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间隙约束二元翼段系统分岔与多解共存现象分析

Analysis on the system bifurcation and coexistence of multiple solutions for typical airfoil section with freeplay

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中文关键词： 间隙非线性 二元翼段 极限环震荡 类Poincaré 截面 分岔 吸引域

英文关键词:freeplay nonlinearity typical airfoil section system limit cycle oscillation quasi-Poincaré section bifurcation attraction basin

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中文摘要：

研究了分段刚度描述的间隙约束二元翼段气动弹性系统，取俯仰角最大幅值处为类 Poincaré 截面，数值计算得到了系统随飞行速度变化的分岔图，发现飞行速度在*Ma*=0.71~0.75属于跨临界颤振区，而在*Ma*=0.75~0.95发生极限环震荡.同时通过构造极限环震荡的四维Poincaré映射分析了极限环震荡的稳定性，结合稳定性和运动流形理论，得到极限环震荡的吸引域一般位于极限环内部并用数值方法进行了验证.且跨临界颤振速度区域中存在多种分岔形式以及多解共存现象，例如由双周期运动直接通向混沌、多周期运动与双周期运动共存现象，振动幅值也存在跳跃现象.

英文摘要：

The typical airfoil section system with freeplay described by a piecewise-stiffness model was studied. The pitch angle at the maximum amplitude was chosen as the quasi-Poincaré sections to obtain numerically the bifurcation diagram with change of flight speed. It was found the trans-critical flutter area was located on flight speed of *Ma*=0.71-0.75 and limit cycle oscillation area located on flight speed of *Ma*=0.75-0.95 based on the bifurcation diagram. The stability of limit cycle oscillation was analyzed through the constructed four-dimensional map. According to the stability and motion manifold theory, it was learnt that the attraction basin of the limit cycle oscillation was located in the interior region of limit cycle, which was validated by the numerical method at last. At the same time, the coexistence of multiple solutions and various forms of bifurcation phenomena were found in trans-critical flutter area, such as the direct transition from double periodic motion to chaos, the coexistence of multiple periodic motion and double periodic motion, and the phenomenon of jump on amplitude.

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