from 2.2 to 4.0, and the wedge angle (θ) differs from 2° to 20°. The stiffness derivative findings are obtained for different Mach numbers (M) and angle of incidence (θ) at pivot various positions (h) spanning the range of 0.0 to 1.0. The present study's conclusions on stiffness derivatives are contrasted with the analytical findings. Excellent consistency is revealed by the current study's results and analytical outcomes. This study shows that the factors pivot position (h), wedge angle (θ), and Mach number (M) have significant effects on the variance of the stiffness derivative. The stiffness derivative rises continuously with the angle of incidence (θ) and reduces continuously as the Mach number (M) increases at each pivot location (h). The present theory is applicable when the shock waves are attached to the nose of the wedge.

Author Keywords
angle of incidence; Mach number; supersonic flow

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