ACOUSTICS2008/1419
Prediction of Self Excitation Frequencies and Amplitudes for a Model Gas Turbine Burner

Catherine Gardner, S. M. Reza Hosseini and Chris Lawn
Queen Mary University of London, School of Engineering and Material Science, Mile End Road, E1 4NS London, UK

Forced excitation of a swirl stabilised methane/air flame by acoustic waves at atmospheric pressure has been characterised in order to show that the frequencies and amplitudes where self-excitation occurs, but the natural limit cycle takes effect, can be predicted from these data. Chemiluminescent emission was therefore recorded to measure the Flame Transfer Function (FTF), as the flame was acoustically excited by two loud speakers. The experiments covered a wide range of frequencies and amplitudes with particular emphasis on the FTF at high amplitudes of excitation, where a non-linear response is often reported. The system was modelled by the 1D thermo-acoustic element method, in which each acoustic element, such as a duct or a contraction, is described by a four-pole matrix. The flame is incorporated as another four-pole matrix that describes the measured flame transfer function. The solution of this set of equations without forcing predicts self-excitation frequencies and amplitudes that can be compared with the experimental data. The minimum magnitudes of the FTF for excitation may also be calculated. When proven at this small scale, the procedure will be applied to predict the limit cycling of actual installations from rig tests.