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# 采用乘性速压摄动的频域颤振预测方法

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# Flutter Prediction Based on Multiplicative Perturbation to Dynamic Pressure

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**摘要** 在鲁棒颤振分析方法基础上，提出一种乘性速压摄动表达式，使得颤振系统成为不确定性系统，并直接应用简谐气动力建立其μ框架，从而可以通过频域μ分析预测颤振临界点。导出了判定颤振临界点的μ极值条件，并给出其算法实现。该方法属于频域方法，在理论上具有良好的一致性；且无需求解颤振特征值，从根本上避免了经典的颤振分析方法中可能出现的“窜支”问题。计算结果表明，该方法与p-k法所得结果精度相当，适用于工程颤振分析。

**关键词：** 颤振 μ 分析 乘性不确定性 速压摄动 频域

Abstract:

A new expression of multiplicative perturbation to dynamic pressure is presented based on the robust flutter analysis method. The flutter system augmented with dynamic pressure uncertainty is formulated into a μ framework directly using frequency domain aerodynamics, which makes use of frequency domain μ analysis to predict the critical flutter point. The conditions for the local maximum of μ at the critical flutter point are derived and the algorithm is expounded in detail. This new method can eliminate the paradox in the classical flutter solutions that use frequency domain aerodynamics to solve the flutter eigenvalues in complex frequency domain. Moreover, this method does not need to solve flutter eigenvalues, thus eliminating the possible branch crossing problem. Numerical examples demonstrate that the proposed method can give as accurate flutter results as those obtained by classical flutter solutions, which suggests that it can be applied to engineering flutter analysis.

Keywords: flutter μ analysis multiplicative uncertainty dynamic pressure perturbation frequency domain

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