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Aeroelastic Analysis of Hypersonic Aircraft Wing

Dan Xie[1,*], Shihao Zhang[1] and Zijun Yi[1]

[1]Northwestern Polytechnical University, Xi'an, 710072, China
[*]Corresponding Author: Dan Xie . Email: dxie@nwpu.edu.cn

ABSTRACT

Considering the high cost of numerical simulation for aeroelastic coupling analysis, it is difficult to directly apply it to engineering. In this paper, the typical swept trapezoidal wing of hypersonic aircraft [1] is simplified to a cantilever trapezoidal plate [2]. Based on semi-analytical method [3], including von Karman plate theory to consider the structural geometric nonlinearity, third-order piston theory to calculate quasi steady aerodynamic force, and Rayleigh-Ritz method to characterize the displacement as a mode superposition form, the aeroelastic equation of the swept trapezoidal wing is established, and the fourth-order Runge Kutta numerical integration is used to solve the aeroelastic response, realizing the rapid prediction of the stability boundary. Furthermore, by changing the geometric parameters of the swept trapezoidal wing, including sweep angle, taper ratio and aspect ratio, the effects of wing geometry parameters on aeroelastic response characteristics and flutter critical dynamic pressure are studied.

KEYWORDS

Hypersonic; aeroelasticity; semi-analytical; fast prediction

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