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Theoretical Source Statistics of Thermo-Acoustic Instability within Reacting Flow STEVEN MILLER, University of Florida, Department of Mechanical and Aerospace Engineering — We develop a statistical tool based on the equations of motion to quantify the various acoustic sources that cause thermo-acoustic instability. The Navier-Stokes equations, energy equation, and mass fraction equations are decomposed into their base, aerodynamic, and acoustic components. The acoustic components are solved for via the method of the vector Green's function. The spectral densities of acoustic fluctuations are then formed. The resultant two-point cross-correlations of the Navier-Stokes operator, energy equation operator, and mass fraction operator on the base and aerodynamic flow-field yield thermo-acoustic statistical sources. Resultant sources are the two-point cross-correlations consisting of terms involving traditional aerodynamic interactions, aerodynamic-combustion interactions, and combustion-combustion interactions. We show that under certain simplifying assumptions, the traditional Rayleigh criterion and combustion acoustic equations are recoverable. We compare the newly proposed theory to traditional Rayleigh criterion and acoustic equations. The benefit of the theory is all thermo-acoustic sources are accounted for in a single two-point cross-correlation model, which is consistent with traditionally accepted theory.

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