EFFECT OF ADJACENT BLADE OSCILLATION ON THE FORCES ON A BLADE OF A COMPRESSOR CASCADE

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Abstract

The current trend of aircraft engines is one towards attaining high isentropic efficiency while minimizing its weight. This leads to a state where the blades are highly loaded and consequently susceptible to vibrations. High cycle fatigue caused as a result of such self-excited flutter or forced vibration due to defects in the air stream are detrimental to the engine. An understanding of the onset of instabilities is essential to predict their occurrences to avoid a catastrophic failure during operation or costly redesign during the development phase. The critical parameters in turbomachine aeroelasticity are the reduced frequency and the interblade phase angle. The damping of the system is known to be a function of the phase difference between the blade forces and the blade motion. In the present study, a linear cascade of five blades is considered to understand the effect of harmonically varying boundary conditions. The second and fourth blades of the cascade are subjected to torsional oscillation by an external mechanism. The third blade, considered as the reference, is stationary and instrumented. The unsteady pressure along the reference blade surface is measured simultaneously with the loads acting on the blade. The unsteady pressures are measured using a multi-sensor pressure scanner by multiplexing and the loads are measured using a five-channel strain gage balance. The blade displacement is determined from the integrated accelerometer signal mounted on an oscillating blade. The experiments are conducted at a low-subsonic speed and multiple oscillation frequencies. The cascade is set at zero incidence and four stagger angles. The effect of inter-blade phase angle is included as the oscillation of the walls adjacent to the reference blade. The phase difference between the harmonic motion of the neighboring walls and the pressure and load signals on the reference blade is related to the damping characteristics of the reference blade. The variation in damping is studied for the range of blade motion phase difference angles and reduced frequencies. The effect of the phase difference between the oscillating blades is seen to strongly affect the damping characteristics of the reference airfoil.