研究室名	錦研究室　論文発表

題名	Influence of Thermal Expansion on Potential and Rotational Components of Turbulent Velocity Field Within and Upstream of Premixed Flame Brush
掲載雑誌	Flow, Turbulence and Combustion (2020). https://doi.org/10.1007/s10494-020-00131-3
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概要	Direct Numerical Simulation (DNS) data obtained earlier from two statistically stationary, 1D, planar, weakly turbulent premixed flames are analyzed in order to examine the influence of combustion-induced thermal expansion on the flow structure within the mean flame brushes and upstream of them. The two flames are associated with the flamelet combustion regime and are characterized by significantly different density ratios, i.e. $\sigma=7.53$ and 2.5. The Helmholtz–Hodge decomposition is applied to the DNS data in order to extract rotational and potential velocity fields. Comparison of the two fields shows that combustion-induced thermal expansion can significantly change the local structure of the incoming constant-density turbulent flow of unburned reactants by significantly increasing the relative magnitude of the potential velocity fluctuations when compared to the rotational velocity fluctuations in the flow. Such effects are documented not only within the mean flame brush, but also well upstream of it. The effect magnitude is increased by the density ratio σ, with the effects being well (weakly) pronounced at $\sigma=7.53$ (2.5, respectively). Moreover, the potential and rotational velocity fields can cause opposite variations of the local area of an iso-scalar surface $c(x,t)=const$ within flamelets by generating the local strain rates of opposite signs.