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Impact of finite rate chemistry on the hydrodynamic stability of shear flows in turbulent lean premixed combustion YUVAL DAGAN, AHMED GHONIEM, Department of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge, MA, USA — Recent experimental observations show that the dynamic response of a reactive flow is strongly impacted by the fuel chemistry. In order to gain insight into some of the underlying mechanisms we formulate a new linear stability model that incorporates the impact of finite rate chemistry on the hydrodynamic stability of shear flows. Contrary to previous studies which typically assume that the velocity field is independent of the kinetic rates, the velocity field in our study is coupled with the temperature field. Using this formulation, we reproduce previous results, e.g., most unstable global modes, obtained for non-reacting shear flow. Moreover, we show that these modes are significantly altered in frequency and gain by the presence of a reaction region within the shear layer. This qualitatively agrees with results of our recent experimental and numerical studies, which show that the flame surface location relative to the shear layer influences the stability characteristics in combustion tunnels. This study suggests a physical explanation for the observed impact of finite rate chemistry on shear flow stability.

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