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On the unsteady response of non-premixed flamelet structures to time-varying curvatures

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Curvature can significantly modify flamelet structures and stability [1–4]. While several studies have focused on flamelets subject to steady curvature profiles, the influence of time-varying curvatures, $\kappa(\tau)$, has received little attention. In this work, the response of an ethanol non-premixed flamelet to several prescribed uniform $\kappa(\tau)$ is studied by means of numerical simulations. Flamelet equations for chemical species, temperature and the gradient of the mixture fraction are solved [4,5], using a flame with $\kappa = 0$ as the initial solution. High positive and negative target curvatures below the extinction limits are imposed either i) suddenly or ii) through linear changes applied at different rates, and then held constant. For $\kappa > 0$, the flames continue burning after i) and ii). On the other hand, when $\kappa < 0$, extinction occurs if the curvature is increased too fast. The contributions of the different terms in the flamelet equations are evaluated and analyzed in order to explain the reported results.

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