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Finite amplitude wave interaction with premixed laminar flames

MOHAMAD ASLANI, JONATHAN D. REGELE, Iowa State University — The physics underlying combustion instability is an active area of research because of its detrimental impact in many combustion devices, such as turbines, jet engines, and liquid rocket engines. Pressure waves, ranging from acoustic waves to strong shocks, are potential sources of these disturbances. Literature on flame-disturbance interactions are primarily focused on either acoustics or strong shock wave interactions, with little information about the wide spectrum of behaviors that may exist between these two extremes. For example, the interaction between a flame and a finite amplitude compression wave is not well characterized. This phenomenon is difficult to study numerically due to the wide range of scales that need to be captured, requiring powerful and efficient numerical techniques. In this work, the interaction of a perturbed laminar premixed flame with a finite amplitude compression wave is investigated using the Parallel Adaptive Wavelet Collocation Method (PAWCM). This method optimally solves the fully compressible Navier-Stokes equations while capturing the essential scales. The results show that depending on the amplitude and duration of a finite amplitude disturbance, the interaction between these waves and premixed flames can produce a broad range of responses.

Mohamad Aslani
Iowa State University

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