

Validity assessments of optical transfer function measurements for technically premixed flames

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Abstract

When analysing thermo-acoustic systems, flame transfer-functions are an essential tool for modelling the feedback of a flame to acoustic perturbations. This paper compares optical and fully acoustic methods for measuring such transfer functions, when progressively switching from fully- to technically-premixed combustion in an atmospheric lab-scale combustor. Optical methods relate the chemiluminescence of the flame to the acoustic forcing, in order to extract the flame response at different frequencies. In the technically-premixed scenario, the validity of the integrated chemiluminescence as a proxy of the heat release rate is jeopardized, and it is usually recommended to adopt the fully acoustic method. The present paper illustrates the progressive deviation of the two approaches when the degree of unpremixedness is increased, and provides a systematic comparison of the 2 approaches. This assessment is of utmost importance, as flame transfer functions are the core element of linear models used for thermoacoustic stability assessment, such as lumped network models or Helmholtz solvers.

Keywords: Flame transfer function, optical measurement, technically premixed