Abstract

Interfaces or "joints", which are unavoidable in design and develop of mechanical equipment, plays a significant role in the behavior of the whole assembly. To some extent, the effect of the interfaces can be studied introducing the two contact parameters known as "contact stiffness" and "equivalent damping".

The normal contact stiffness (acting along the interface normal) and the tangential contact stiffness (acting on the interface plane) behave nonlinearly and depend on the condition of the contact surfaces. Moreover, if the contact surfaces undergo a relative displacement the interface dissipates the energy of friction. This energy dissipation results in additional damping of the structure. From a mechanical point of view joints affect, i) the static behavior of the assembly, ii) the dynamic behavior and iii) the local stress at the interfaces.

Joints affect the static behavior of the whole structure in terms of displacements and static strength. Furthermore, they change the dynamic behavior of the structure in terms of resonance frequency and peak amplitude. Uncertainties on the value of the contact parameters make the dynamic performance of the structure less predictable than desired.

This thesis focuses on the contact characteristics of the blade root joints subjected to the dry friction damping under periodic excitation. The numerical method and experimental procedure are combined to trace the contact behavior in the nonlinear vibration conditions. In the experimental procedure, a novel excitation method alongside the accurate measurements is used to determine the frequencies of the blade under different axial loads. In numerical simulations, the local behavior of contact areas is investigated using the reduction method as a reliable and fast solver. Subsequently, by using both experimental measurements and numerical outcomes in a developed code, the global stiffness matrix is calculated. This leads to finding the normal and tangential stiffness in the contact areas of a dovetail blade root joints. The results indicate that the proposed method can provide an accurate quantitative assessment for the investigation of the dynamic response of the joints by focusing on the contact areas.